Restoration Plan for the South Branch of the Sandy River in Phillips, ME

Prepared for

Town of Phillips, ME

South Branch of the Sandy River

Prepared by

John Field
Field Geology Services
Portland, ME

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Field Geology Services

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1.0 INTRODUCTION

A plan is presented herein for restoring geomorphic function and aquatic habitat impacted by December 2023 flooding and subsequent emergency repair work along approximately one mile of the South Branch of the Sandy River (subsequently referred to as the South Branch) in Phillips, ME (Figure 1). The flood resulted in the South Branch main channel infilling with sediment and wood and, subsequently, diverting flow towards numerous residential properties and the Number 6 Road. A large portion of the wide floodplain was inundated (Figure 2a) with flow concentrated along the Number Six Road where a new channel was carved as a result (Figure 2b). This closed the road and stranded elderly residents needing access to medical facilities (Phillips, 2024).

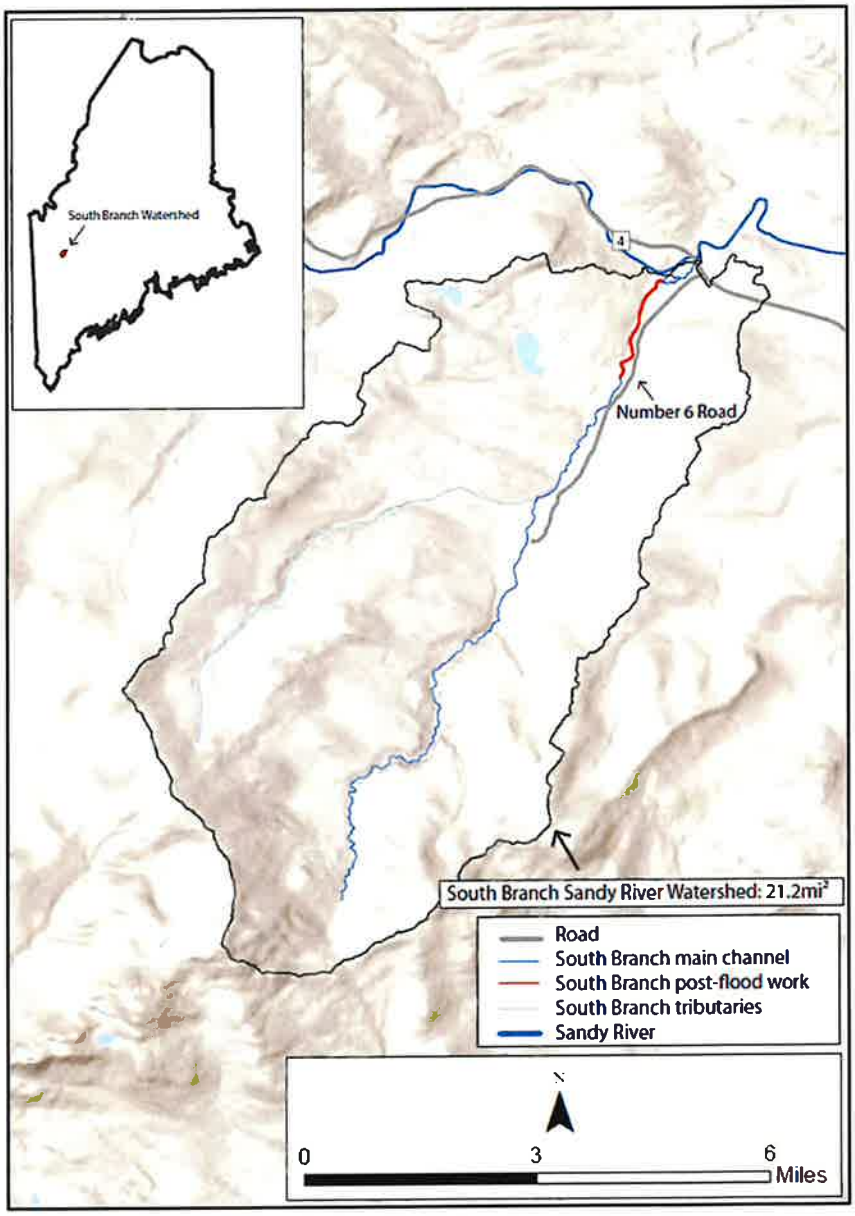

Figure 1. Watershed map of the South Branch showing the location of the post-flood repair work in Phillips, ME.

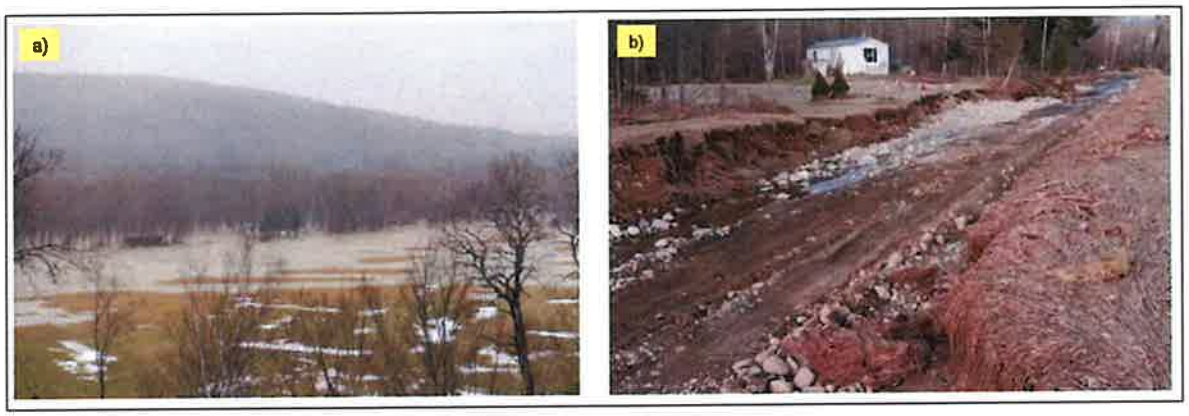

Figure 2. Flooding on the South Branch of the Sandy River in December 2023 a) inundated much of the floodplain surface and b) carved a new channel along the Number 6 Road. (Photos courtesy of landowner.)

As the December 2023 flood was receding, the Town of Phillips (subsequently referred to as the Town) received permission, on an emergency basis, from the Maine Department of Environmental Protection (DEP) to remove three discrete blockages in the main channel of the South Branch formed by trees, rocks, and boulders that were considered the primary cause for the flow diversion onto the Number 6 Road (DEP, 2024). The Natural Resource Protection Act (NRPA) provides an exemption for work related to emergency public works repair. While the removal of obstructions by the Town fell within this exemption, DEP did not approve the excavation of gravel from the main channel and construction of berms (Figure 3) that occurred at the same time

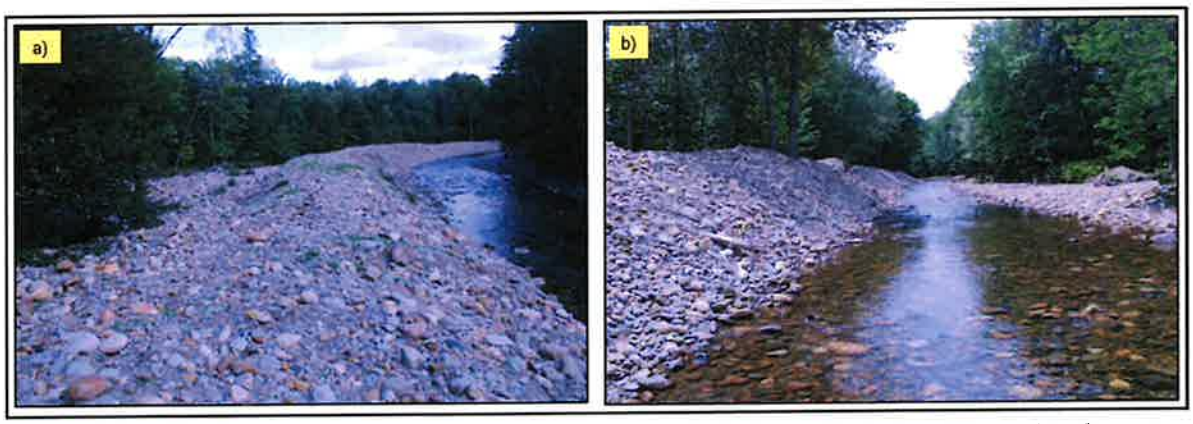

Figure 3. Post-flood emergency repair work in December 2023 included the construction of berms a) in the center of the channel and b) along the margins of the channel (both views looking upstream).

The Town, in the midst of the severe flood, did not intentionally or knowingly violate NRPA's provision for emergency public works repair and repeatedly sought, but did not receive, guidance during the emergency response (Phillips, 2024). Nevertheless, DEP issued a Notice of Violation (NOV) (Docket number 389) to the Town for the post-flood recovery work not exempted from NRPA regulations, citing, in particular, the substantial impact the post-flood work had on the South Branch's critical habitat for the federally endangered Atlantic salmon (*Salmo salar*) (DEP, 2024). The NOV requests that the Town develop a plan: 1) for the re-grading of the berms in and adjacent to the South Branch; 2) for the restoration of Atlantic salmon and brook trout (*Salvelinus fontinalis*)

habitat in this area; and 3) with a timeline for when each part of the restoration plan will take place and be completed. The requested plan is presented in Appendix 1 with the basis for that plan presented in the narrative below subdivided into four sections describing: 1) the natural setting and pre-flood human activities effecting the geomorphological processes and ecological conditions on the South Branch; 2) the December 2023 flooding and its impacts; 3) the post-flood emergency work; and 4) the methods, location, and timing of the proposed restoration.

2.0 NATURAL SETTING AND PRE-FLOOD HUMAN ACTIVITIES

The severity of the December 2023 flooding on the South Branch was a consequence of both the natural setting and past human alterations of the stream channel. The South Branch, with a watershed area of 21.2 mi^2 (Figure 1), begins in a steep confined valley between Jackson and Blueberry Mountains. Flowing to the north, the South Branch becomes less steep and confined in the final few miles before reaching its confluence with the Sandy River (Figure 4). During large floods, the steep confined nature of the upper watershed leads to high erosive forces and the generation of high volumes of sediment that readily move downstream. Upon reaching the less confined and lower gradient reach downstream, the floodwaters lose their capacity to transport sediment, so significant deposition naturally occurs, especially when log jams form across the channel. The infilling of the channel leads to flow bifurcation and a complex network of side channels (Figure 5) as well as the periodic shifting of the main channel (as in December 2023). Prior to human settlement of the region, active side channels and channel migration likely occurred across the entire triangular unconfined floodplain of the South Branch (technically what would be best described as an alluvial fan but referred to in this report as a floodplain), including those portions east of the Number 6 Road that are now fields.

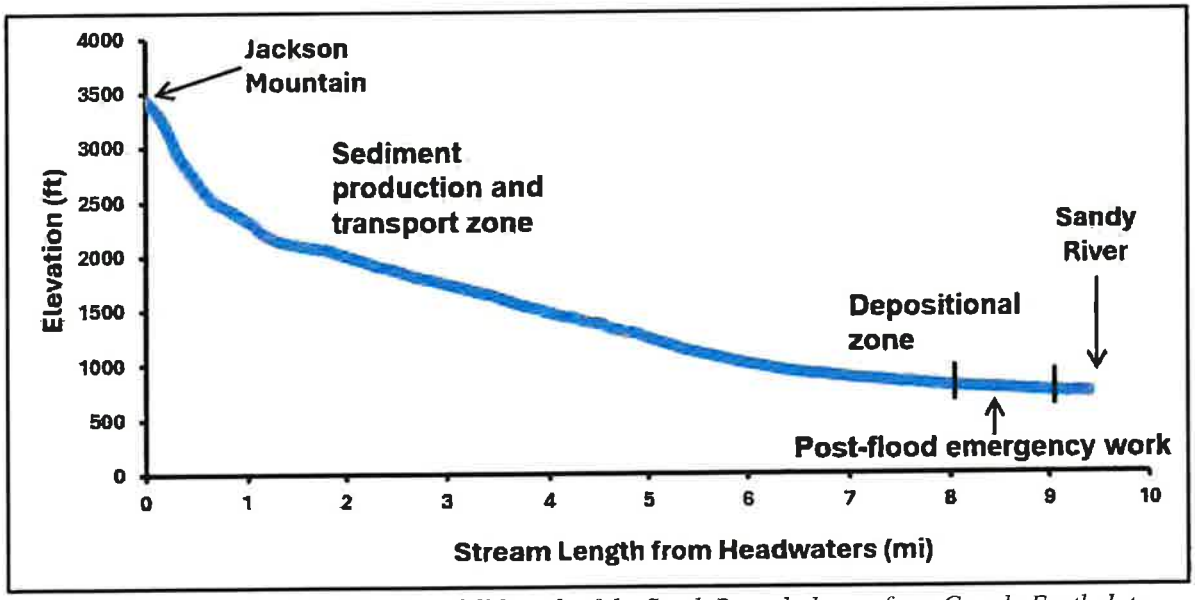

Figure 4. Longitudinal profile of the full length of the South Branch drawn from Google Earth data showing steep upper reach where sediment production and transport occurs and gentler lower reach where deposition occurs. Post-flood emergency work in December 2023 occurred in depositional zone.

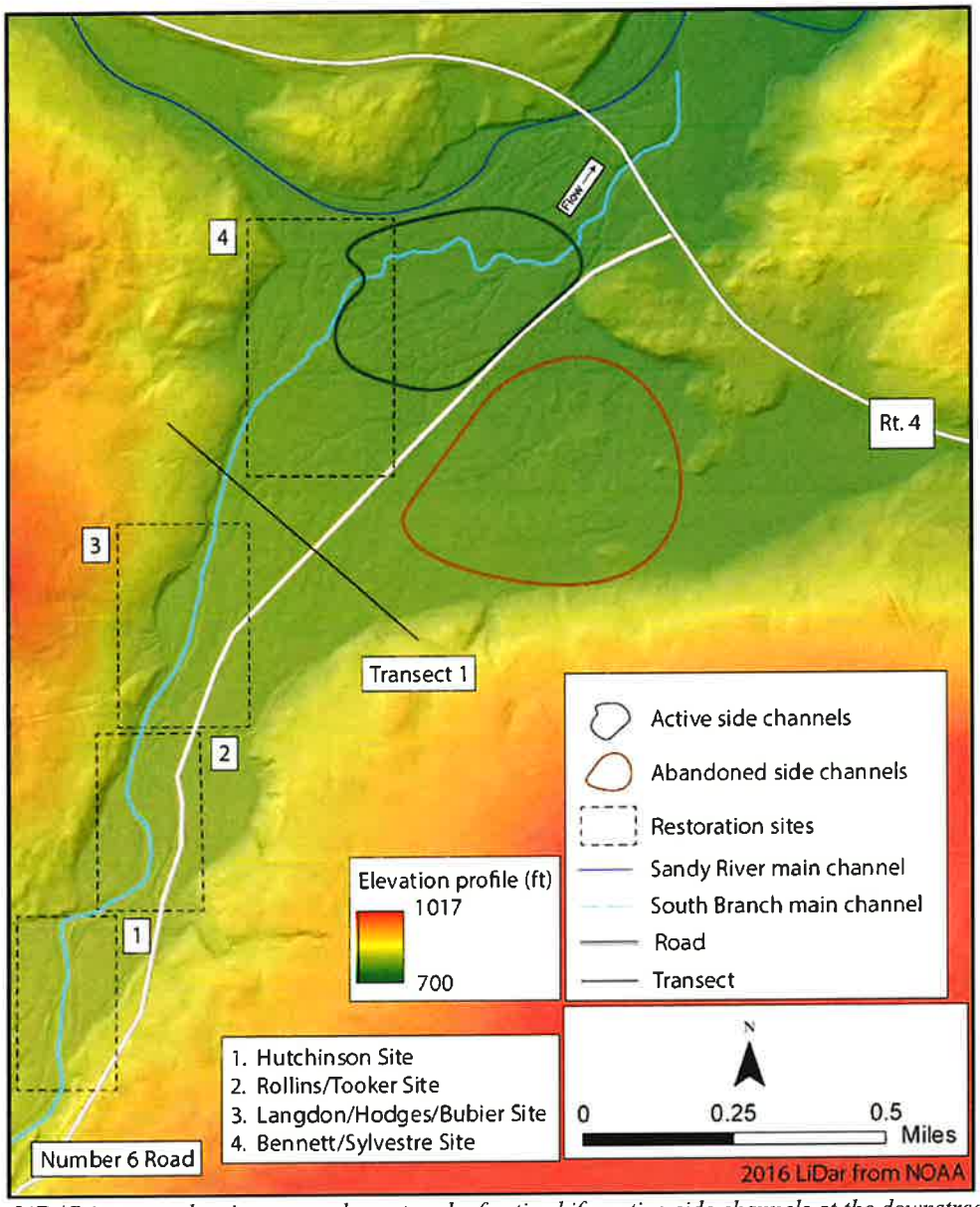

Figure 5. LiDAR imagery showing a complex network of active bifurcating side channels at the downstream end of the South Branch and vestiges of older inactive side channels across the entire unconfined floodplain, including east of the Number 6 Road where the main channel likely shifted periodically prior to human settlement. Four sites of post-flood emergency work and location of LiDAR generated transect also shown.

Under natural conditions, the main channel of the South Branch would be expected to flow anywhere across the wide flat unconfined floodplain (Figure 5). Currently, the South Branch flows against the western edge of the valley and has so since at least 1929 (Web citation 1), telltale evidence of channelization and artificial straightening associated with log drives (Field, 2007). Log drives did occur in the Sandy River watershed in Phillips back into the 19th century (Web citation 2).

The Number 6 Road, associated homes, and a railroad to the east extended up the South Branch valley by 1929 (Web citation 1) and must have altered flow into the now-abandoned side channels at the eastern edge of the floodplain (Figure 5). The channelization along the western edge of the South Branch valley was maintained by removing gravel, wood, and debris throughout much of the 20th century (as relayed through personal communications with multiple longtime Town residents). Despite these efforts, flooding in April 1987 caused damage, similar to December 2023, to the Number 6 Road. The damage resulted in a solicitation from the Soil Conservation Service (now Natural Resources Conservation Service) in 1987 for "obstruction and debris removal" along the South Branch (as revealed in documents stored in the Town office). The long lengths of South Branch that remain in a straightened configuration (Figure 6a) have a significant impact on geomorphic and ecological processes and increase flood, erosion, and channel migration risks. These conditions are enhanced where berms built along the edge of the channel in 1987 or before (Figure 6b) further constrain the channel.

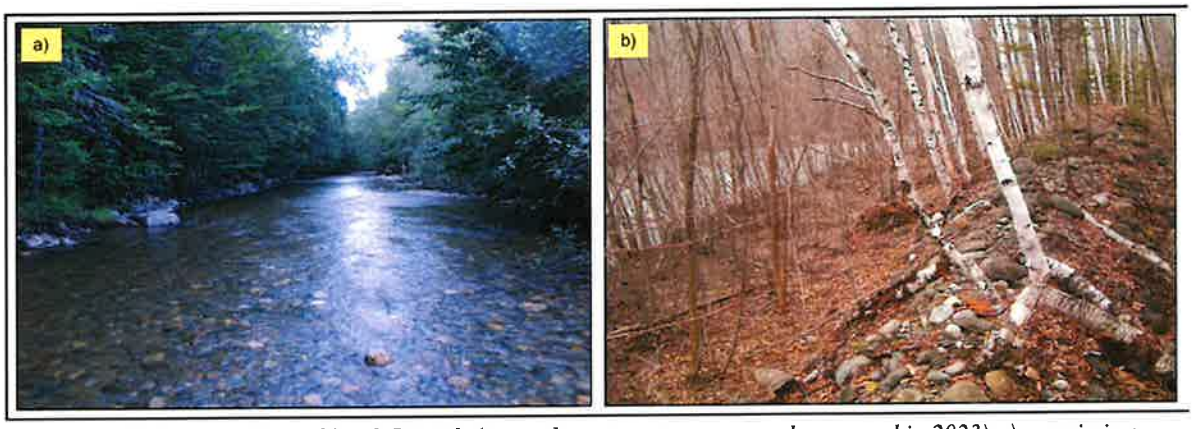

Figure 6. Long sections of South Branch (even where no emergency work occurred in 2023) a) remain in a straightened condition and, in places, b) have older berms built along them that further constrain the channel.

Artificially straightened and channelized streams are typically associated with poor physical habitat for aquatic organisms, particularly cold-water fish species such as Atlantic salmon and brook trout. The removal of wood, boulders, and gravel bars as part of the channelization process eliminates the flow heterogeneity key to creating diverse and closely-spaced habitats. For example, alternating pools and riffles along a naturally meandering stream provide resting and feeding habitat, respectively, adjacent to each other. Furthermore, cutting off side channels through channelization destroys important rearing habitat that keeps juveniles isolated from adults that favor conditions in the main channel. Finally, channelized reaches tend to be straighter with fewer obstructions (i.e., less roughness), so flood flow velocities are greater, providing little refuge for fish from the strong currents, especially where access to side channels has been lost.

The South Branch is a dynamic stream owing to the natural setting and past human alterations of the stream channel. Channelized and straightened channels are inherently unstable and, over time, naturally reform meanders (Field, 2007) and, in an alluvial-fan setting like the South Branch, side channels. The deposition of sediment and wood accumulations drive these channel adjustments on the South Branch with significant bar growth and meander development occurring over short time periods (Figure 7). Within this dynamic setting, a bank stabilization project on the South Branch completed by the Maine Department of Transportation (as part of mitigation for Route 4

widening) was unsuccessful (Figure 8) given the erosive pressures generated from flow deflection around the rapidly growing bar shown in Figure 7.

Figure 7. Rapid growth of gravel bar causes meander reformation between a) 2002 and b) 2016 at downstream end of straightened reach at Rollins/Tooker Site.

Figure 8. The dynamic nature of the South Branch illustrated by a bank stabilization project completed in a) September 2003 but damaged by b) April 2004 (due to a moderate flood in December 2003).

The dynamic nature of the South Branch has developed excellent habitat for Atlantic salmon and brook trout as the stream naturally adjusts to decades of channelization. Unfortunately, these same dynamic conditions threaten the Number 6 Road and the surrounding properties with flooding, bank erosion, and channel migration hazards. Deposition and wood accumulations reduce channel bank heights and the carrying capacity of the channel, increasing flood inundation, bifurcation of flow into side channels, and the risk of a channel avulsion (i.e., rapid shifts in channel position). Where flow becomes concentrated, a small depression can quickly enlarge through erosion into a

new main channel elsewhere on the wide flat floodplain. Since the South Branch has been trained along the western edge of the valley for many decades, the main channel is prone to shifting to the sediment-starved eastern portion of the fan surface where swales are essentially at the same elevation as the existing unstable channel (Figure 9). During large floods, flow has had a tendency to funnel down the Number 6 Road along which a new channel was carved in April 1987 and again in December 2023 (Figure 2b).

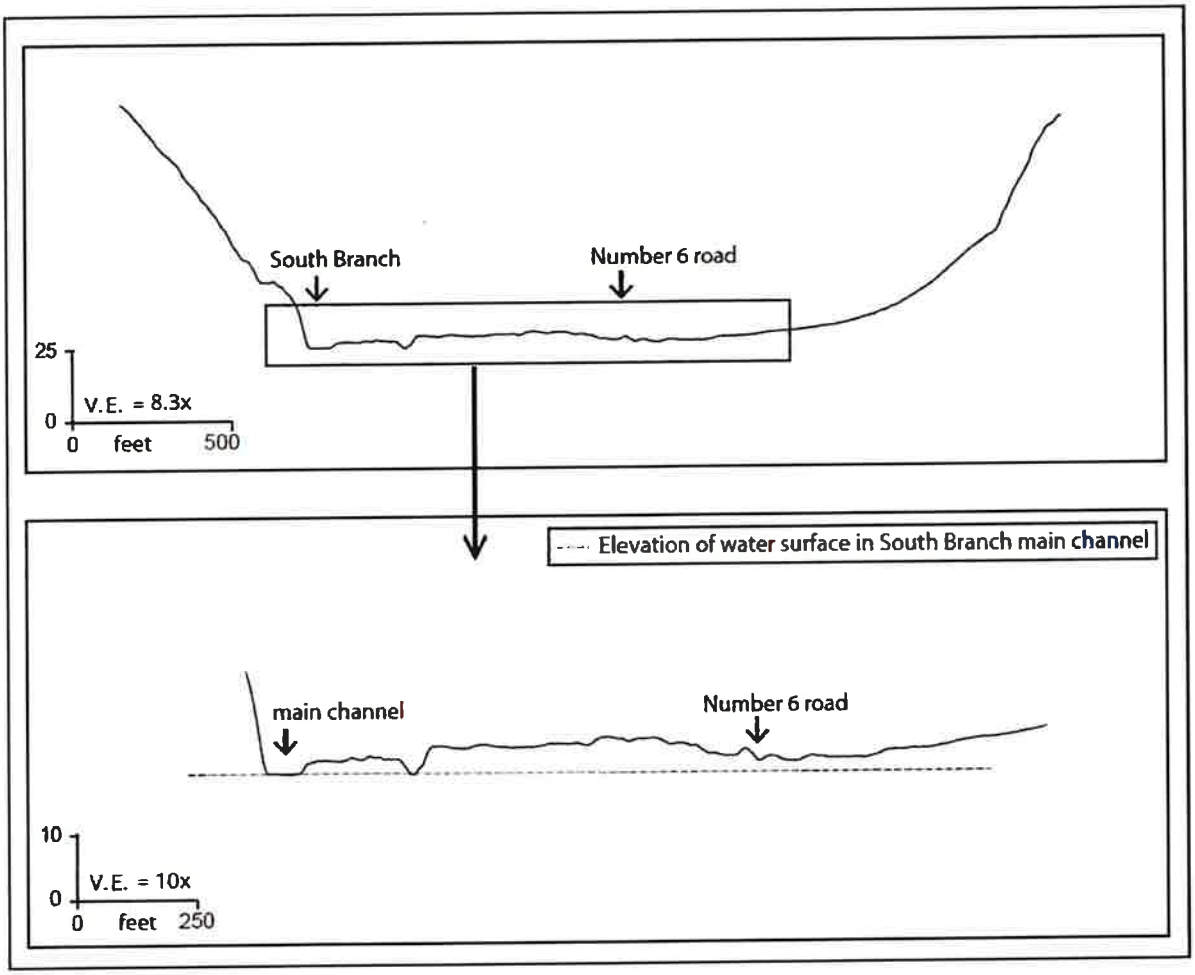

Figure 9. Transect drawn from LiDAR data showing main channel with low banks and side channels on the flat floodplain surface at nearly the same elevation as the main channel, highlighting the risk of a channel avulsion during a large flood. See Figure 5 for transect location. Bottom figure is area within box of top figure.

3.0 DECEMBER 2023 FLOODING AND ITS IMPACTS

In the weeks preceding the December 2023 flooding, snow accumulations of more than a foot were recorded nearby (Web citation 3) with likely greater depths in the higher elevations of the South Branch watershed. On December 18, 2023 rainfall totals of more than 5.0 inches were recorded throughout Franklin County (Web citation 4), again likely greater at higher elevations. Temperatures in Phillips throughout the rainstorm were over 50 degrees Fahrenheit (Web citation

5), aiding snowpack melting that added to the storm's discharge. While no stream gauge is present on the South Branch, the flood resulted in a record discharge on December 18 at the nearby Madrid gauge on the Sandy River (operating for 15 yrs) (Web citation 6) and the second highest discharge (slightly below the 1987 peak) on December 19 at the Mercer gauge (operating for nearly 100 yrs) several miles downstream on the Sandy River (Web citation 7). Based on the weather and gauge records, the South Branch flooding in December 2023 must be considered severe as corroborated by one long-time resident of the Number 6 Road who rated the flooding as the worst in memory.

Considerable sediment (and wood) production occurred in the upper South Branch watershed during the December 2023 flooding as would be expected in the steep confined terrain (Figure 4). Observations made along the 0.5 mi of the South Branch upstream of the post-flood emergency work reveal that large boulders were transported at the peak of the flood. As the flood receded, the channel shifted into one of the banks as the finer-grained bank materials were more readily transported than the boulders deposited on the channel bed (Figure 10). This process of the channel shifting off of the coarse boulder substrate into more erodible bank sediments was seen multiple times in the 0.5 mi reach of the upper watershed and resulted in significant sediment production and the loss of trees that were growing on the high banks prior to the flood.

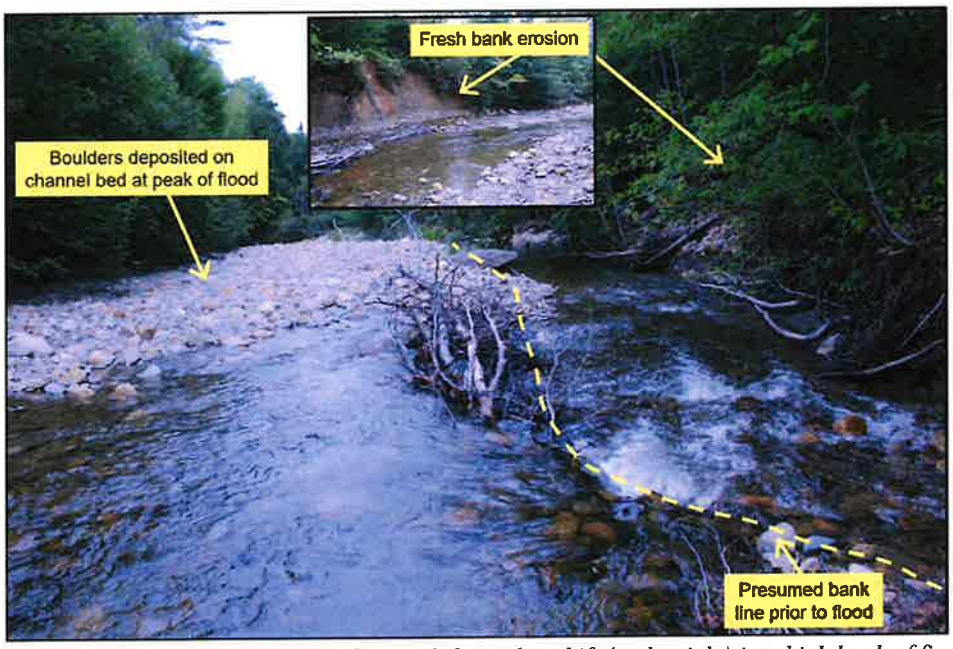

Figure 10. Boulders deposited on channel bed caused channel to shift (to the right) into high bank of finer sediment as flood receded. View looking downstream. (Inset photo looking upstream.)

The flooding on the lower reaches of South Branch inundated most of the wide valley (Figure 2a), surrounding several homes with floodwaters. At least three log jams blocked flow on the main channel (see DEP, 2024) that largely infilled with sediment (enhanced by the log jams) as evidenced by reductions in bank heights (Figure 11a-b), gravel tongues deposited on the floodplain at the edge of the channel (Figure 11c), and the development of new side channels (Figure 11d). This infilling of the channel led to the main channel shifting to the Number 6 Road where snow banks from road plowing concentrated the flow (as reported by the Town). Consequently, the highest flow velocities occurred on the Number 6 Road and a new channel was carved along

the road alignment (Figure 2b). Significant deposition also occurred on the floodplain surface, completely infilling a portion of one side channel (Figure 12). Extensive deposition on the floodplain, including east of the Number 6 Road, may have been enhanced by backwatering due to simultaneous highwater on the Sandy River given that most of the deposition occurred further downstream rather than where the flow first escaped the South Branch channel.

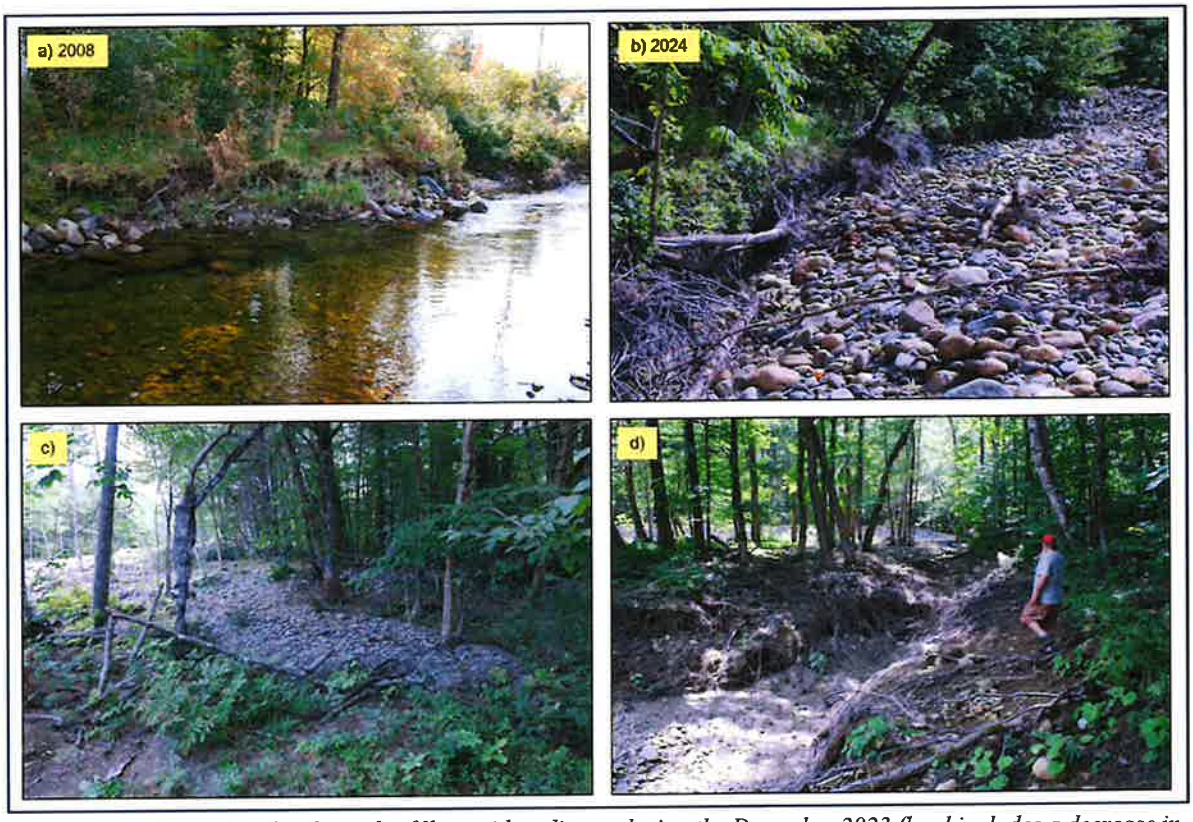

Figure 11. Evidence for the channel infilling with sediment during the December 2023 flood includes a decrease in bank height in the same area between a) 2008 and b) 2024, c) gravel tongues deposited on the floodplain, and d) formation of a new side channel with headcut (to the left of standing person) approaching main channel.

Figure 12. Photographs from the same location in a) 2004 and b) 2024 document the infilling of a side channel by sediment deposited during the December 2023 flood.

4.0 POST-FLOOD EMERGENCY WORK

Town officials first arrived on the South Branch as the flood was receding with the main channel blocked by log jams and the Number 6 Road serving as the primary flow path for floodwaters spilling out of the main channel (Figure 13). If no post-flood emergency work had occurred, flow would likely still be concentrated along the road alignment as the new channel carved along the road was probably deeper than the infilled South Branch (Figure 2b). Flow along the Number 6 Road would likely bifurcate over time into numerous side channels across the fields and lower areas east of the road (Figure 9). The new channel system would look much like the pre-flood channel with numerous interwoven side channels resulting from significant deposition, but would differ in that no forested canopy would shade a channel flowing through open fields.

Figure 13. Floodwaters escaping the South Branch through the woods towards the Number 6 Road during the December 2023 flood. (Drone photo courtesy of the Town.)

To reopen the Number 6 Road, Town officials received authorization to remove the log jams blocking the South Branch. However, removing those blockages was insufficient to redirect flow away from the road and back into the main channel. Without clarification on the limits of the authorization but facing an urgency to reopen the road, the Town excavated the channel back to roughly its pre-flood depth in four discrete locations (see location of restoration sites in Figure 5) and piled the excavated gravel into berms in order to block the flow, still overtopping the natural banks at the time of the emergency work, from continuing towards the Number 6 Road.

The length, volume, and character of the berming varied between the four sites named based on landowner last names bordering each work area from upstream to downstream: 1) Hutchinson Site; 2) Rollins/Tooker Site; 3) Langdon/Hodges/Bubier Site; and 4) Bennett/Sylvestre Site (subsequent references to the site names will use only the initial name listed). (A map, photograph, and other details of the berming at each site is included in Appendix 1.) The berms are comprised largely of material taken from the channel, including wood, with a small amount perhaps consisting of material deposited on the adjacent floodplain during the flood. The berms are not reinforced in anyway and remain loose and unstable. The length and volume of the December 2023 berming within or at the edge of the bankfull channel were calculated from topographic surveys of each site conducted with a Sokkia Set 5 electronic total station in August 2024 (Table 1). A small portion of the berming at the Hutchinson Site, across from a tributary confluence, had already eroded prior to the survey but had not completely breached the berm. The berming was primarily completed

on the right bank (looking downstream), the side on which the Number 6 Road is found, although berming did occur on both banks at the Langdon Site. Berms constructed prior to December 2023 and not directly on the bank or in the channel were not surveyed.

Site	Berm length (feet)	Gravel re-distributed per linear ft (sq.ft.)	Volume gravel re-distributed (cu.yd.)	Berm type(s)
Hutchinson	483	61	1,091	On floodplain
	350	140	1,815	In channel
Site Total	833		2,906	
Rollins/Tooker	436	300	4,844	In channel
	280	84	871	On floodplain
Site Total	716		5,716	
Langdon/Hodges/Bubier	369	0	0	Gravel veneer
LB	525	124	2,411	On floodplain
RB	885	0	0	Gravel veneer
	420	28	436	Blocking side channel
Site Total	2,199		2,847	
Bennett/Sylvestre	590	77	1,683	On floodplain
	110	77	314	Blocking side channel
	310	43	494	On floodplain
Site Total	1,010		2,490	
Project Area	**4,758**	**79**	**13,958**	

Table 1. Length, volume, and type of berming at each site of emergency work following December 2023 flooding.

Four distinct types of berming occurred during the December 2023 emergency work. At the Hutchinson Site and the Rollins Site, the majority of the berming is within the bankfull channel (Figure 14a). This "in channel" berming is confining flow to within a narrower area (essentially the baseflow width), further from the Number 6 Road, than existed prior to the flood. The area within the bankfull channel on the backside of the berm (and now largely dry) remained largely undisturbed by the emergency work and preserves the elevated channel bed that formed from the infilling of the channel during the December 2023 flood. Most of the berming at the Bennett Site is built at the edge of the channel on the floodplain with the gravel sometimes extending down the bank and built up against it (Figure 14b). This "on floodplain" berming was often completed by placing gravel in between trees and is present at all four sites to varying extents. While numerous trees are now buried in several feet of gravel at the base of their trunks, most, if not all, of the trees were still healthy during the first growing season after the "on floodplain" berms were constructed. Some berms were constructed across the upstream ends of side channels and, therefore, block flow from entering them (Figure 14c). "Blocking side channel" berms refer only to berms blocking side channels that were active at or near baseflow conditions; berms blocking side channels that are active only at high flow are merely designated as "in channel", or most commonly, "on floodplain" berms. "Gravel veneer" berms are the final designated berm type and represent a thin layer of gravel (less than 0.5 ft thick) (Figure 14d). Perennial vegetation growing on the floodplain soil just beneath the thin veneer of gravel demonstrates that this berming is not a thick pile of gravel through which no vegetation would be expected to grow in the first season following berming. Most of the berming at the Langdon Site is a gravel veneer and does not block floodplain flow.

Figure 14. Four berm types constructed in December 2023: a) "in channel" berm (Rollins Site), b) "on floodplain" berm (Bennett Site), c) "blocking side channel" berm (Langdon Site), and d) "gravel veneer" berm (Langdon Site).

Excavation in the channel to form the berms returned the channel to the pre-flood depth but not deeper. At the Bennett Site, an unblocked side channel is just barely higher than the excavated main channel (Figure 15a). In addition to gravel, considerable wood was also removed from the channel (Figure 15b). The logs in Figure 15b were likely part of a log jam just downstream of the side channel and would have elevated the water surface enough to maintain flow in the side channel at baseflow. Excavation at the Rollins Site created a channel across what was a large unvegetated cobble point bar (Figure 16), shifting the channel's position but not increasing its depth.

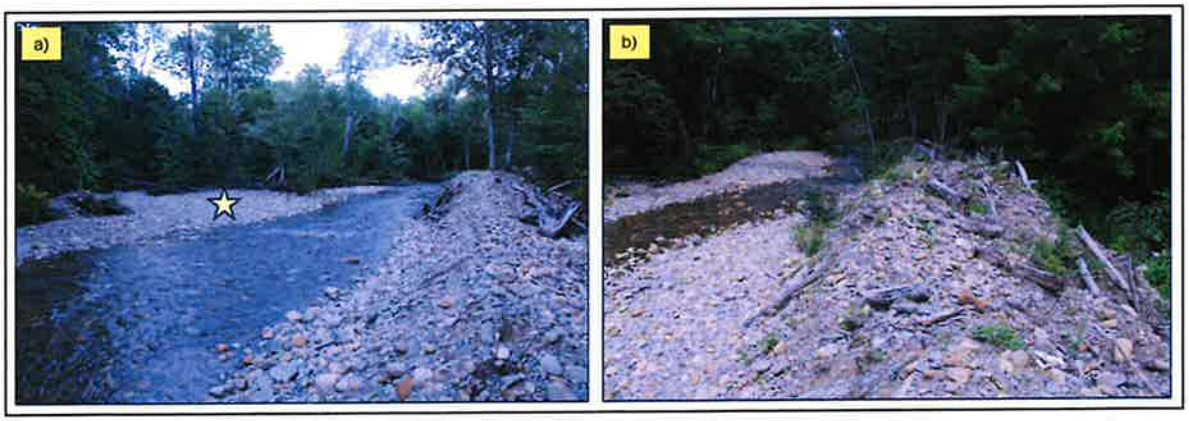

Figure 15. Entrance to a) a side channel (star) upstream of b) logs in berm that were likely part of a nearby log jam.

Figure 16. Photos from the same location looking upstream at the Rollins Site in a) 2008 and b) 2024 showing how large cobble point bar was excavated to form new channel and adjacent "in channel" berm.

The berming and wood removal from the main South Branch channel has greatly simplified the stream network and impacted physical habitat for Atlantic salmon and brook trout, but has not reduced the hazards of flood inundation, bank erosion, and channel avulsion during large floods. After the post-flood emergency work, very little wood remains in the low-flow channel (Figures 3, 14, 15a, and 16b) compared to wood loadings calculated during a habitat survey by the Maine Department of Marine Resources (DMR) in 2006, especially at the Bennett Site (see wood loading map in Appendix 1). Even in areas where no post-flood emergency work occurred, wood loading is low (Figure 6a), reflecting the ongoing impacts of the decades of channelization on the South Branch. Wood provides cover habitat and is essential for creating the flow complexity needed to form side channels, carve pools, and maintain clean spawning gravels free of fines. The berms, by constricting high flows to a narrower area, block flows to side channels with critical juvenile rearing habitat. Additionally, the berms generate higher flow velocities in the main channel that make wood retention in the channel difficult and will, therefore, slow the natural recovery of the stream. The berms, however, are not reinforced and another flood similar in scale to December 2023 could readily breach the berms, infill the channel, and cause a rapid shift in the channel's position to the Number 6 Road or elsewhere on the wide floodplain. While such a flood would also quickly naturally restore much of the habitat lost by the berming and wood removal, the impacts of the post-flood emergency work could persist for decades (until the next large sediment-laden flood like December 2023).

5.0 METHODS, LOCATION, AND TIMING OF RESTORATION

The narrative above has established the need for restoration of the South Branch following the December 2023 flooding and post-flood emergency work. In summary, the impacts to Atlantic salmon and brook trout habitat could persist for decades without corrective action as the rate of natural recovery is largely dependent on the timing of infrequent large flood events. The NOV issued to the Town by DEP formalizes this need for restoration (DEP, 2024). The methods, location, and timing of the proposed restoration detailed in Appendix 1 and described below address the NOV's two requested corrective actions, which were to submit:

1) a plan for the re-grading or removal of the dredge spoils/berms in and adjacent to the SB Sandy River and the restoration of Atlantic salmon and brook trout habitat in this area. The plan must include a narrative that details how the restoration will be accomplished, the type and location of erosion controls to be used and a reference to the NOV; and

2) a timeline of when each part of the restoration plan will take place and when restoration will be completed;

The restoration will remain within the limits of the four discrete sites where post-flood emergency work was completed in December 2023 (Figure 5 and Appendix 1) and will focus on: a) re-grading of berms and b) restoring Atlantic salmon and brook trout habitat. The restoration intends to remove the constraints (i.e., berms) and add the structure (i.e., wood and boulders) needed for the full natural recovery of geomorphic and ecological function, so will essentially target a return to conditions that existed prior to the December 2023 flood. The restoration plan (Appendix 1) is summarized in the following sections below on the: 1) location of the restoration, 2) methods of restoration, and 3) timing and other details of the restoration.

5.1 Location of restoration

The restoration will be conducted within the limits of the four discrete sites of post-flood emergency work in December 2023 (Figure 5 and Appendix 1). Impacts to side channels, for example, blocked by the berming will be only passively restored by removing the constraining berm but work further down the side channels will not be completed. Timely restoration is essential (see Section 5.3 below) as revegetation of the blocked side channels over a period of years will lead to more permanent changes that could no longer be reversed through passive restoration alone. Each of the four sites of restoration have particular site-specific conditions, briefly described below, that will control access to the site, restoration targets, and construction methods. All four sites are on private land, so landowner permission will be required before implementing the restoration work.

5.1a Hutchinson Site

The Hutchinson Site will ideally be accessed through the driveway and back field of the Hutchinson property. The berm at the Hutchinson Site is largely within the bankfull channel, much of it built on top of a mid-channel island that existed prior to the December 2023 flood (Figure 17). Flow was split into two channels around the island prior to the December 2023 flood with all the flow now concentrated to the left side of the island (looking downstream) with the berm blocking flow to the other channel. Restoration of the site will restore flow to both channels around the island, requiring excavation of the now-blocked channel given the infilling of the channel that occurred during the December 2023 flood. The volume of sediment to be removed from the berms and excavated to reform the channel to the right of the island will be redistributed into the channel to the left of the island and on the island itself. This will raise the elevation of the island slightly while maintaining more depth in the channels in order to reduce overbank flooding, although continued deposition in the channel after restoration will increase that risk over time.

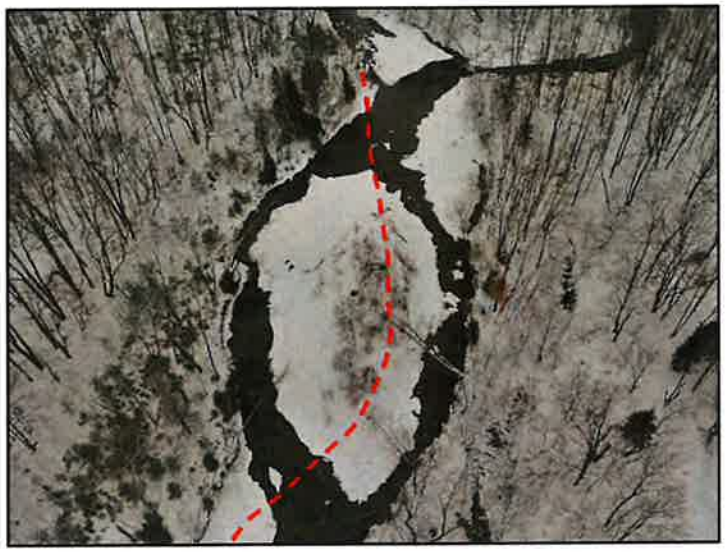

Figure 17. Drone image of Hutchinson Site prior to December 2023 flooding (courtesy of landowner) showing split flow around mid-channel island. Dashed line shows approximate position of "in-channel" berm. Upstream view.

5.1b Rollins/Tooker Site

The Rollins Site will be accessed directly off of the Number 6 Road along the access path created for the post-flood emergency work. The Maine Department of Transportation bank stabilization project completed in 2003 (Figure 8) was constructed at the Rollins Site across from a wide unvegetated cobble point bar (Figure 16a) that has been growing in size for years (Figure 7) and was excavated and bermed in December 2023 (Figure 16b). The site is at the downstream end of an artificially straightened reach confined by a berm built in 1987 or before (Figure 6b). The resulting increase in transport capacity through the straightened and bermed reach leads to excess sediment deposition and growth of the bar where the channel becomes less constrained at the Rollins Site. Since the earlier berming and straightening will not be addressed by the restoration, bar growth at the site is expected to continue and the channel likely to migrate towards the right bank where the channel was prior to December 2023. Given this likely natural evolution of the channel, the restoration will not only remove the "in-channel" berm but will re-excavate the channel along the right bank (removing the sediment that infilled the channel during the December flood) with the sediment generated from the berm and channel excavation to be redistributed in the current channel (Figure 16b) to recreate the point bar (Figure 16a) that existed prior to the flood and is likely to reform naturally.

5.1c Langdon/Hodges/Bubier Site

The Langdon Site will be accessed along the short access road off of the Number 6 Road that leads to a legally deeded ford across the South Branch. Most of the berming at the Langdon Site consists of a gravel veneer spread thinly over the preexisting floodplain. The gravel veneer will not be removed as flow is not being constrained and its removal will increase the disturbance area of the restoration. The gravel veneer is spread over an area of the floodplain where trees were not growing along the bank, so plantings through the gravel veneer could be considered as a means of

improving the canopy but is not part of the restoration plan as further landowner permission would be required. The Langdon Site is an artificially straightened section of the channel that was constrained by "on floodplain" berming along the left bank, blocking a high-flow side channel. A "blocking side channel" berm on the right bank prevents flow from entering a low-flow side channel. The re-grading of these two portions of elevated berm will remove the recently placed constraints on the channel but the straightened configuration, in which little wood was being retained prior to the December 2023 flood (Figure 18 and wood loading map in Appendix 1), will remain.

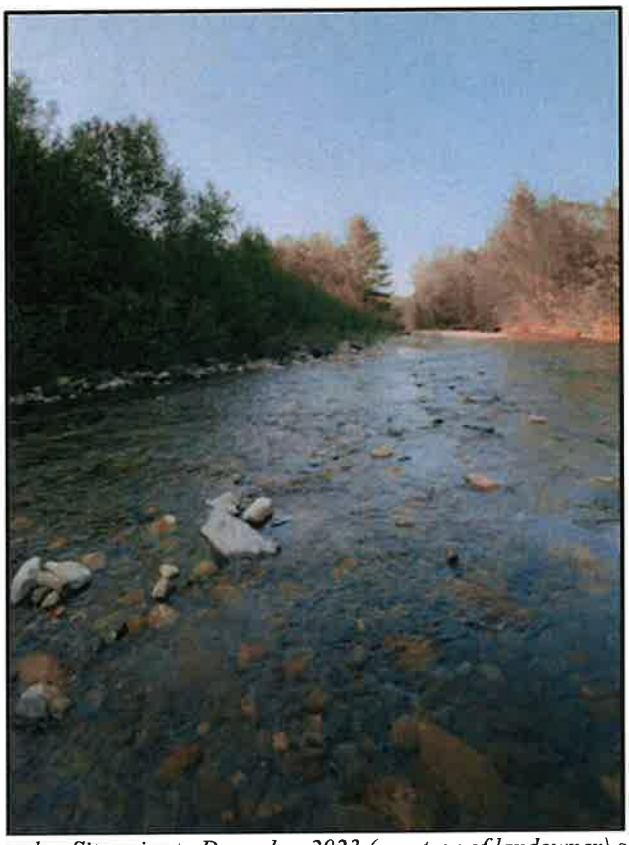

Figure 18. Photo of Langdon Site prior to December 2023 (courtesy of landowner) showing its straightened alignment and lack of wood retention.

5.1d Bennett/Sylvestre Site

Access to the Bennett Site will be the longest and most difficult of the four sites as heavy machinery will need to traverse a long section of a side channel. As with all sites, landowner permission will be needed to access and work in the site area. Numerous side channels bifurcate from the main channel through the site, including a low-flow side channel newly formed as a result of the December 2023 flood (Figure 11d), low-flow side channels not blocked by berms but left dry by the removal of log jams (Figure 15), and both low-flow (Figure 19) and high-flow side channels blocked by berms. Access to the side channels will be restored by re-grading the berm material and redistributing the material to elevate the channel bed. To ensure the low-flow side

channels are active even during baseflow conditions, channel-spanning log jams will be constructed just downstream of side channel entry points in order to slightly elevate the water surface. The loss of transport capacity as the flow bifurcates into numerous side channels at the Bennett Site led to large wood accumulations recorded in previous habitat surveys (see wood loading map in Appendix 1). Wood loading was much higher prior to the December 2023 flood at the Bennett Site compared to the other three sites, but now very little wood is present in the channel (Figures 14b and 15).

Figure 19. Entrance to low-flow side channel blocked by berm at Bennett Site.

5.2 Methods of restoration

Restoration of the South Branch will be completed using two primary methods described separately below: a) re-grading of berms and b) restoring Atlantic salmon and brook trout habitat.

5.2a Re-grading of berms

Re-grading of the berm material at the four sites will remove constrictions to flow, unblock side channels, and reestablish the complex flow patterns that create excellent habitat conditions for Atlantic salmon and brook trout. Topographic surveying results established the location, type, and volume of berming (Table 1 and map of berms and side channels in Appendix 1) and were used to determine how redistributing the berm material would alter the morphology and depth of the channel at each site (Figure 20). The "gravel veneer" berms at the Langdon Site will not be removed given that they are thin and not hindering overbank flows. All other berms will be regraded with the material to be redistributed within the bankfull limits of the channel, most to be placed on the channel bed but some used to recreate a point bar (at the Rollins Site) or placed on a mid-channel island (at the Hutchinson Site). Some additional excavation will be required at the Hutchinson Site and Rollins Site to reestablish pre-flood flow patterns.

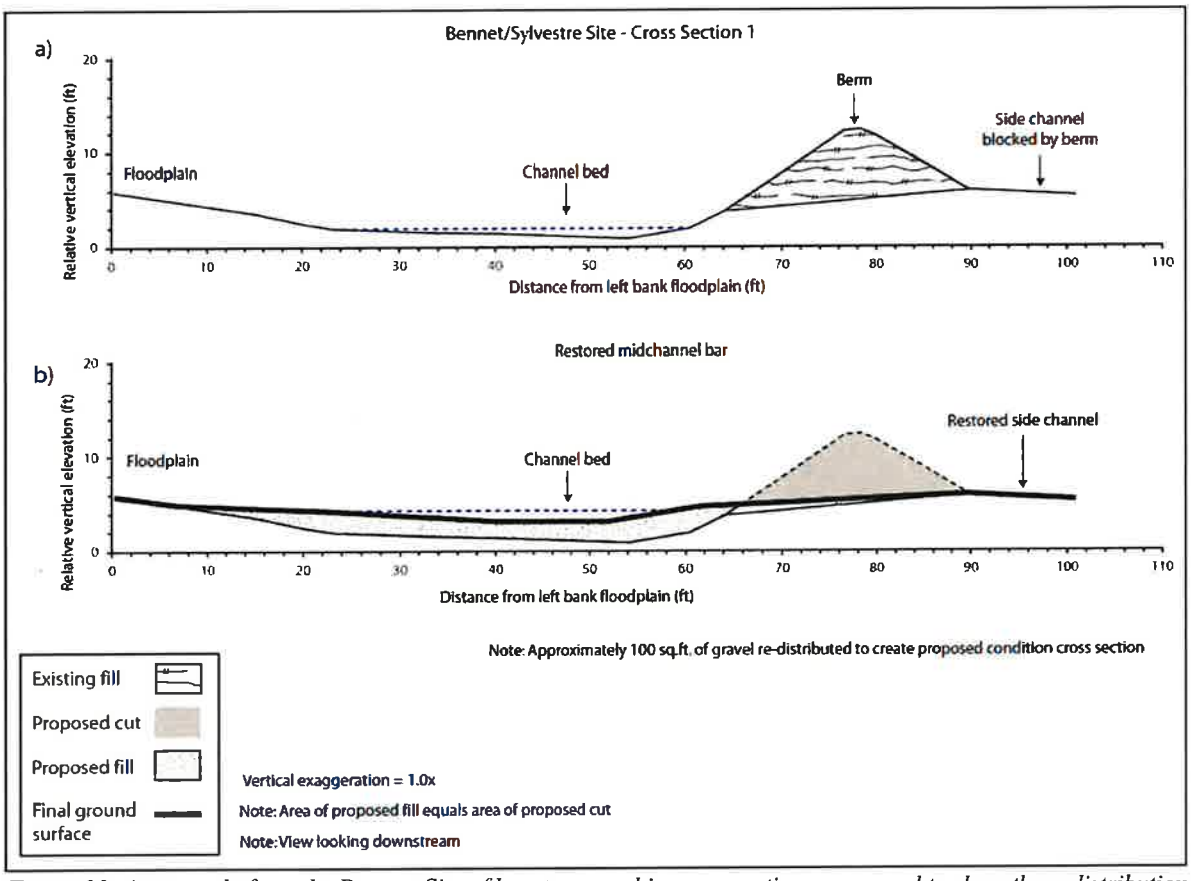

Figure 20. An example from the Bennett Site of how topographic cross sections were used to show the redistribution of berm material in the channel. Similar cross sections for all sites available in Appendix 1.

The best approach to re-grading the berms will ultimately be the choice of the selected contractor but an excavator will likely be needed for re-grading the "on floodplain" berms in order to dig between partially buried tree trunks with minimal disturbance and damage. For "in channel" berms, the use of a D8 bulldozer or similar equipment would be more feasible and likely quicker, especially when spreading the removed material across the channel bottom, mid-channel island, or recreated point bar. However, an excavator will also be needed at sites with "in channel" berms, because these sites will also require channel excavation on portions of the channel bed and removal of short lengths of "on floodplain" berms with partially buried trees. Furthermore, an excavator will also be needed at all sites for restoring Atlantic salmon and brook trout habitat.

5.2b Restoring Atlantic salmon and brook trout habitat

Flow complexity created by wood and boulder structure is essential for high-quality Atlantic salmon and brook trout habitat. The post-flood emergency work in December 2023 removed a considerable number of boulders (see map of boulders in Appendix 1) and volume of wood (Figure 15b) from the channel. The future retention of wood in the channel, in the absence of restoration, will be limited by high-velocity flows generated by the constricting berms. The re-grading of the

berms (see Section 5.2a above) will enable retention of wood but will not, by itself, create the structure removed by the post-flood emergency work in December 2023.

Boulder and wood structure will be reconstructed in the channel following the redistribution of berm material within the bankfull channel in order to restore Atlantic salmon and brook trout habitat. Prior to the December 2023 flood, wood in the channel was in the form of isolated logs, small marginal log jams, and channel-spanning log jams. While some wood remains in the channel, three types of wood structures will be built as part of the restoration to mimic those structures that were in the channel prior to the December 2023 flood: a) isolated logs, b) boulder-supported marginal log jams (Figure 21), and c) channel-spanning log jams. All of these structure types have been built as part of restoration projects elsewhere in Maine and no difficulty is anticipated for their construction on the South Branch. All trees needed for the restoration will be imported to the site with wood found in the berm material to be used as filler, but not as structural members, in the wood structures. Usable boulders contained within the berm material will be distributed randomly in the channel to provide additional structure with the boulders required to anchor the constructed wood structures to be imported to the site.

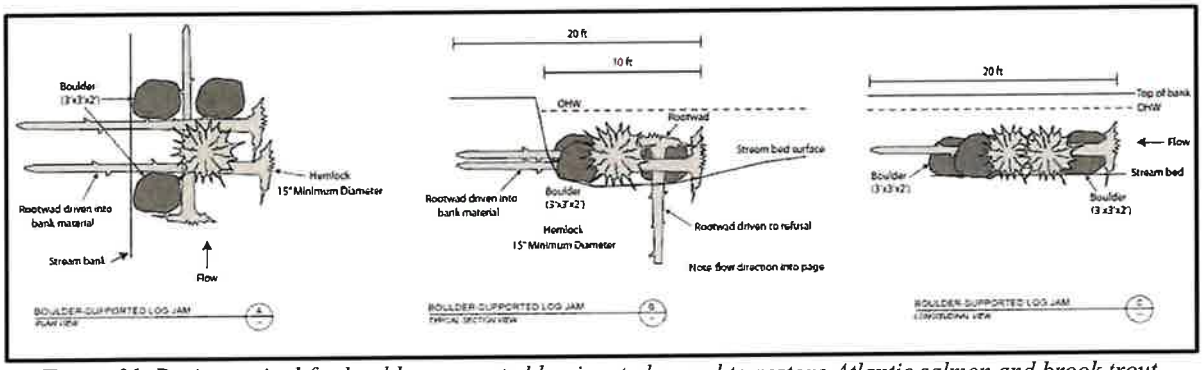

Figure 21. Design typical for boulder supported log jam to be used to restore Atlantic salmon and brook trout habitat on the South Branch. Design typicals for all log structures found in Appendix 1.

The amount of wood to be added will match the wood loading recorded during the habitat survey by DMR in 2006 for the three upstream sites (see wood loading map in Appendix 1) where wood loading was relatively low (due to the channel still recovering from decades of channelization). At the downstream Bennett Site where natural recovery to channelization was largely complete, wood loading was much higher with numerous side channels forming and frequent shifts in the main channel position occurring. The wood loading at the Bennett Site in 2006 was extremely high and greatly exceeded the target wood loading of up to 225 pieces/mile for streams in New England (McKinley et al., no date). The upper end of those restoration targets, 225 pieces/mile will be used in the main channel at the Bennett Site with additional wood already present in the numerous side channels branching off from the primary flow path.

5.3 Timing and other details of restoration

The timing and other details of the restoration will be critical to its implementation and success. Both the re-grading of berms and restoring Atlantic salmon and brook trout habitat should occur during the same field season and will begin once all permits, funding, construction contracts, and landowner permissions are secured. Actual construction will need to be completed within the in-

stream work window from July 15-October 1. Ideally, the restoration will be completed in 2025 as a multi-year period of no action could lead to vegetation growing in blocked low-flow side channels and a permanent loss of geomorphic and ecological function. Table 2 provides a timeline for completing the restoration in 2025. Construction is envisioned for September, typically a low flow time period, with six work days required at each site, assuming all materials are in place beforehand (based on two days for erosion control and dewatering, two days for re-grading berm material, and two days for restoring Atlantic salmon and brook trout habitat). Multiple excavators or bulldozers will be operating on site at the same time. The total length of calendar time needed could be reduced by working on two or more sites simultaneously.

Project Task Description	2025 January	February	March	April	May	June	July	August	September	October	November	December
Proposed Design	x											
Finalize Design		x										
Permitting			x	x	x							
Contracting / Materials Acquisition						x	x					
Pre-Construction Monitoring Survey								x				
Construction / Design Implementation									x			
As Built Monitoring Survey										x		

*Monitoring will continue in 2026, 2028, and 2030

Table 2. Timeline for 2025 completion of restoration.

Construction oversight by a qualified fluvial geomorphologist during all phases of the restoration will be necessary. This will ensure the bulldozer and excavator operators are aware of the target elevations for the berm re-grading, reforming point bars, and excavating new channel positions. The fluvial geomorphologist will also need to oversee the construction of wood and boulder structures required to restore Atlantic salmon and brook trout habitat. This will ensure the proper spacing and elevation of the structures and that they are adequately anchored in the bed and banks of the channel. Re-grading will begin at the upstream end of each site with habitat structures installed as the re-grading progresses downstream.

Details on erosion control and dewatering during restoration are provided in Appendix 1. A staging area at each site for stockpiling wood and boulders will be surrounded by silt fencing. Construction "in the wet" is preferable in terms of reaching target elevations and structure placement but may not be permissible due to fisheries and other environmental concerns. Assuming that working "in the dry" will be required, a dewatering plan has been developed for each site to temporarily divert flow into side channels (Appendix 1). If side channels prove impractical, given their height or reentry point back into the South Branch, pumping flow around work areas will be considered.

Monitoring of the restoration will be required to document its success. During development of the restoration plan, two surveyed cross sections at each site (for a total of eight) were monumented (see cross sections for monitoring map in Appendix 1), so they can be resurveyed in the future. The sites of the monumented cross sections were selected to ensure coverage of a full variety of river conditions and impacts over the entire restoration area. The cross sections were initially surveyed in August 2024 and should be resurveyed immediately prior to construction (to document any pre-restoration changes) and immediately following construction (to document the as-built conditions). Assuming restoration is completed in 2025, subsequent monitoring is also recommended in 2026, 2028, and 2030 in order to document the type and rate of post-restoration adjustments. Monitoring will also include: a) survey of a longitudinal profile, b) substrate particle

size analysis (i.e., pebble count), and c) at least five oriented ground photographs of the site to be repeated each monitoring round, showing overviews of the site as well as close-ups of log habitat structures.

The estimated nearly $700,000 cost of restoration is based on: a) the volume of berm material to be re-graded (Table 1), b) the amount of wood and boulders to be reintroduced to the stream (see materials list in Appendix 1), c) the time estimated to complete the construction, d) the estimated costs for erosion control and dewatering, and e) the estimated costs of permitting assistance, construction oversight, and monitoring. A local contractor with extensive experience in stream restoration was consulted to develop this cost estimate but a 15 percent contingency to cover uncertainties and price fluctuations is also included. A more detailed breakdown of costs is provided in Appendix 1.

6.0 CONCLUSIONS

The South Branch is a dynamic stream with minor meander growth, side channel formation, and growth of gravel bars occurring annually. Large flood events pose severe risks of flood inundation, bank erosion, and channel migration due to large sediment deposits and wood accumulations. These same dynamic conditions are associated with high quality habitat for Atlantic salmon and brook trout due to the flow complexity generated around bars, wood accumulations, and side channels. The proposed South Branch restoration presented in Appendix 1 will create a channel morphology consistent with the excellent Atlantic salmon and brook trout habitat impacted by the December 2023 flood and subsequent post-flood emergency work. If implemented, the restoration will create in the span of a few weeks the channel conditions that might otherwise develop over decades of natural recovery and channel evolution (or during a single large flood with an expected frequency of once every several decades). Given the concerns in the watershed for preserving Atlantic salmon and brook trout habitat, the rapid restoration of geomorphic and habitat functions on the South Branch will prevent the potential permanent loss of habitat that might result in the absence of timely restoration.

The restoration plan presented in Appendix 1 is not intended to be nor should be construed as an effort to reduce flood inundation, bank erosion, and channel avulsion hazards along the South Branch. The Number 6 Road and other infrastructure experienced these hazards in December 2023. Those hazards remain a threat after completion of the post-flood emergency work and will remain largely unchanged with implementation of the proposed restoration. Wood structures, particularly channel-spanning log jams, will be built at a low profile sufficient to improve habitat while avoiding increases, or the appearance of increases, in flood hazards.

7.0 REFERENCES

DEP (Maine Department of Environmental Protection), 2024, Notice of Violation and accompanying letter sent to the Town of Phillips July 15, 2024, 6 p.

Field, J.J., 2007, The recreation of meanders along artificially straightened stream channels: Geological Society of America Abstracts with Programs, v. 39, p. 243.

McKinley, D., Monthey, R., and Welsch, D., No date, Restoring brook trout habitat in headwater streams using large woody debris: Unpublished US Forest Service document, 3 p.

Phillips (Town of Phillips), 2024, Response of the Town of Phillips to the Notice of Violation dated July 15, 2024: Unpublished document sent to DEP, 6 p.

Web citations

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Web citation 2: https://www.facebook.com/groups/2107225159500244/posts/3705068696382541/ (Accessed January 9, 2025)

Web citation 3: https://www.newscentermaine.com/article/weather/maine-snow-totals-new-hampshire-national-weather-service-nws-gray-caribou/97-a476aed5-df8c-40cd-8ec9-1da5b5c0a917 (Accessed January 11, 2025)

Web citation 4: https://www.sunjournal.com/2023/12/20/rainfall-amounts-from-mondays-storm/ (Accessed January 11, 2025)

Web citation 5: https://www.wunderground.com/history/monthly/us/me/byron/KMEPHILL3/date/2023-12 (Accessed January 11, 2025)

Web citation 6: https://nwis.waterdata.usgs.gov/nwis/inventory/?site_no=01047200&agency_cd=USGS (Accessed January 11. 2025)

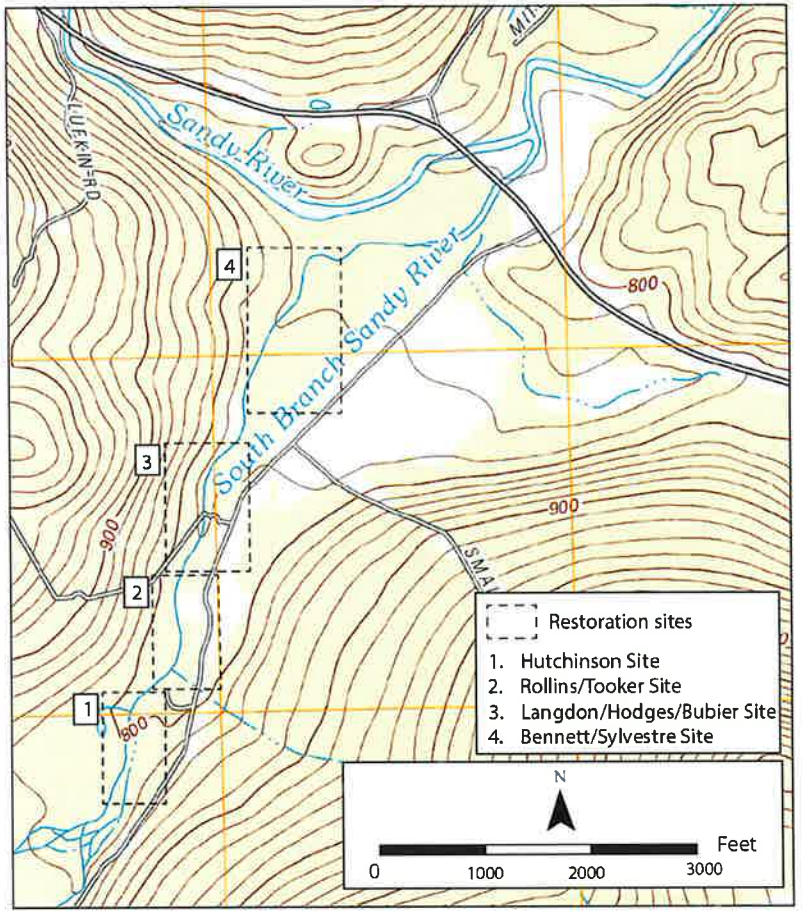
Web citation 7: https://nwis.waterdata.usgs.gov/me/nwis/inventory/?site_no=01048000&agency_cd=USGS (Accessed January 11, 2025)

APPENDIX 1

(South Branch restoration plan)

Hutchinson Site - portion of project area (upstream view)

Bennett/Sylvestre Site - portion of project area (upstream view)



Project Locus

South Branch Sandy River Restoration Project, Multiple Parcels, Town of Phillips, Franklin County, Maine

Prepared by:
Field Geology Services

Title Sheet
South Branch Sandy River Restoration
Phillips, ME

Sheet 1 of 47
January 15, 2025

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL CALL DIG SAFE AT 1-888-344-7233 AT LEAST 72 HOURS PRIOR TO EXCAVATION IN ACCORDANCE WITH MAINE STATE LAW.
2. THE CONTRACTOR SHALL ESTABLISH "CONSTRUCTION LIMITS" ON THE SITE BY ACCEPTABLE VISIBLE MARKERS. ALL WORK SHALL BE CONFINED TO WITHIN THE LIMITS, UNLESS OTHERWISE SPECIFICALLY AUTHORIZED.
3. THE CONTRACTOR SHALL COMPLY WITH ALL FEDERAL, STATE AND LOCAL SAFETY CODES, REGULATIONS, LEGAL REQUIREMENTS, AND PERMIT CONDITIONS.
4. THE CONTRACTOR SHALL TAKE ADEQUATE PRECAUTIONS TO PROTECT ALL INFRASTRUCTURE AND PROPERTY ON OR OFF THE PREMISES, AND SHALL REPAIR OR REPLACE ANY ITEMS DAMAGED AS A RESULT OF THE CONTRACTOR'S WORK.
5. THE CONTRACTOR SHALL COMPLETE ALL LAYOUTS, SURVEYS, ETC. REQUIRED FOR CONSTRUCTION OF THE PROJECT AS SHOWN AND AS SPECIFIED.
6. THE CONTRACTOR SHALL POST AND MAINTAIN ROADWAY SIGNS AS REQUIRED.
7. AT THE PRE-CONSTRUCTION MEETING THE CONTRACTOR SHALL DESIGNATE A CONTACT PERSON TO RESPOND TO EMERGENCIES THAT OCCUR OUTSIDE OF WORKING HOURS. THE DESIGNATED CONTACT PERSON WILL BE RESPONSIBLE FOR EFFECTIVELY RESPONDING TO ALL EMERGENCIES.
8. THE CONTRACTOR SHALL CHECK THE WEATHER FORECAST PRIOR TO EACH DAY'S CONSTRUCTION AND SHALL BE RESPONSIBLE FOR SAFE HANDLING OR ANY EXISTING OR FORECAST FLOWS. CONTRACTOR IS RESPONSIBLE FOR STABILIZING THE CONSTRUCTION AREA TO PREVENT THE LOSS OF MATERIAL AND EROSION FROM THE SITE AND REPAIRING SEDIMENTATION AND EROSION CONTROL MEASURES AS NECESSARY.
9. THE WORK AREA SHALL BE STABILIZED AT THE END OF EACH WORK DAY TO PROTECT SITE FROM OVERNIGHT STORMS.
10. DISTURBANCE OF THE CHANNEL SUBSTRATE SHALL BE MINIMIZED TO AVOID IMPACTS TO FISH AND AQUATIC ORGANISMS.
11. AREAS OF DISTURBANCE SHALL BE MINIMIZED TO THE EXTENT POSSIBLE.
12. RESTORE CONSTRUCTION ACCESS TO PRE-CONSTRUCTION CONDITIONS BY BACKBLADING THE SURFACE SMOOTH WHERE NEEDED, ADD SEED AND MULCH.

SUGGESTED CONSTRUCTION SEQUENCE:

1. OBTAIN APPROPRIATE PERMITS, NOTIFY TOWN OFFICIALS OF CONSTRUCTION COMMENCEMENT, AND SUBMIT CONSTRUCTION TIMETABLE.
2. ESTABLISH "CONSTRUCTION LIMITS" AND INSTALL REQUIRED EROSION CONTROL MEASURES.
3. INSTALL COFFER DAM AND CONSTRUCT WATER DIVERSION. DEPLOY NET UPSTREAM OF LIMIT OF WORK, ELECTRO-FISH AND REMOVE FISH AND AQUATIC ORGANISMS FROM WORK AREA.
4. RE-DISTRIBUTE GRAVEL FROM BERMS ACCORDING TO RESTORATION PLAN.
5. GRADE AND RESHAPE CHANNEL ACCORDING TO RESTORATION PLAN.
6. CONSTRUCT BOULDER-SUPPORTED LOG JAMS, CHANNELSPANNING LOG JAMS, AND ISOLATED LOG STRUCTURES.
7. RESTORE CONSTRUCTION ENTRANCES AND ALL DISTURBED AREAS.
8. SEED DISTURBED AREAS IN ACCORDANCE WITH PLANTING PLAN.

SEDIMENTATION AND EROSION CONTROL NOTES:

1. SEDIMENTATION AND EROSION CONTROL MEASURES SHALL BE INSTALLED, AS REQUIRED, PRIOR TO THE START OF WORK AND MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.
2. EROSION CONTROL MEASURES SHALL BE INSPECTED PRIOR TO THE BEGINNING OF WORK EACH DAY. THE CONTRACTOR SHALL MAINTAIN AND REPAIR SEDIMENTATION AND EROSION CONTROL DEVICES AS NECESSARY.
3. THE REDISTRIBUTION OF GRAVEL FROM THE BERMS REQUIRES HEAVY EQUIPMENT WORKING WITHIN THE BANKFULL CHANNEL. CARE WILL BE TAKEN TO MINIMIZE EXCESS SEDIMENTATION OR DISTURBANCE THEREBY MINIMIZING ADVERSE FISHERIES IMPACTS.
4. DURING CONSTRUCTION A FLOATING TURBIDITY CURTAIN SHALL BE DEPLOYED DOWNSTREAM OF THE ACTIVE WORK AREA. THE TURBIDITY CURTAIN CAN BE MOVED AS NEEDED AS CONSTRUCTION PROGRESSES.
5. FOLLOWING COMPLETION OF CONSTRUCTION, THE CONTRACTOR SHALL REPAIR ALL ERODED AREAS AND ENSURE THE ESTABLISHMENT OF APPROPRIATE VEGETATION THROUGHOUT.
6. THE CONTRACTOR SHALL FOLLOW STANDARD BEST MANAGEMENT PRACTICES DURING WORK TO CONTROL THE SPREAD OF NON-NATIVE AND INVASIVE SPECIES. REGULAR MONITORING SHALL BE CONDUCTED TO IDENTIFY CORRECTIVE ACTIONS, IF ANY.
7. ALL DISTURBED AREAS SHALL BE SEEDED AS SOON AS POSSIBLE, WITH APPROVED SEED MIXES AT APPLICATION RATES RECOMMENDED BY THE DISTRIBUTOR.
8. SEEDED AREAS WILL BE MULCHED WITH WEED-FREE STRAW.

MATERIALS NOTES:

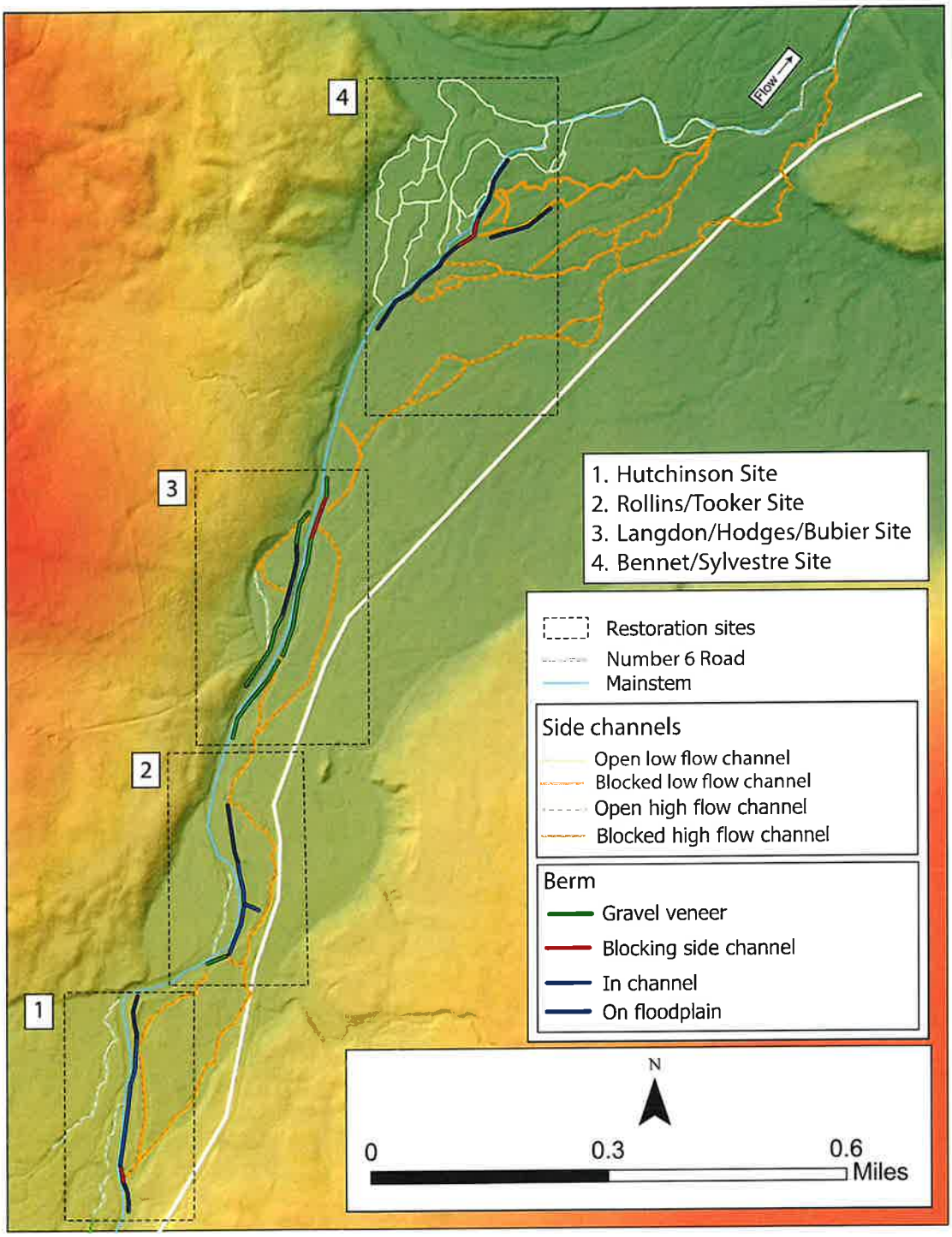
1. BOULDERS SHALL BE GEOLOGICALLY APPROPRIATE, AND OF NATIVE REGIONAL LITHOLOGY
2. TREES TO BE USED IN THE CONSTRUCTION SHALL CONSIST OF A MIX OF SPECIES INCLUDING: AT LEAST 50% HEMLOCK, AND LESSER AMOUNTS OF OAK, ASH, BLACK LOCUST, SUGAR MAPLE, SILVER MAPLE, RED MAPLE, AND RED PINE. TREE DIAMETERS AT BREAST HEIGHT OF 12 TO 20 INCHES (DBH) WILL BE ACCEPTED WITH LESS THAN 25% 12 TO 14 INCHES, AND AT LEAST 50% GREATER THAN OR EQUAL TO 18 INCHES (DBH). TO THE GREATEST EXTENT POSSIBLE HEMLOCK, BLACK LOCUST AND OTHER ROT-RESISTANT SPECIES SHALL BE USED.
3. ROOTWADS AND LOGS SHALL BE CUT FROM FRESH, GREEN TREES. A REPRESENTATIVE SAMPLE SHALL BE APPROVED BY THE FLUVIAL GEOMORPHOLOGIST PRIOR TO DELIVERY TO THE SITE.

ENVIRONMENTAL REQUIREMENTS:

1. THE CONTRACTOR SHALL MAINTAIN A DEPTH GAUGE AT OR ADJACENT TO THE PROJECT SITE. INSTREAM WORK SHALL ONLY BE CONDUCTED WHEN FLOW IS AT OR BELOW THE LEVEL ON THE GAUGE SPECIFIED BY THE FLUVIAL GEOMORPHOLOGIST.
2. A FLUVIAL GEOMORPHOLOGIST WILL BE ON SITE FOR THE DURATION OF CONSTRUCTION TO DIRECT THE REDISTRIBUTION OF GRAVEL AND INSTALLATION OF ALL STRUCTURES. THE FLUVIAL GEOMORPHOLOGIST SHALL:
   - 2.1 ASSESS THE PROPOSED DESIGN WITH REGARD TO ACTUAL FIELD CONDITIONS AT THE TIME OF CONSTRUCTION, IDENTIFY ANY CHANGES IN DESIGN CONSIDERATIONS, AND DIRECT THE CONTRACTOR TO MAKE ANY NECESSARY FIELD ADJUSTMENTS BASED ON THESE CONDITIONS. ADJUSTMENTS WILL CONSIDER THE MATERIALS AVAILABLE.
   - 2.2 INSPECT FLOW DEPTH AND CERTIFY THAT INSTREAM WORK ONLY OCCURS WHEN FLOWS ARE BELOW SPECIFIED LEVELS.
   - 2.3 INSPECT DISTURBED AREA DAILY AND CERTIFY THAT THE DAY'S WORK HAS BEEN PERFORMED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND/OR FIELD ADJUSTMENTS.
   - 2.4 INSPECT ALL EROSION CONTROL MEASURES DAILY AND CERTIFY THAT THEY ARE IN WORKING CONDITION.
   - 2.5 DIRECT THE PLACEMENT AND INSTALLATION OF ALL STRUCTURES TO ENSURE THAT THEY HAVE BEEN COMPLETED CORRECTLY.
   - 2.6 REPORT ABOVE CERTIFICATIONS TO THE CONTACT DESIGNATED BY THE CONTRACTOR AT THE PRE-CONSTRUCTION MEETING.
3. ALL INSTREAM WORK SHALL BE COMPLETED DURING THE FOLLOWING TIME OF YEAR RESTRICTION: JULY 15 TO OCTOBER 1.
4. SOUTH BRANCH SANDY RIVER IS RECOGNIZED AS A COLDWATER FISHERY AND ATLANTIC SALMON AND BROOK TROUT STREAM.
5. ALL FUELING OR CHANGING OF FLUIDS SHALL BE DONE OUTSIDE OF THE RESOURCE AREAS.
6. A CHANNEL-SPANNING FLOATING HAZMAT BOOM SHALL BE DEPLOYED DOWNSTREAM OF WORK AREA PRIOR TO COMMENCEMENT OF WORK AND MAINTAINED UNTIL COMPLETION OF CONSTRUCTION.

PLANTING NOTES AND INVASIVE SPECIES CONTROL:

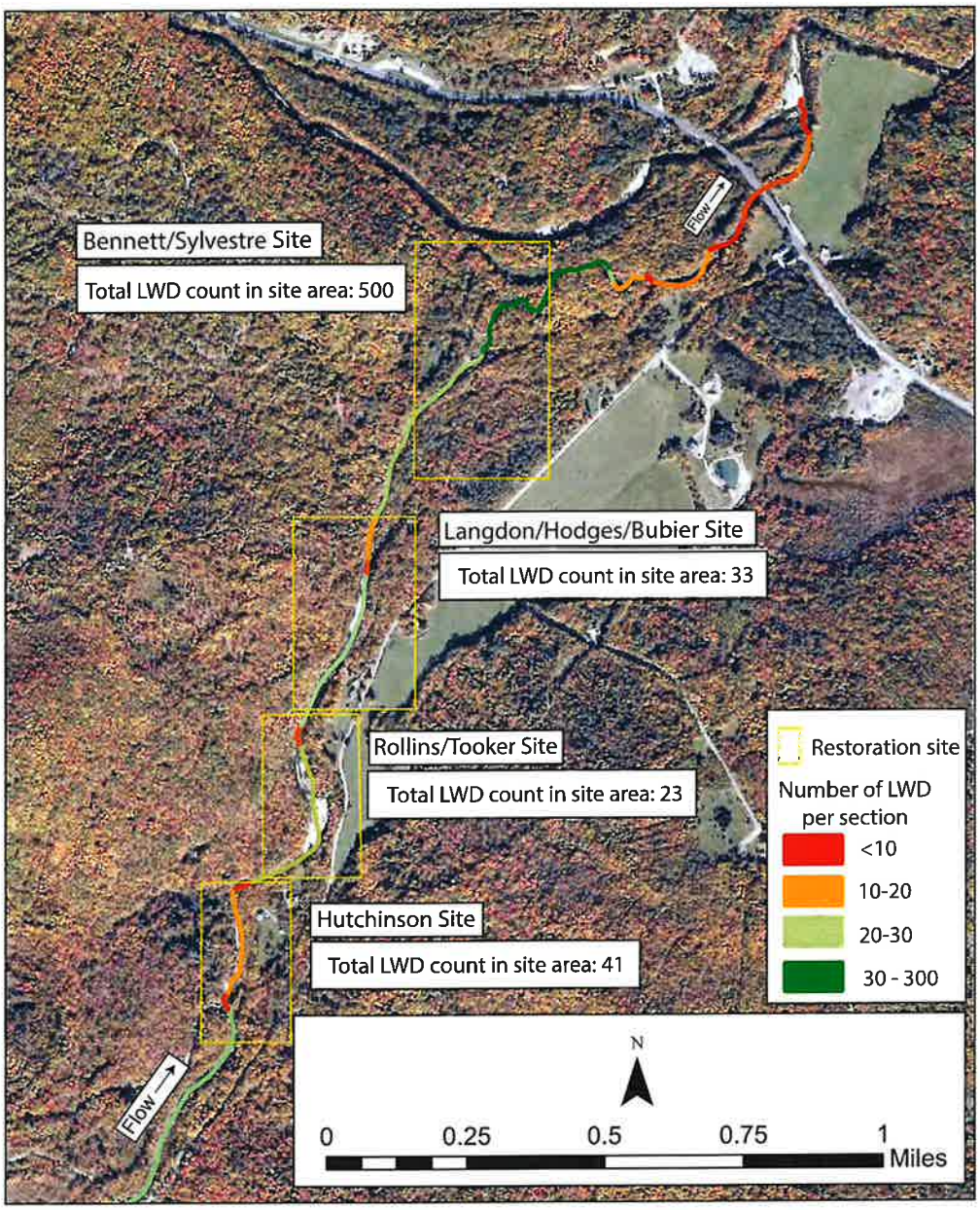
1. THE CONTRACTOR SHALL FOLLOW STANDARD BEST MANAGEMENT PRACTICES DURING WORK TO CONTROL THE SPREAD OF NON-NATIVE AND INVASIVE SPECIES. REGULAR MONITORING SHALL BE CONDUCTED TO IDENTIFY CORRECTIVE ACTIONS, IF ANY.
2. ALL DISTURBED AREAS SHALL BE SEEDED AS SOON AS POSSIBLE, WITH APPROVED SEED MIXES AT APPLICATION RATES RECOMMENDED BY DISTRIBUTOR.
3. SEEDED AREAS WILL BE MULCHED WITH WEED-FREE STRAW.



Sheet 3 of 47
January 15, 2025

o fo Side Channel and Berming Overview
South Branch Sandy River Restoration Phillips, ME

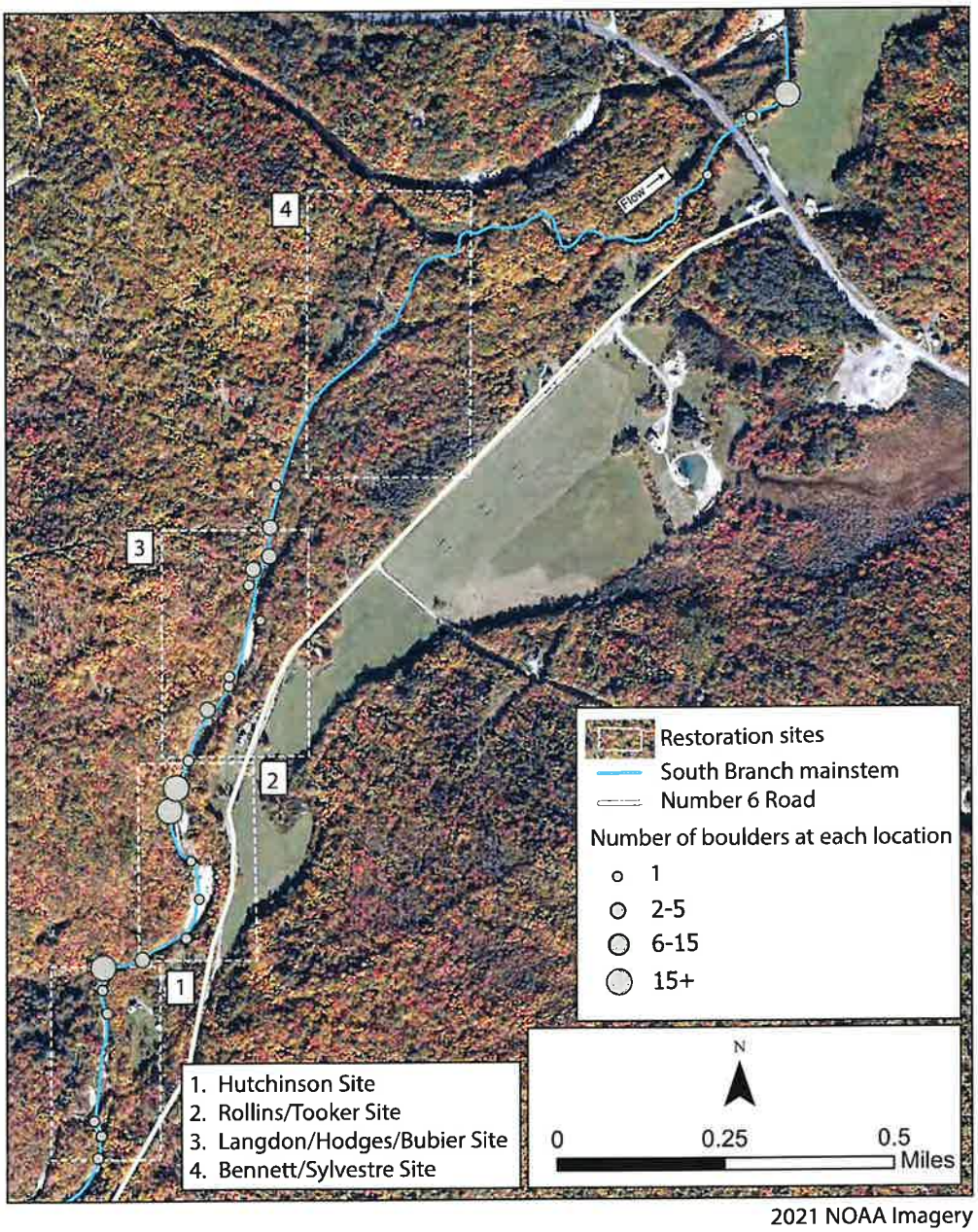
Prepared by:
Field Geology Services



Data from ATS 2006 habitat survey. LWD count.

o fo 2006 Woodloading
South Branch Sandy River Restoration
Phillips, ME

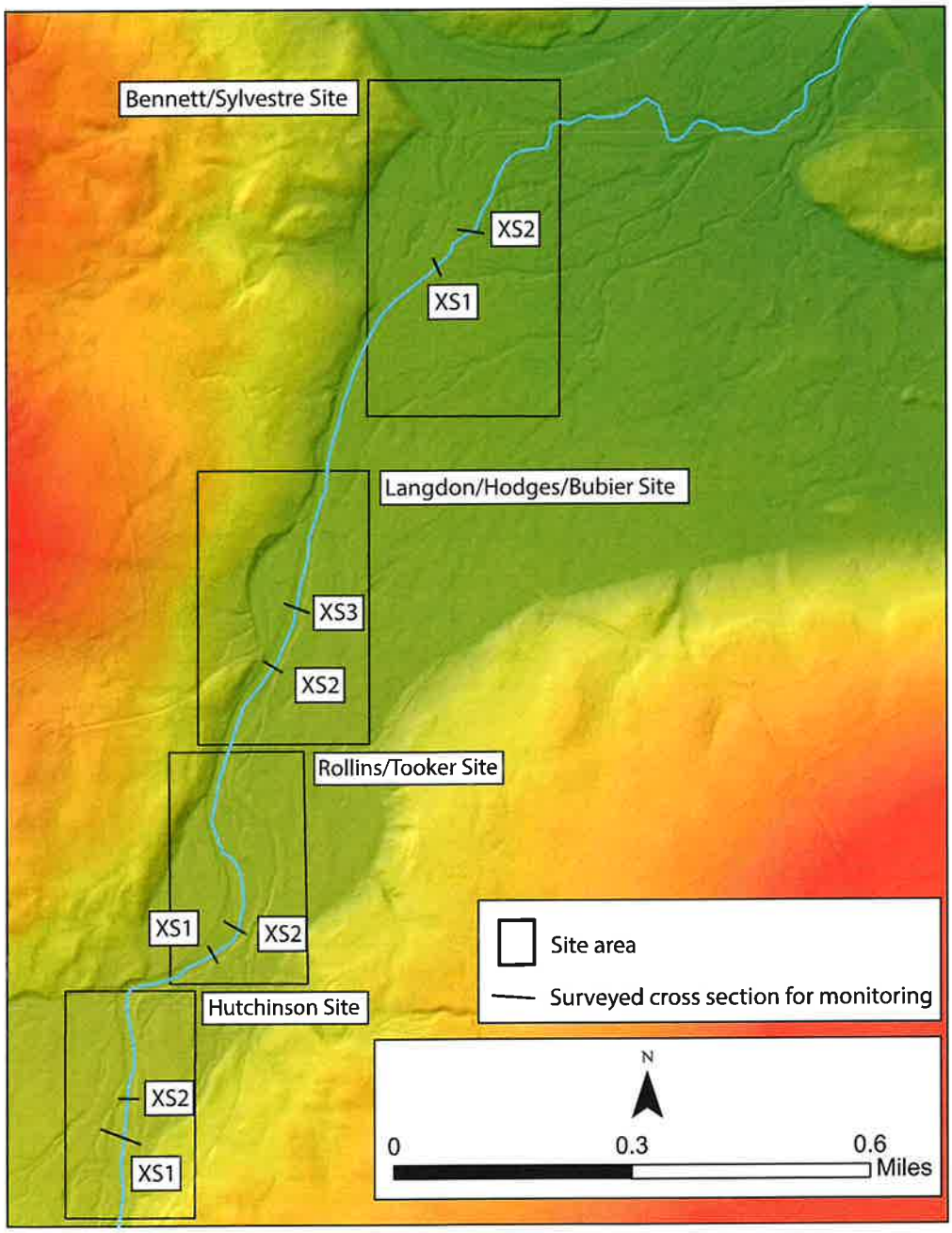
Prepared by:
Field Geology Services



2021 NOAA Imagery

o fo Usable Boulders
South Branch Sandy River Restoration
Phillips, ME

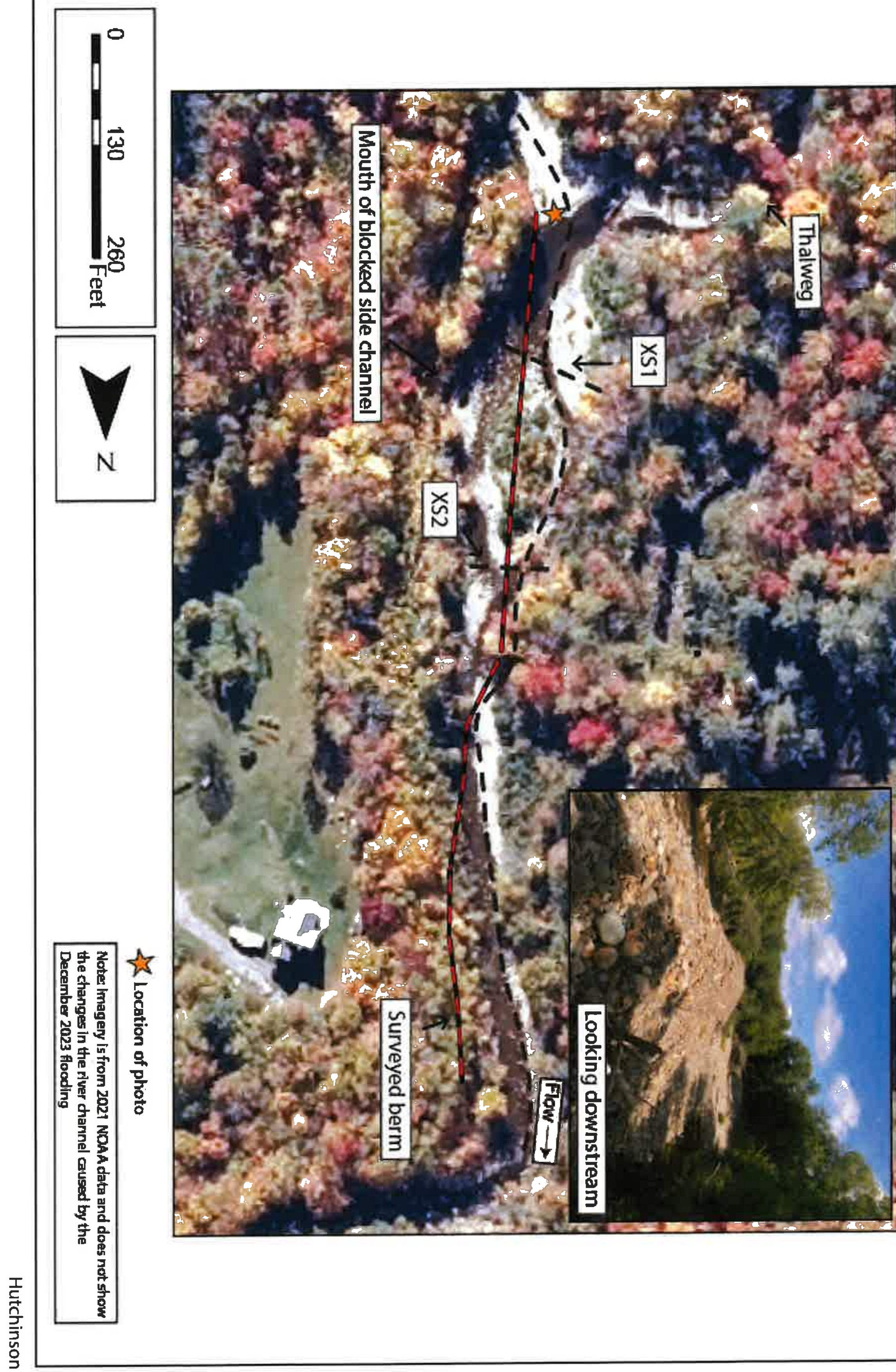
Prepared by:
Field Geology Services

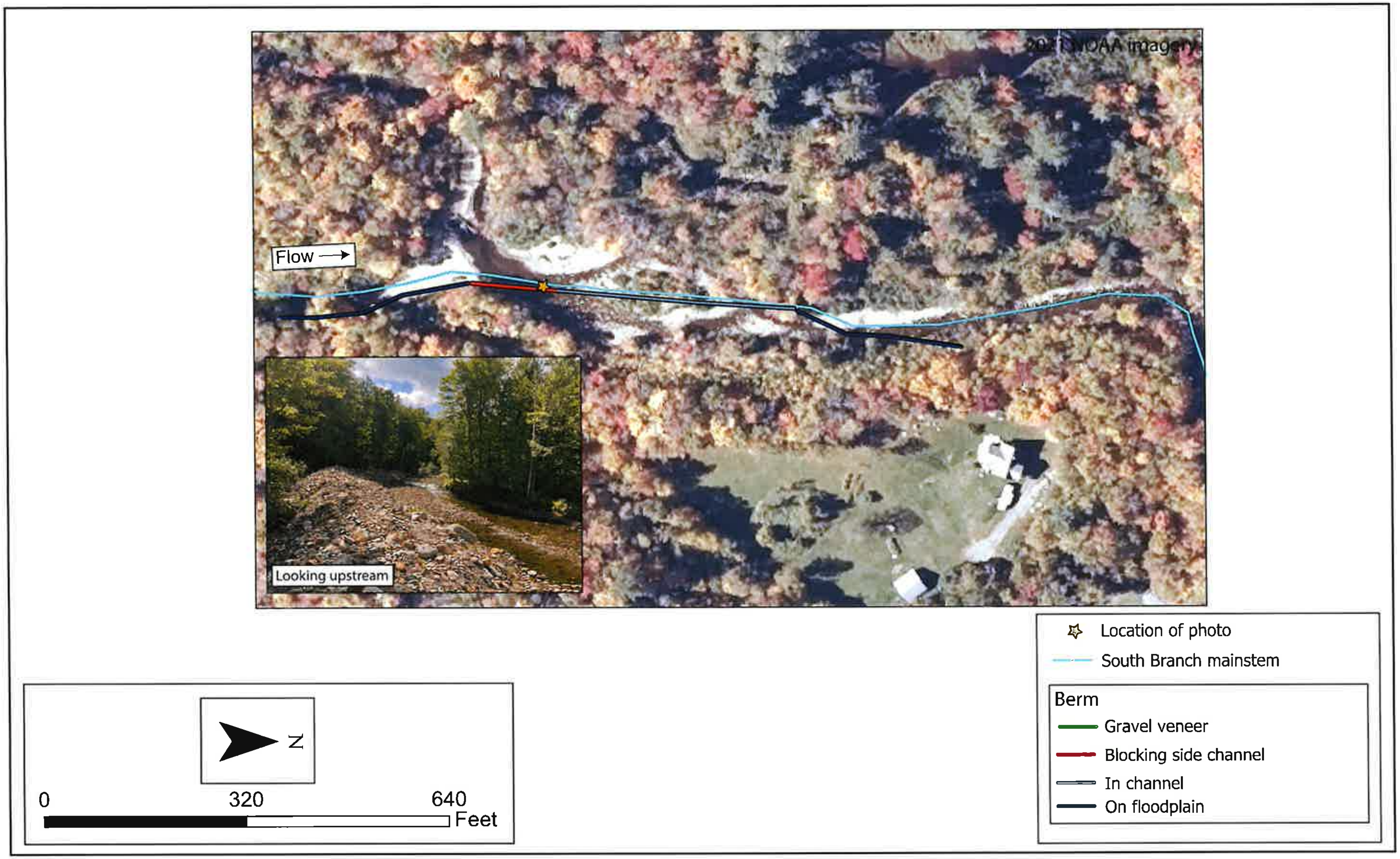


Sheet 6 of 47
January 15, 2025

o fo Cross Sections for Monitoring
South Branch Sandy River Restoration Phillips, ME

Prepared by:
Field Geology Services


0
130
260
Feet
N
Thalweg
XS1
XS2
Mouth of blocked side channel
Surveyed berm
Flow
Looking downstream
Location of photo
Note: Imagery is from 2021 NOAA data and does not show the changes in the river channel caused by the December 2023 flooding
Hutchinson



Hutchinson

South Branch Sandy River Restoration
Phillips, ME

Sheet 8 of 47
January 15, 2025

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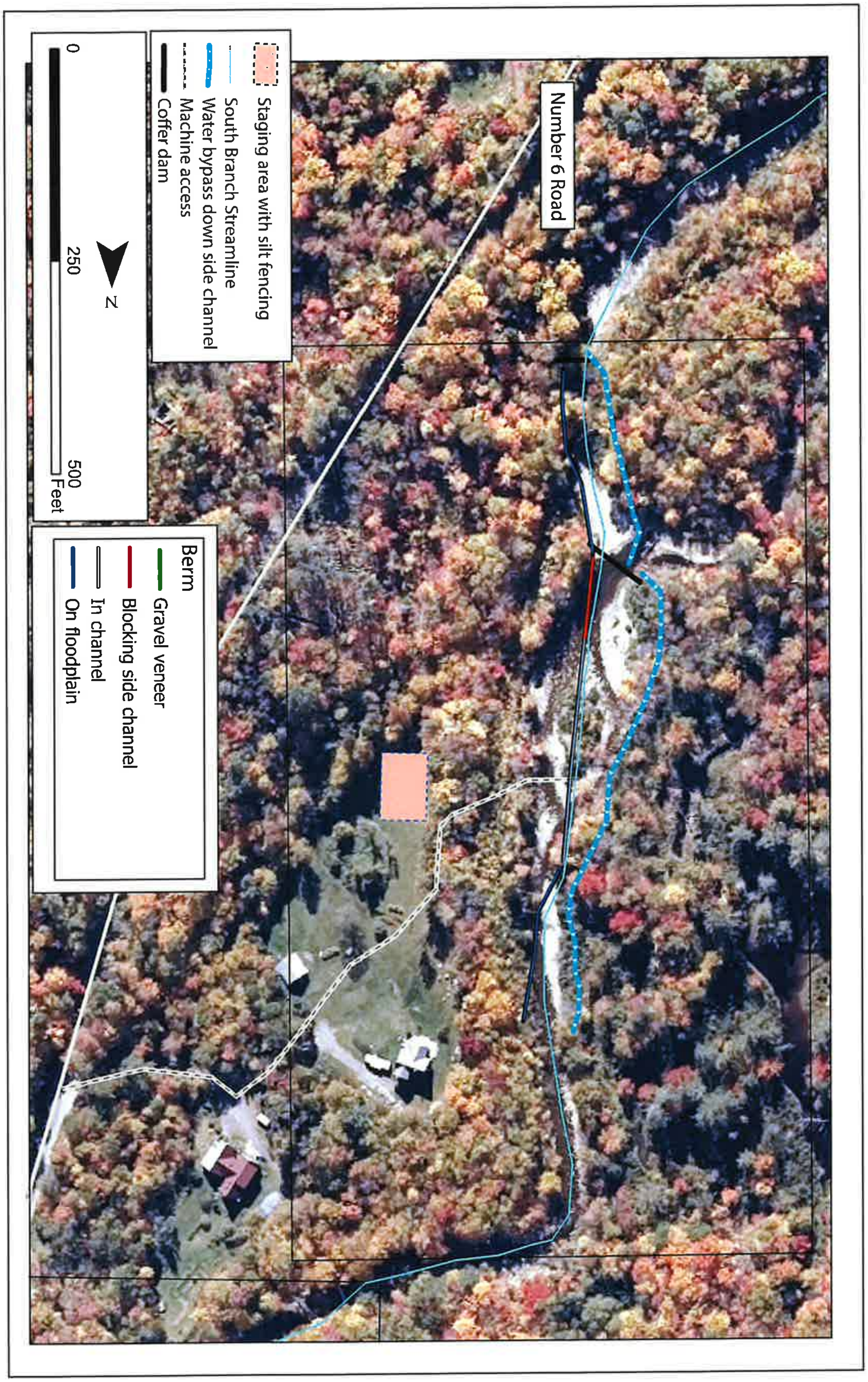

Hutchinson

South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Hutchinson

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South Branch Sandy River Restoration
Phillips, ME

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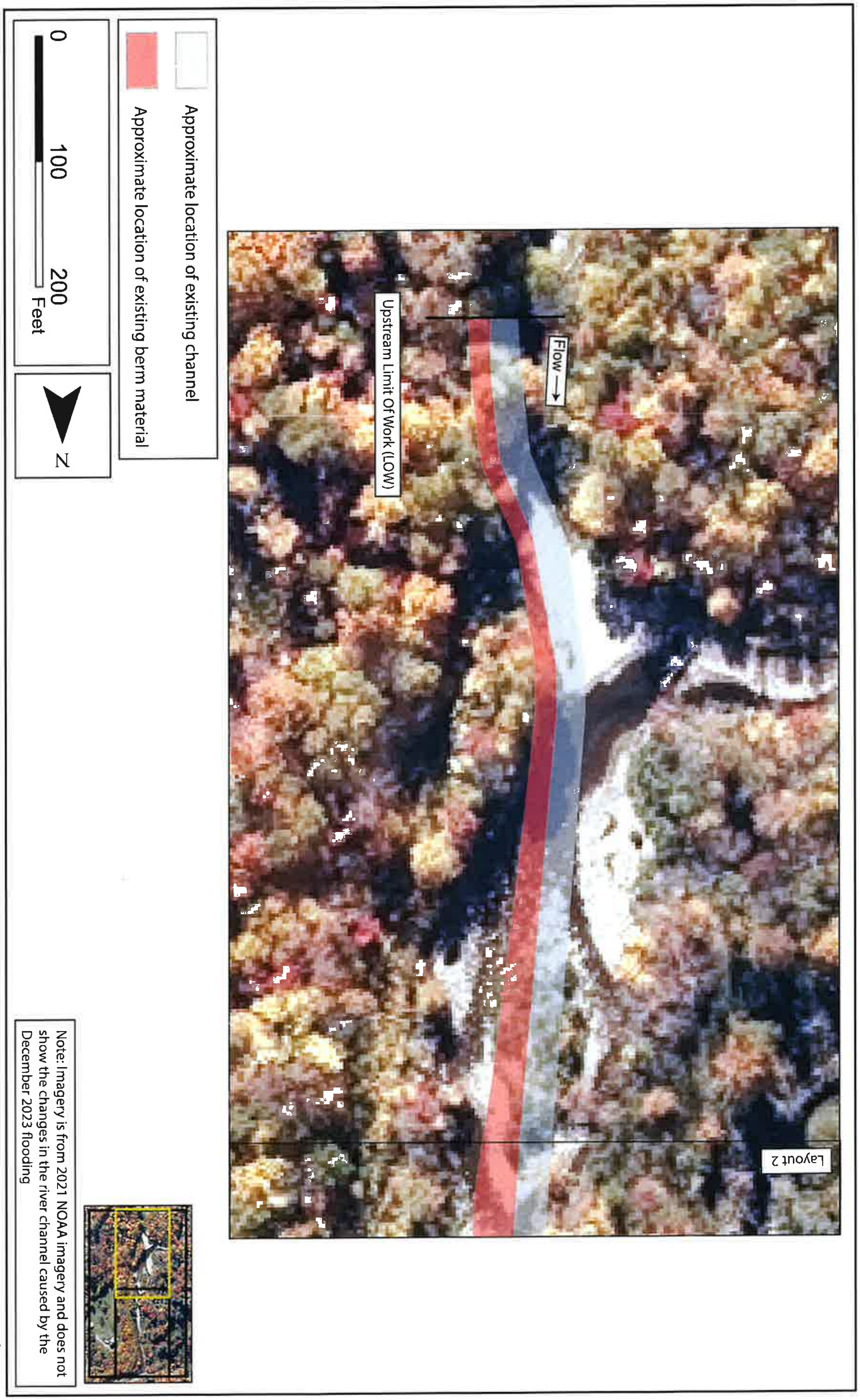
Field Geology Services



Sheet 11 of 47
January 15, 2025

Exising Conditions/Layout 1
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Approximate location of existing channel

Approximate location of existing berm material

0 100 200 Feet

N

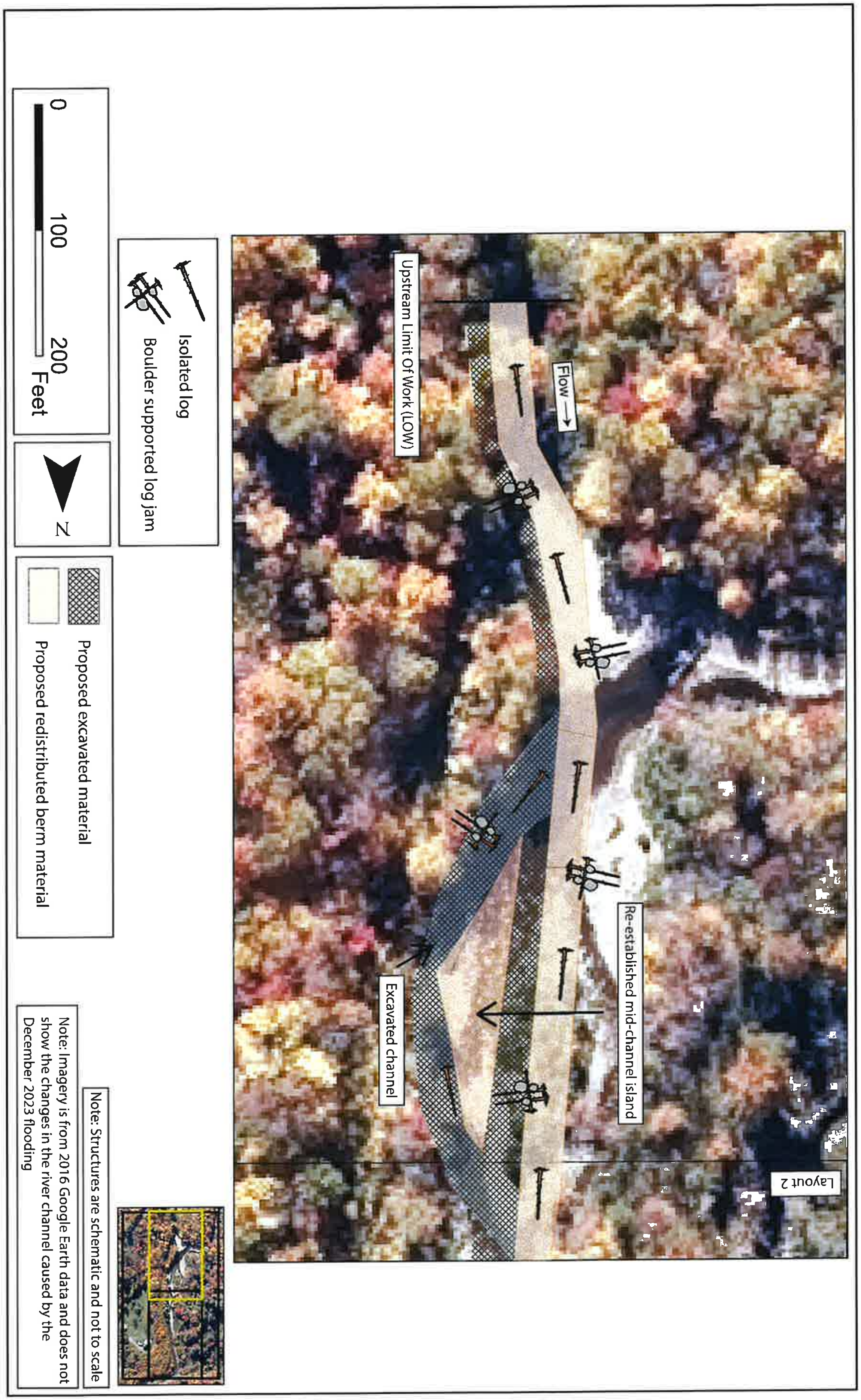
Note: Imagery is from 2021 NOAA imagery and does not show the changes in the river channel caused by the December 2023 flooding

Hutchinson

Existing Conditions/Layout 2
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

January 15, 2025



Hutchinson

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January 15, 2025

Proposed Planview/Layout 1
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Isolated log

Boulder supported log jam

0 100 200 Feet

N

Proposed excavated material

Proposed redistributed berm material

Note: Structures are schematic and not to scale

Note: Imagery is from 2016 Google Earth data and does not show the changes in the river channel caused by the December 2023 flooding

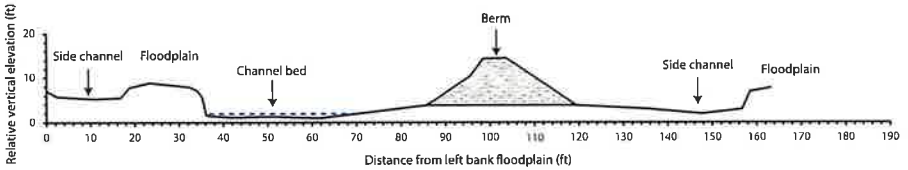
Hutchinson

Prepared by: Field Geology Services

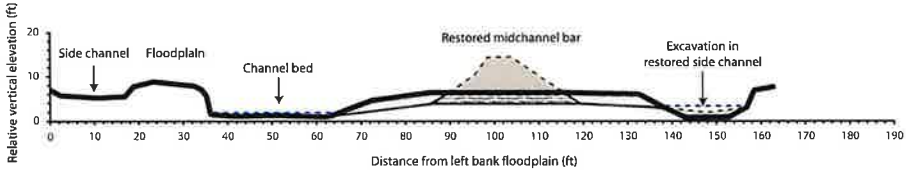
Proposed Planview/Layout 2
South Branch Sandy River Restoration
Phillips, ME

Hutchinson Site - Cross Section 1

Existing Condition

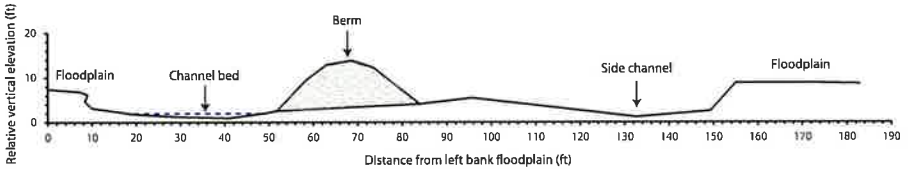


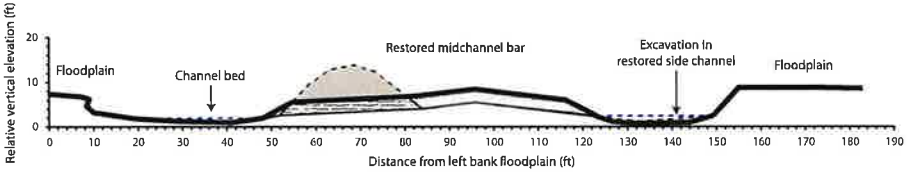
Proposed Condition



Note: Approximately 136 sq.ft. of gravel re-distributed to create proposed condition cross section

Hutchinson Site - Cross Section 2





Note: Approximately 144 sq.ft. of gravel re-distributed to create proposed condition cross section

Existing fill
Proposed cut
Proposed fill
Final ground surface

Vertical exaggeration = 1.0x

Note: Area of proposed fill equals area of proposed cut

Note: View looking downstream

Hutchinson Site

Prepared by:
Field Geology Services

Existing/Proposed Condition Cross Sections
South Branch Sandy River Restoration
Phillips, ME

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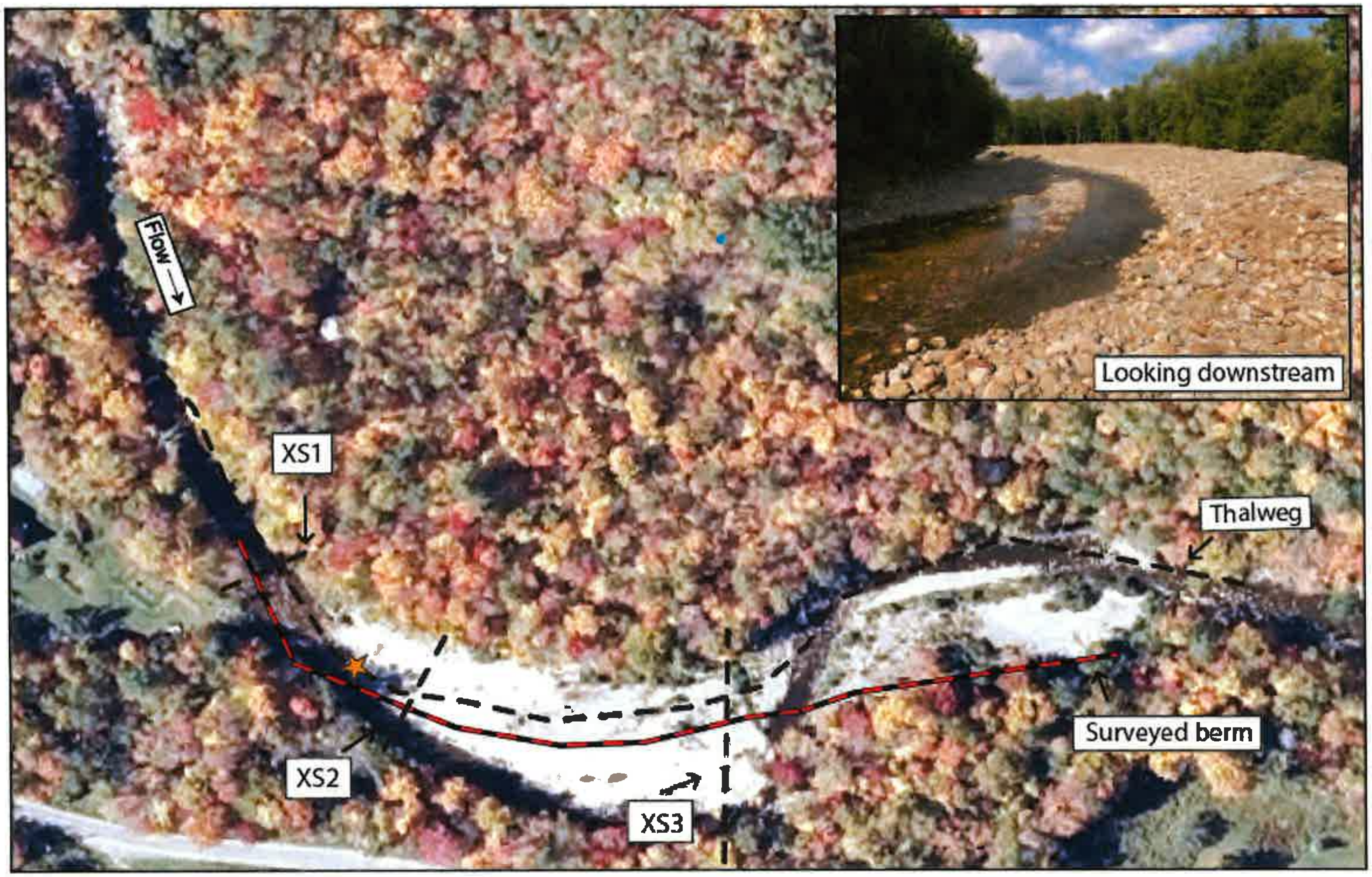
January 15, 2025



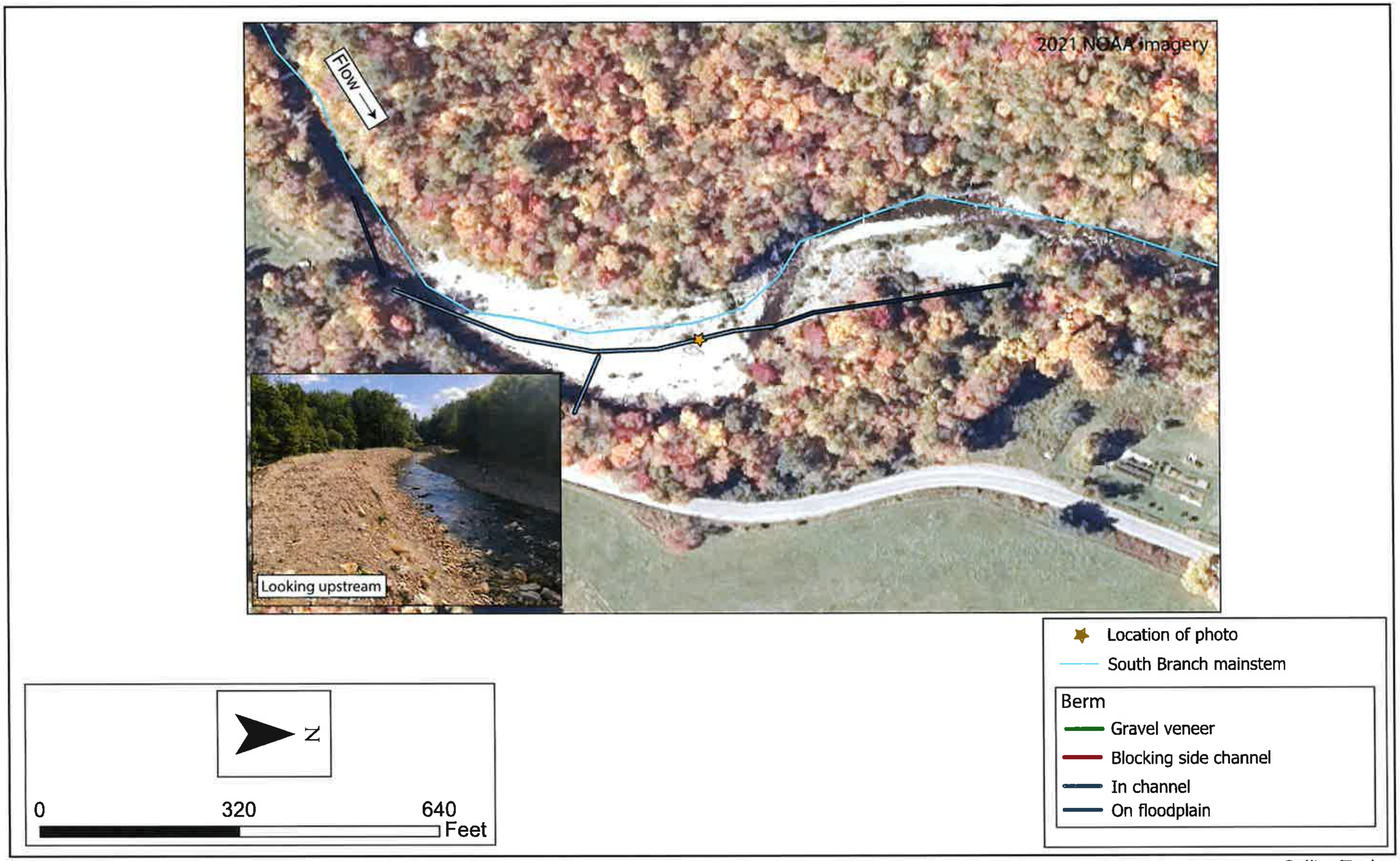
0 160 320 Feet

N

Location of photo

Note: Imagery is from 2021 NOAA data and does not show the changes in the river channel caused by the December 2023 flooding

Rollins/Tooker



Rollins/Tooker

Prepared by:
Field Geology Services

South Branch Sandy River Restoration
Phillips, ME

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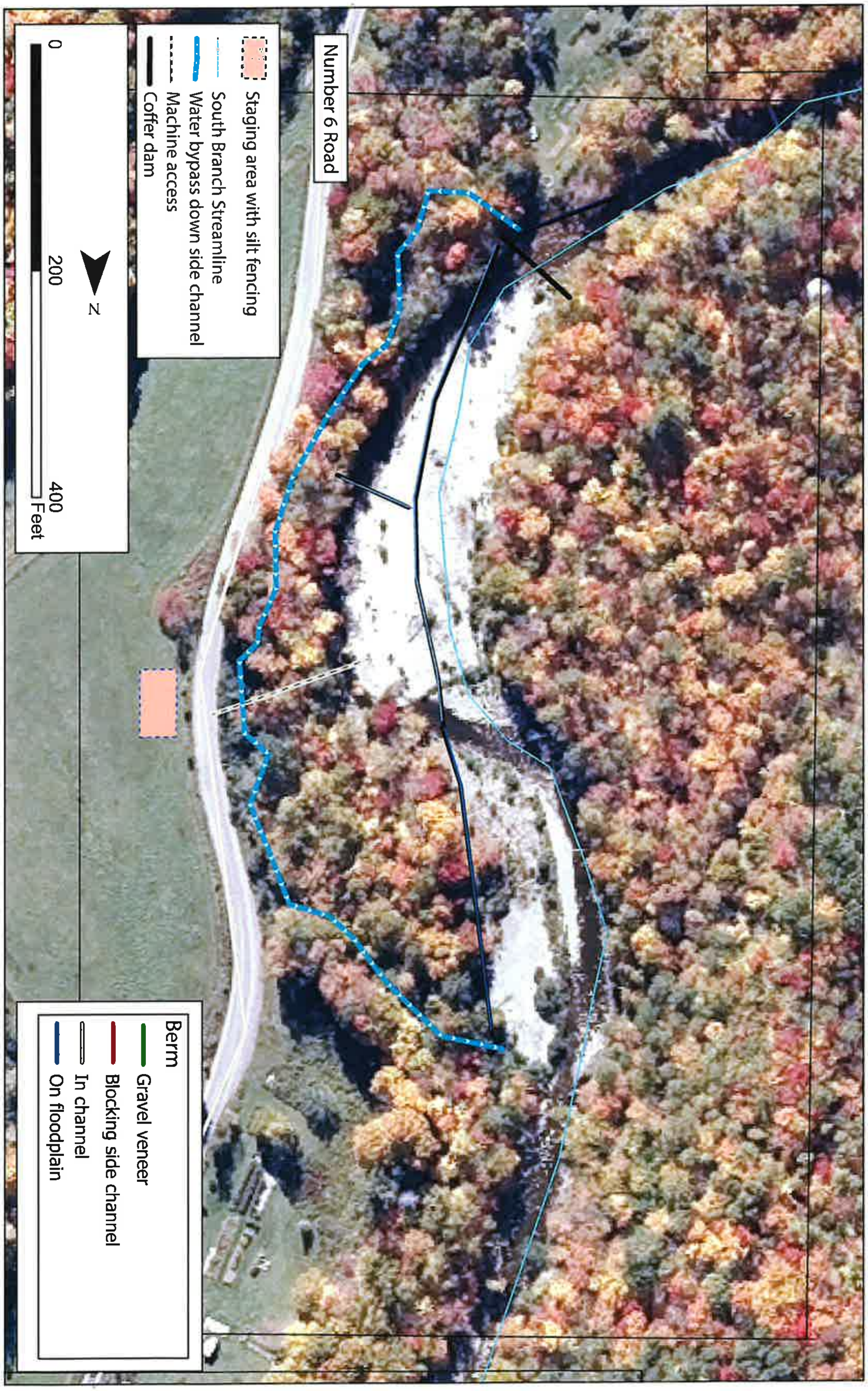
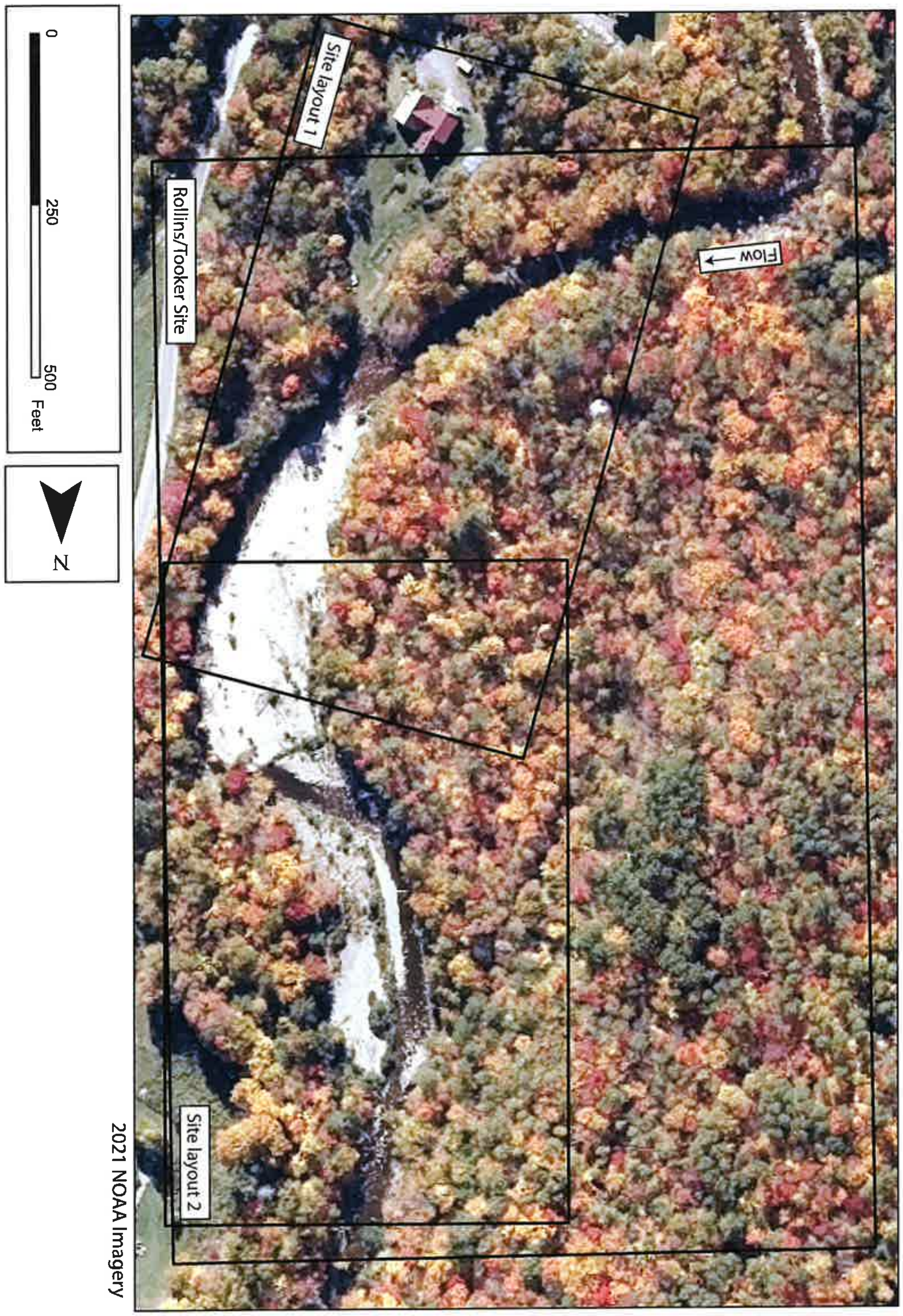


Rollins/Tooker

South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services



Rollins/Tooker

o
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Approximate location of existing channel

Approximate location of existing berm material

0 125 250 Feet

N

Note: Imagery is from 2021 NOAA imagery and does not show the changes in the river channel caused by the December 2023 flooding

Rollins/Tooker

Existing Conditions/Layout 1
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Approximate location of existing channel

Approximate location of existing berm material

0 125 250 Feet

N

Note: Imagery is from 2021 NOAA imagery and does not show the changes in the river channel caused by the December 2023 flooding

Rollins/Tooker

Prepared by:

Field Geology Services

Existing Conditions/Layout 2
South Branch Sandy River Restoration
Phillips, ME

Isolated log

Boulder supported log jam

0 125 250 Feet

N

Proposed excavated material

Approximate proposed channel location

Remaining gravel veneer

Proposed redistributed berm material

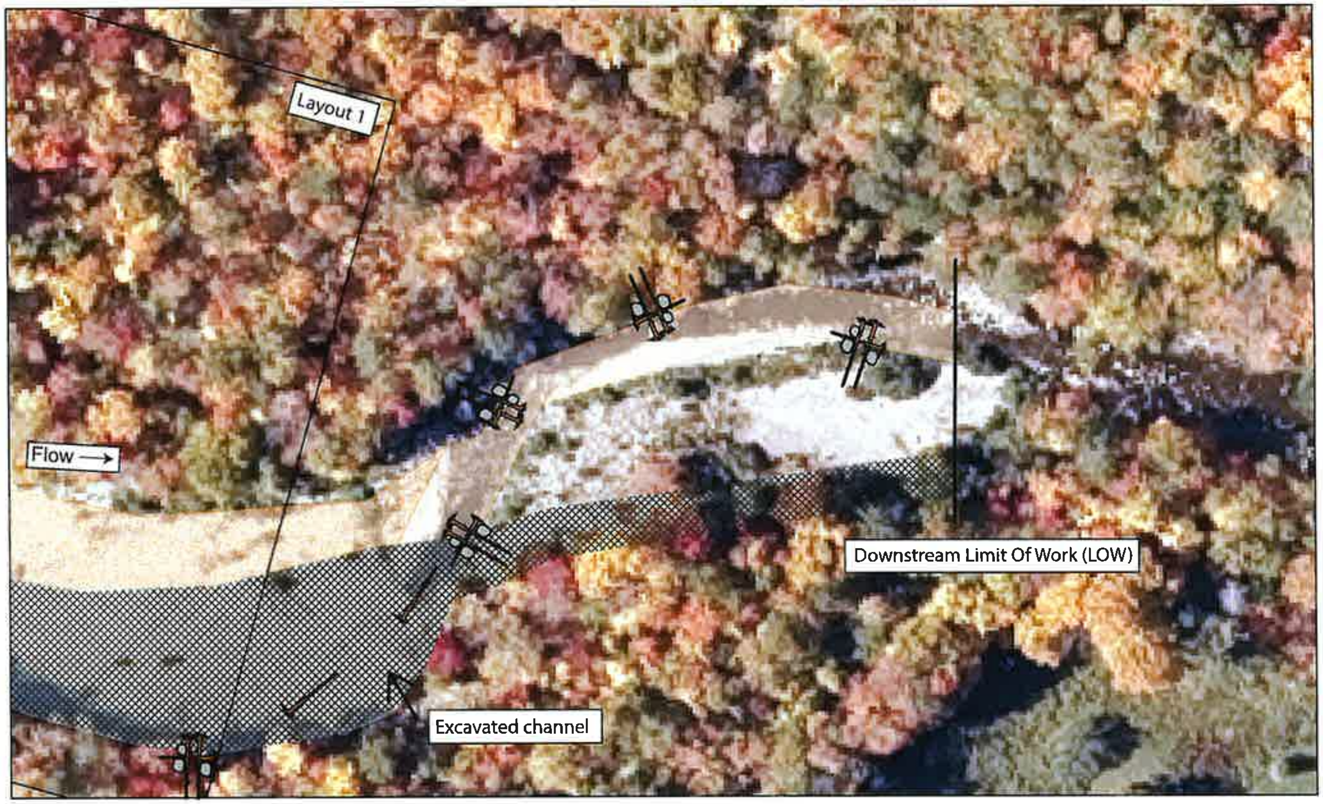
Note: Structures are schematic and not to scale

Note: Imagery is from 2016 Google Earth data and does not show the changes in the river channel caused by the December 2023 flooding

Rollins/Tooker

Prepared by:
Field Geology Services

Proposed Planview/Layout 1
South Branch Sandy River Restoration
Phillips, ME



Isolated log

Boulder supported log jam

Proposed excavated material

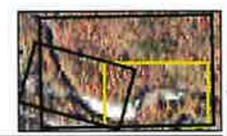
Approximate proposed channel location

Remaining gravel veneer

Proposed redistributed berm material

0 125 250 Feet

N



Note: Structures are schematic and not to scale

Note: Imagery is from 2016 Google Earth data and does not show the changes in the river channel caused by the December 2023 flooding

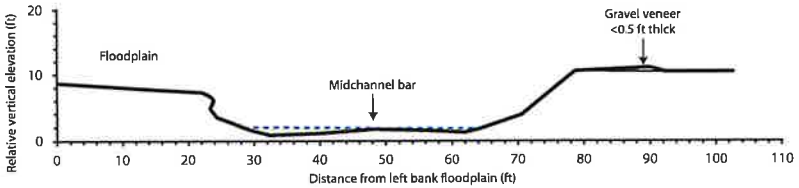
Rollins/Tooker

Proposed Planview/Layout 2
South Branch Sandy River Restoration
Phillips, ME

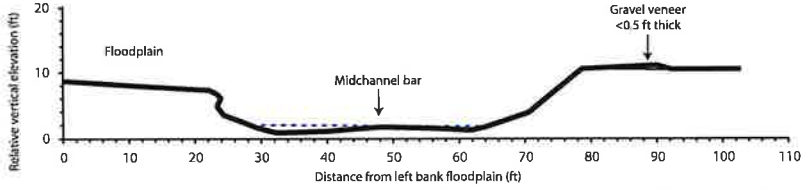
Prepared by:
Field Geology Services

Rollins/Tooker Site - Cross Section 1

Existing Condition

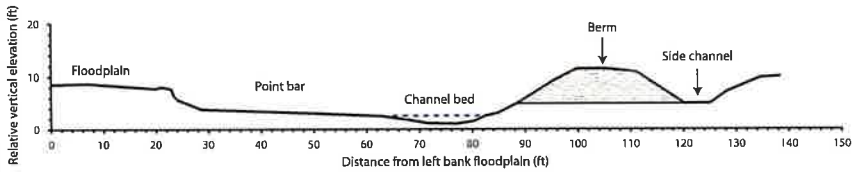


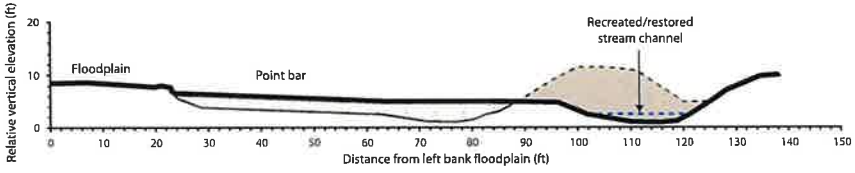
Proposed Condition



Note: No gravel re-distributed to create proposed condition cross section

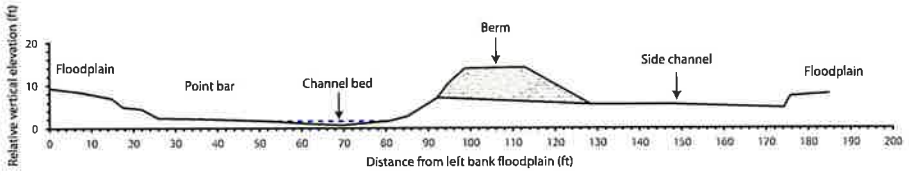
Rollins/Tooker Site - Cross Section 2

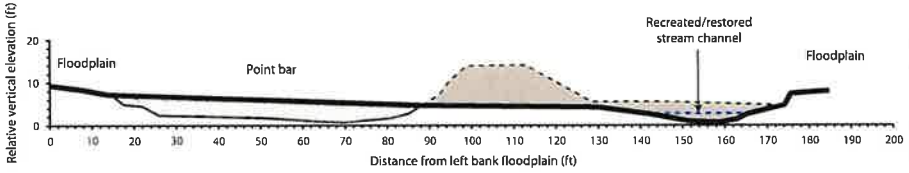




Note: Approximately 200 sq.ft. of gravel re-distributed to create proposed condition cross section

Rollins/Tooker Site - Cross Section 3





Note: Approximately 400 sq.ft. of gravel re-distributed to create proposed condition cross section

Existing fill
Proposed cut
Proposed fill
Final ground surface

Vertical exaggeration = 1.0x

Note: Area of proposed fill equals area of proposed cut

Note: View looking downstream

Prepared by: Field Geology Services

Existing/Proposed Condition Cross Sections
South Branch Sandy River Restoration
Phillips, ME

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January 15, 2025

Rollins/Tooker Site

0 185 370 Feet

N

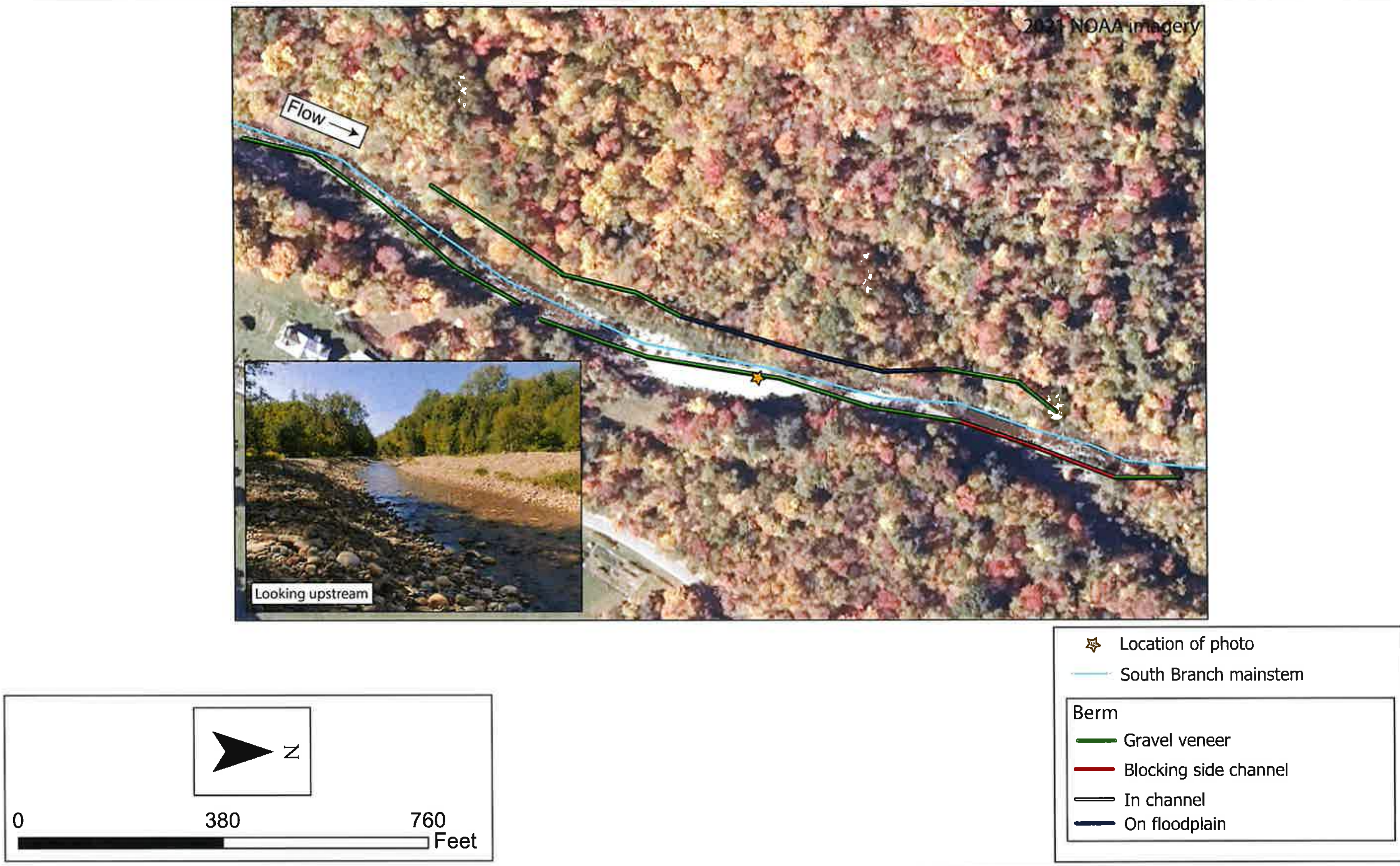
Location of photo

Note: Imagery is from 2021 NOAA data and does not show the changes in the river channel caused by the December 2023 flooding

Langdon/Hodges/Bubier

South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services



Langdon/Hodges/Bubier

South Branch Sandy River Restoration
Phillips, ME

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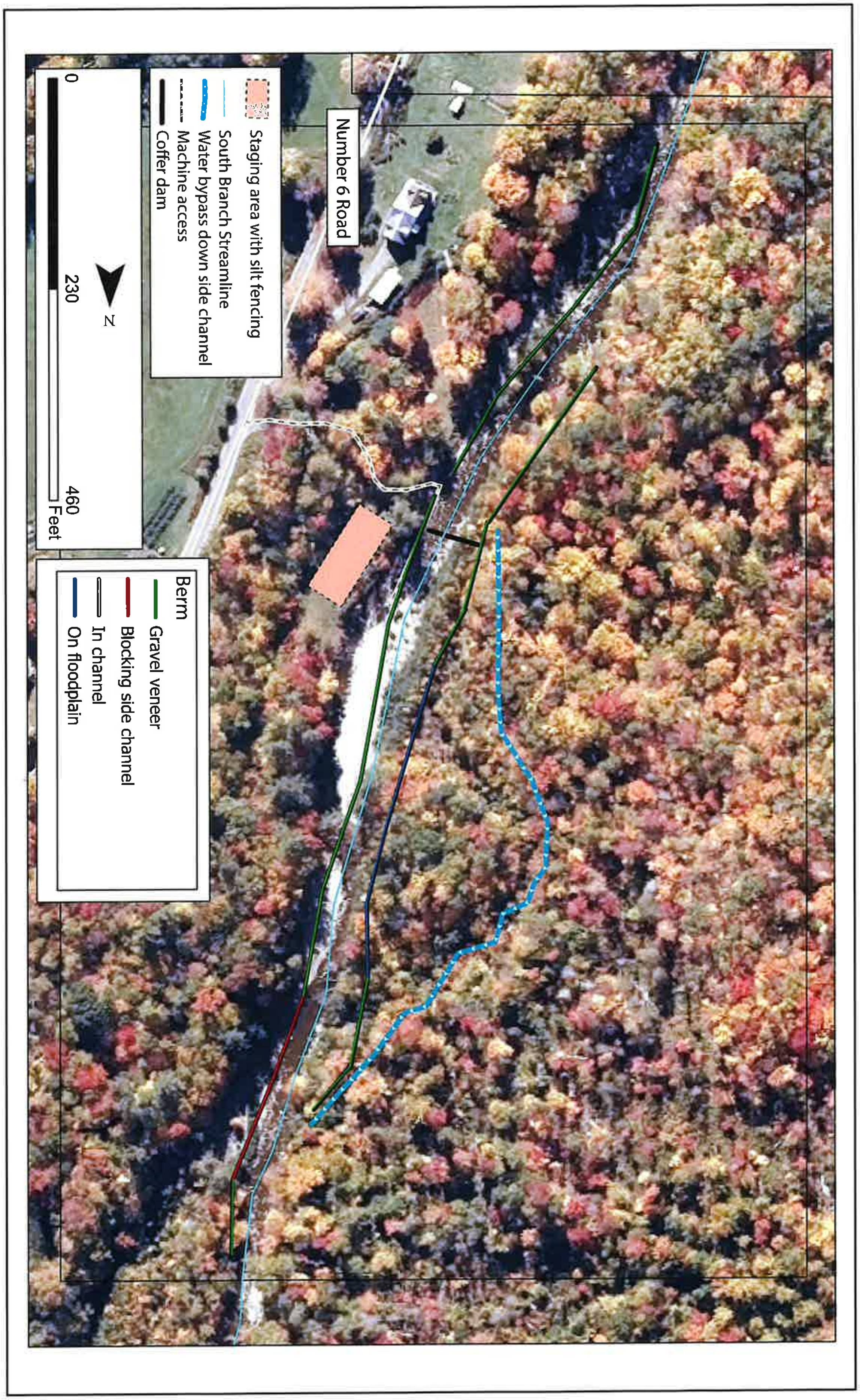
January 15, 2025

Prepared by:
Field Geology Services

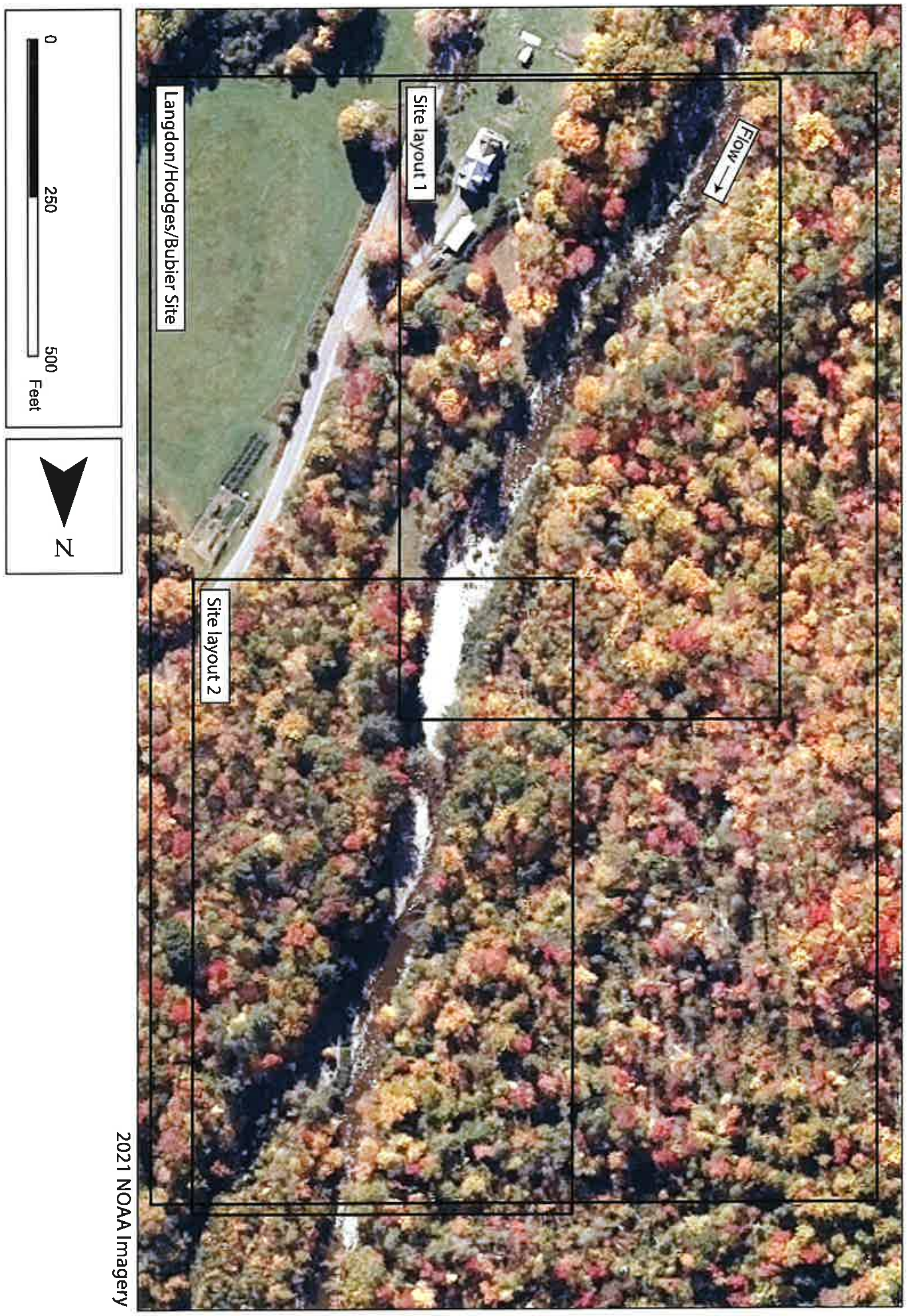


Langdon/Hodges/Bubier

South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Langdon/Hodges/Bubier



South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Approximate location of existing channel

Approximate location of existing berm material

0 125 250 Feet

N

Note: Imagery is from 2021 NOAA imagery and does not show the changes in the river channel caused by the December 2023 flooding

Existing Conditions/Layout 1
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

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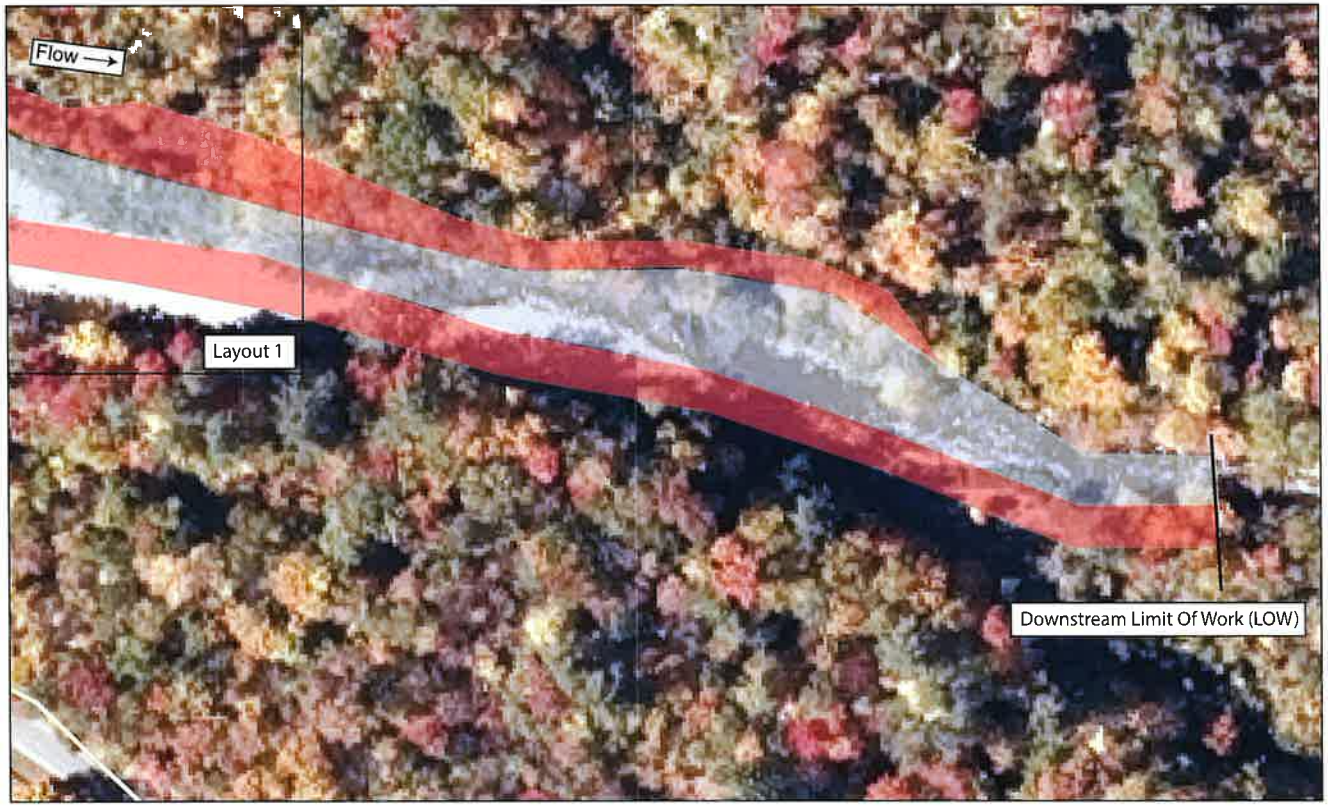
Langdon/Hodges/Bubier



Approximate location of existing channel

Approximate location of existing berm material

0 125 250 Feet

N

Note: Imagery is from 2021 NOAA imagery and does not show the changes in the river channel caused by the December 2023 flooding

Existing Conditions/Layout 2
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

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Langdon/Hodges/Bubier

Isolated log

Boulder supported log jam

0 125 250 Feet

N

Proposed excavated material

Remaining gravel veneer

Proposed redistributed berm material

Proposed restored side channel

Note: Structures are schematic and not to scale

Note: Imagery is from 2016 Google Earth data and does not show the changes in the river channel caused by the December 2023 flooding

Langdon/Hodges/Bubier

Prepared by: Field Geology Services

Proposed Planview/Layout 1
South Branch Sandy River Restoration
Phillips, ME

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January 15, 2025

Isolated log

Boulder supported log jam

0 125 250 Feet

N

Proposed excavated material

Remaining gravel veneer

Proposed redistributed berm material

Proposed restored side channel

Note: Structures are schematic and not to scale

Note: Imagery is from 2016 Google Earth data and does not show the changes in the river channel caused by the December 2023 flooding

Langdon/Hodges/Bubier

Proposed Planview/Layout 2
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

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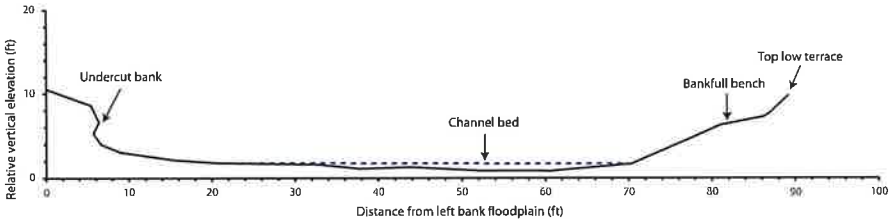
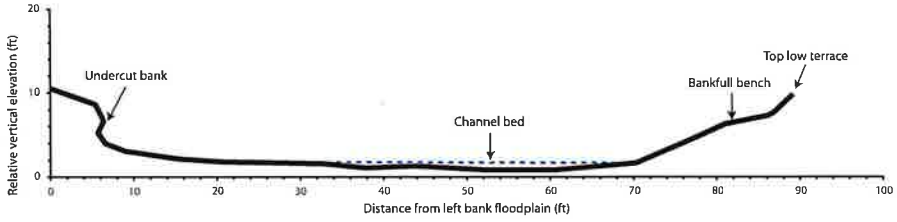
Langdon/Hodges/Bubier Site - Cross Section 1

Existing Condition

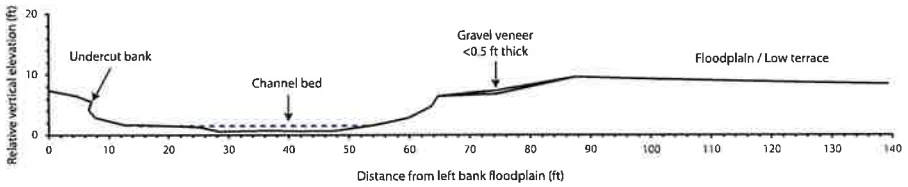


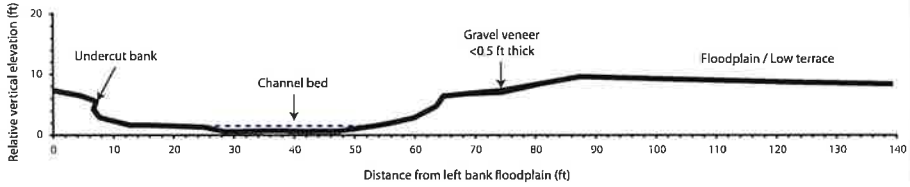
Proposed Condition



Note: No gravel re-distributed to create proposed condition cross section

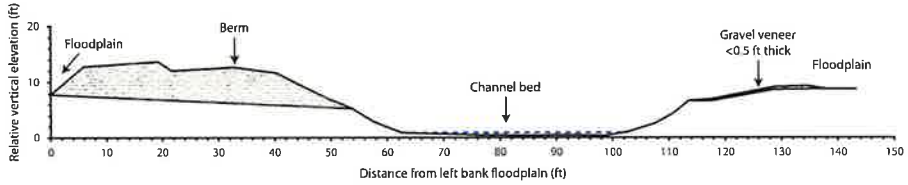
Langdon/Hodges/Bubier Site - Cross Section 2

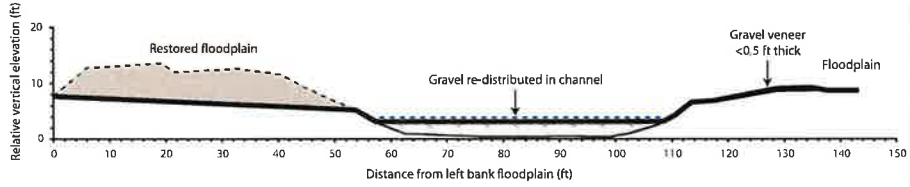




Note: No gravel re-distributed to create proposed condition cross section

Langdon/Hodges/Bubier Site - Cross Section 3





Note: Approximately 124 sq.ft. of gravel re-distributed to create proposed condition cross section. Quantity of gravel represents mean value over length of left bank berm, proposed fill area does not equal proposed cut area at this Cross Section 3 transect location.

Existing fill

Proposed cut

Proposed fill

Final ground surface

Vertical exaggeration = 1.0x

Note: Area of proposed fill equals area of proposed cut

Note: View looking downstream

Prepared by: Field Geology Services

Existing/Proposed Condition Cross Sections
South Branch Sandy River Restoration
Phillips, ME

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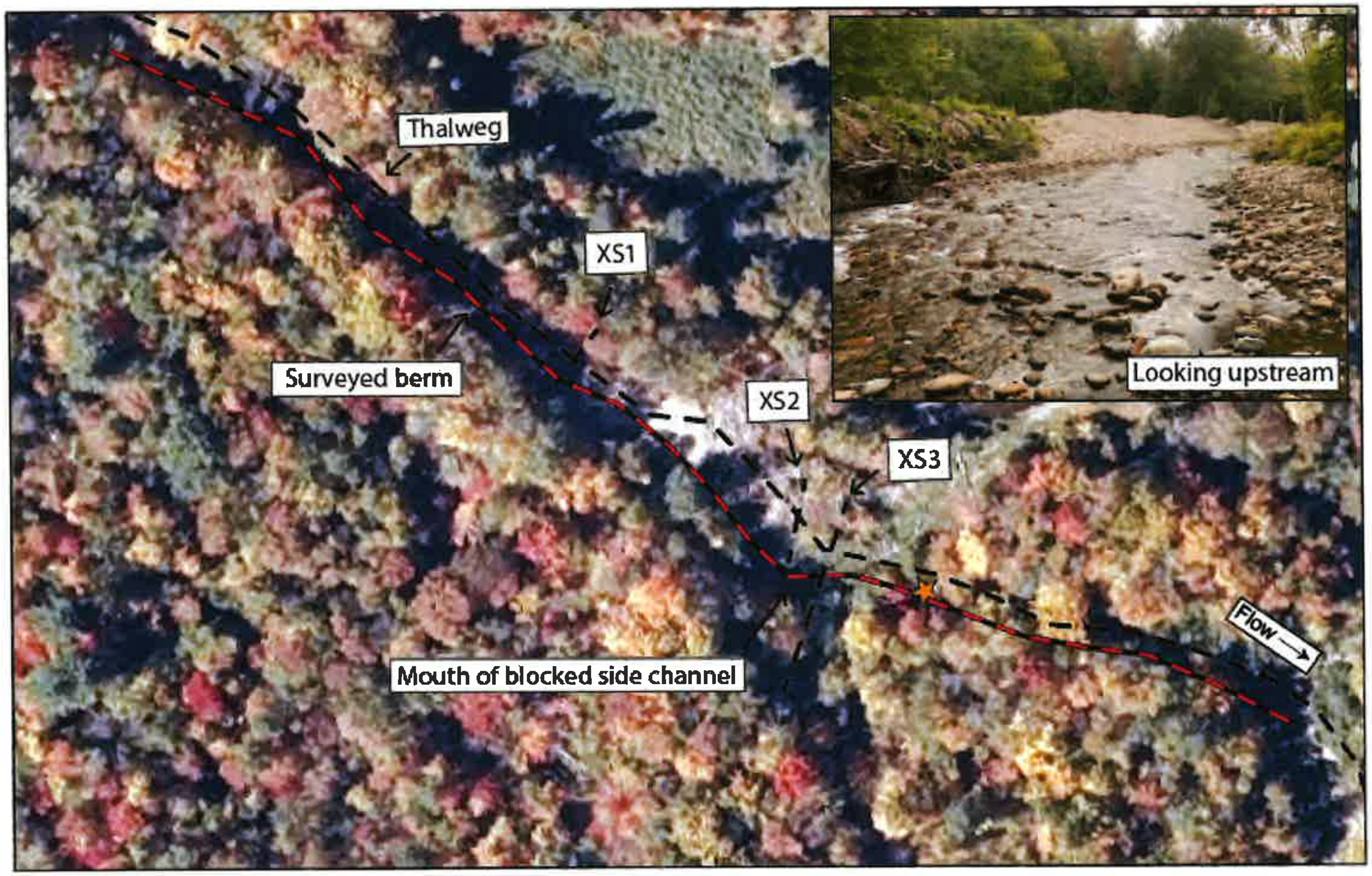
Langdon/Hodges/Bubier Site



0 132 264 Feet

N

Location of photo

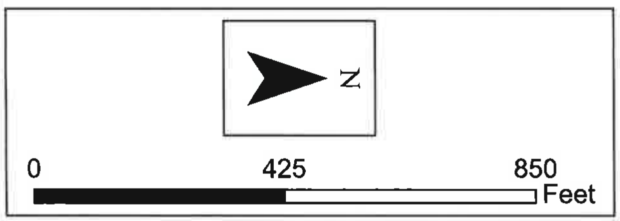
Note: Imagery is from 2021 NOAA data and does not show the changes in the river channel caused by the December 2023 flooding

Bennett/Sylvestre

Prepared by:
Field Geology Services

Location of photo
South Branch mainstem

Berm
Gravel veneer
Blocking side channel
In channel
On floodplain

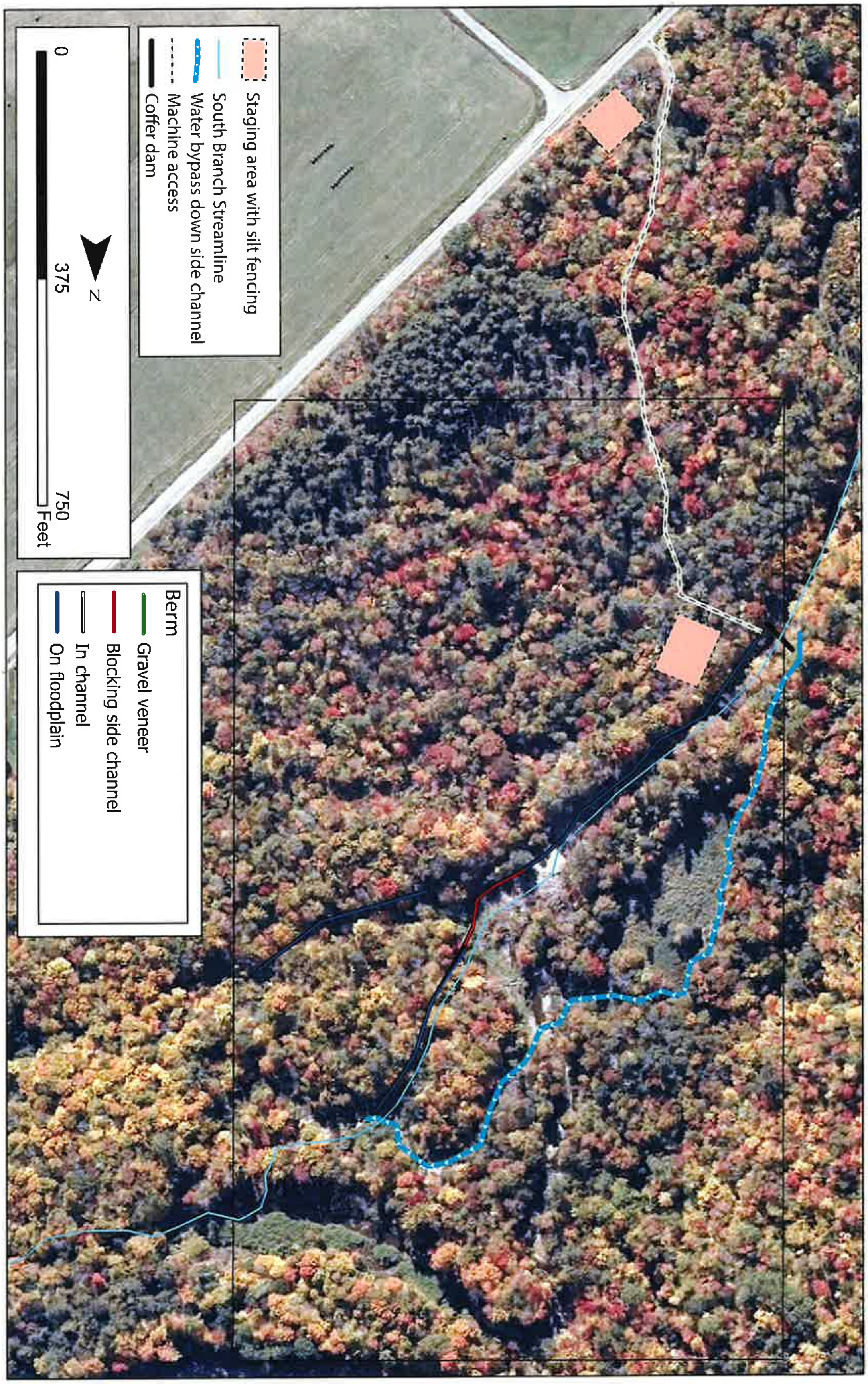


Bennett/Sylvestre

Prepared by: Field Geology Services

South Branch Sandy River Restoration
Phillips, ME

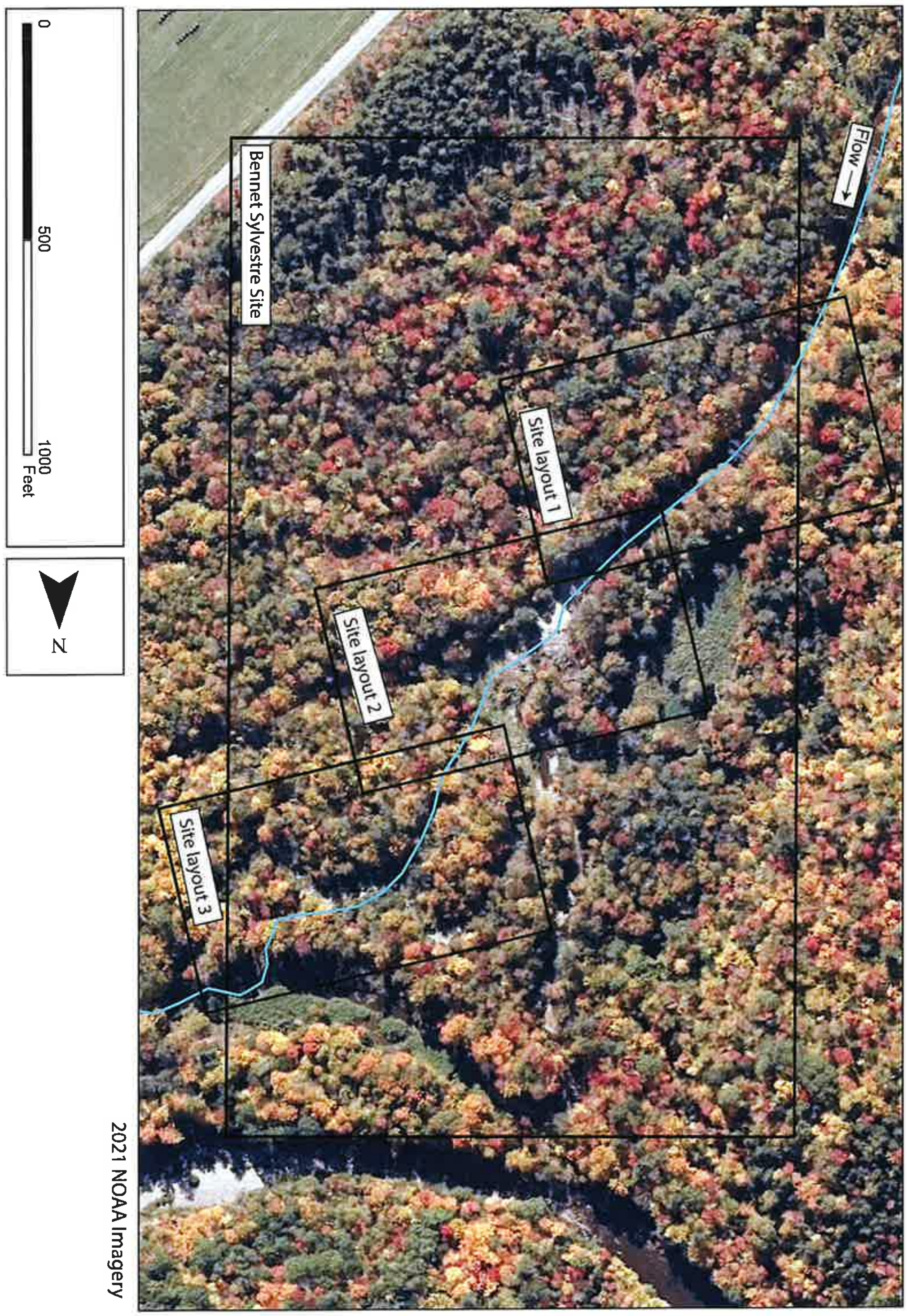
January 15, 2025



Bennett/Sylvestre

South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services



Bennett/Sylvestre

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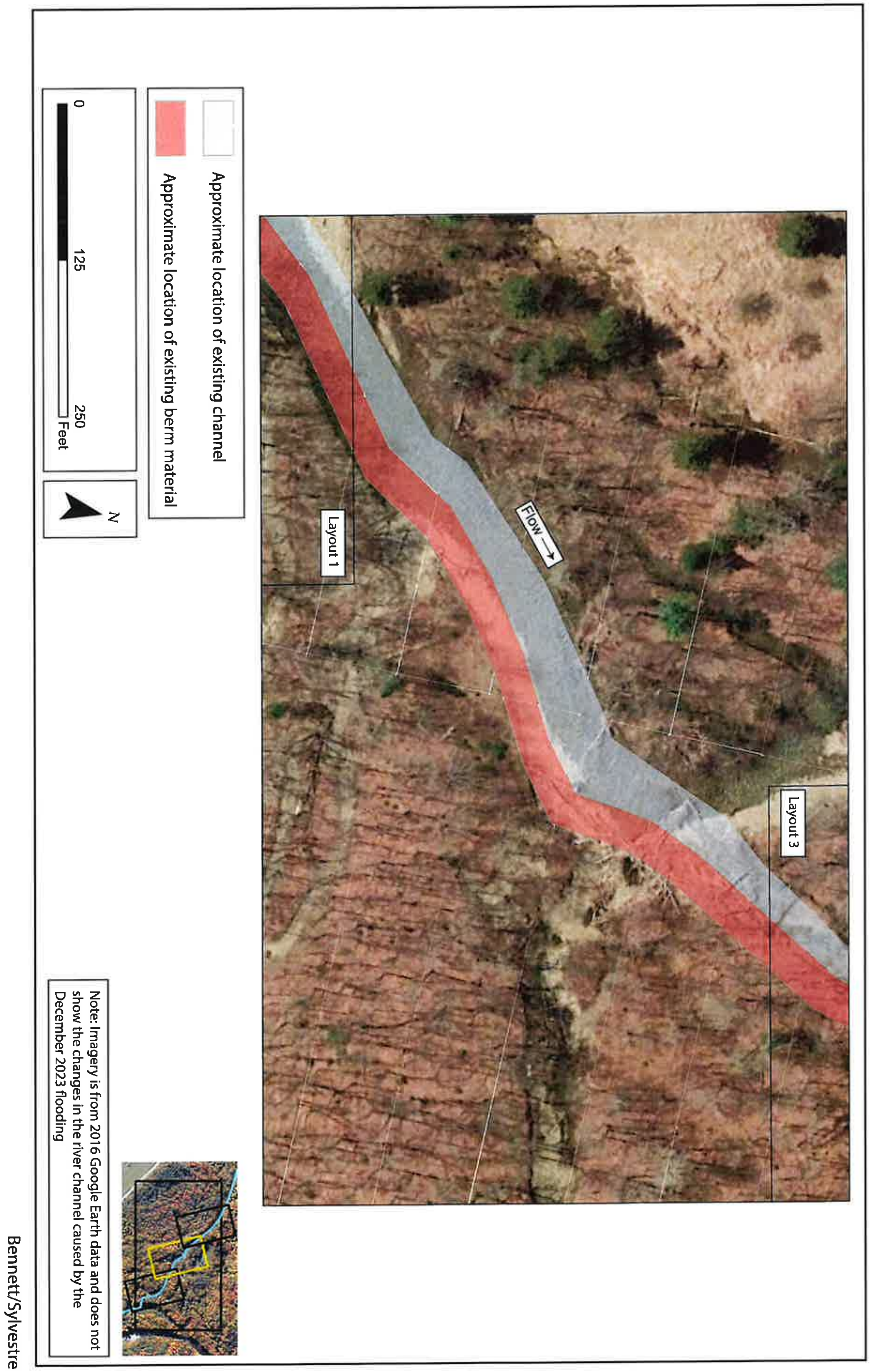
Existing Conditions/Layout 1
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services



Existing Conditions/Layout 2
South Branch Sandy River Restoration
Phillips, ME

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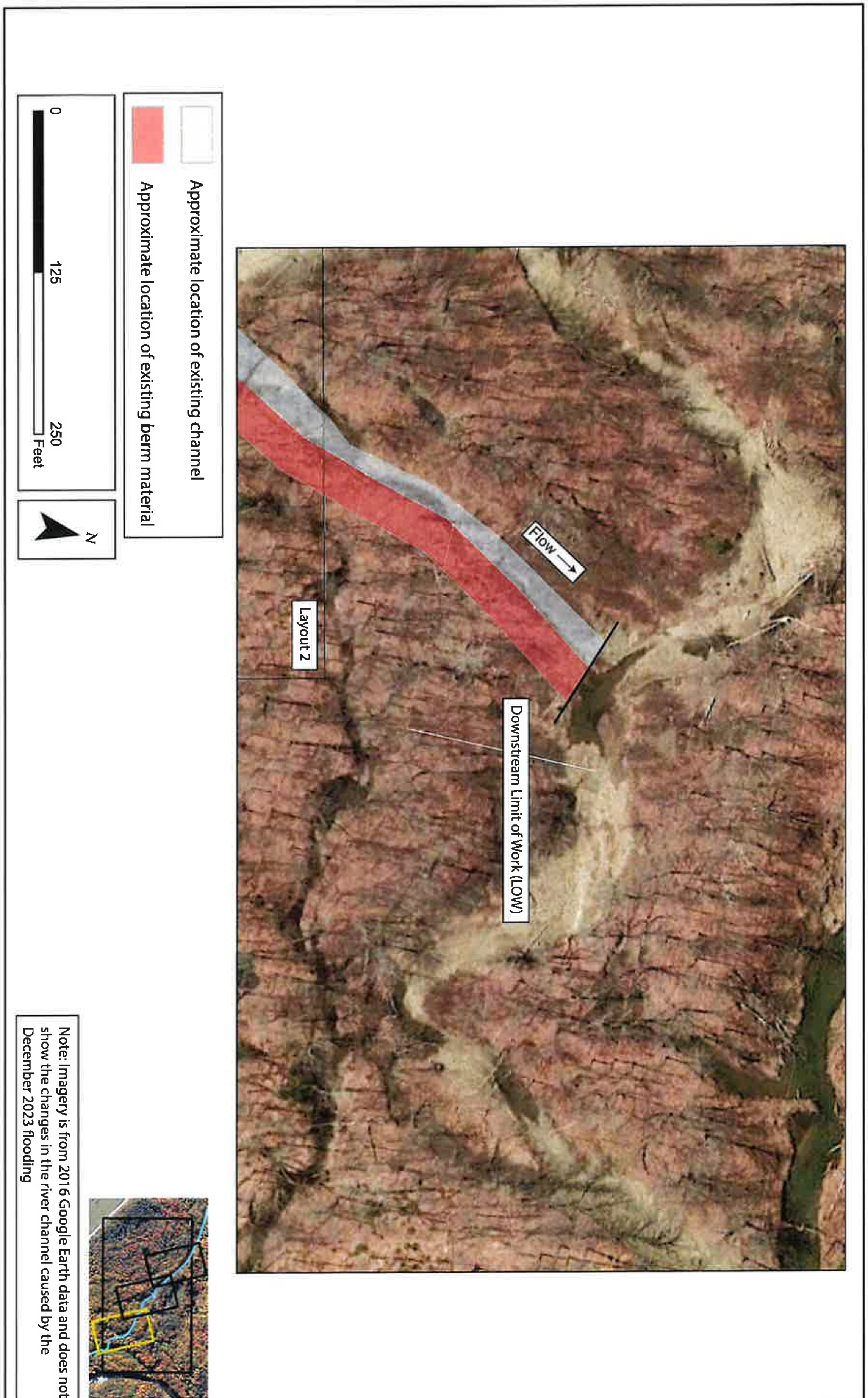
Prepared by:
Field Geology Services



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Existing Conditons/Layout 3
South Branch Sandy River Restoration
Phillips, ME

Prepared by:
Field Geology Services

Spanning log jam
Isolated log
Boulder supported log jam

0 125 250 Feet

N

Passive restoration of side channel through berm removal
Proposed redistributed berm material
Proposed excavated material

Note: Structures are schematic and not to scale

Note: Imagery is from 2016 Google Earth data and does not show the changes in the river channel caused by the December 2023 flooding

Bennett/Sylvestre

Prepared by: Field Geology Services

Proposed Planview/Layout 1
South Branch Sandy River Restoration
Phillips, ME

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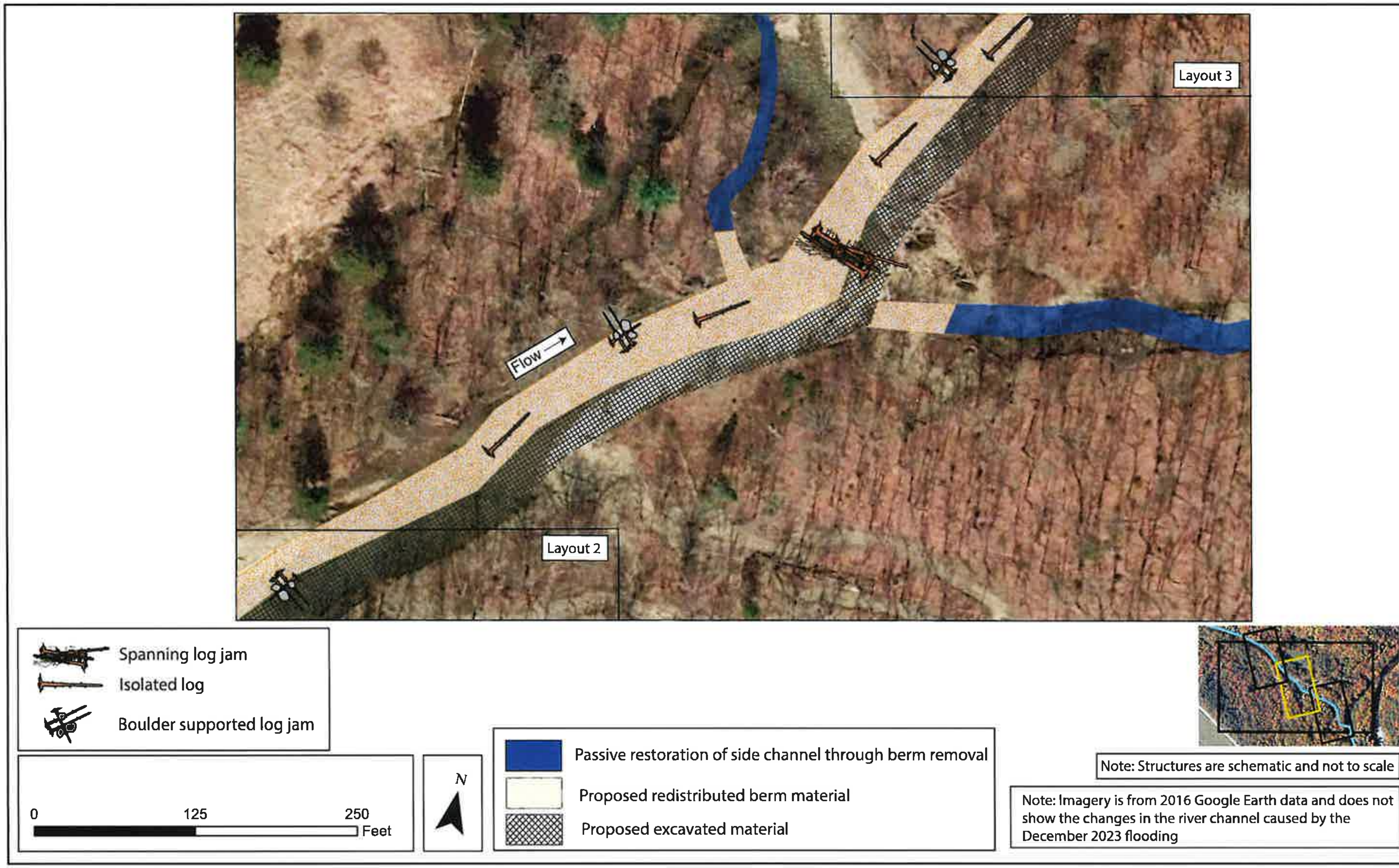
January 15, 2025



Bennett/Sylvestre

Prepared by:
Field Geology Services

Proposed Planview/Layout 2
South Branch Sandy River Restoration
Phillips, ME

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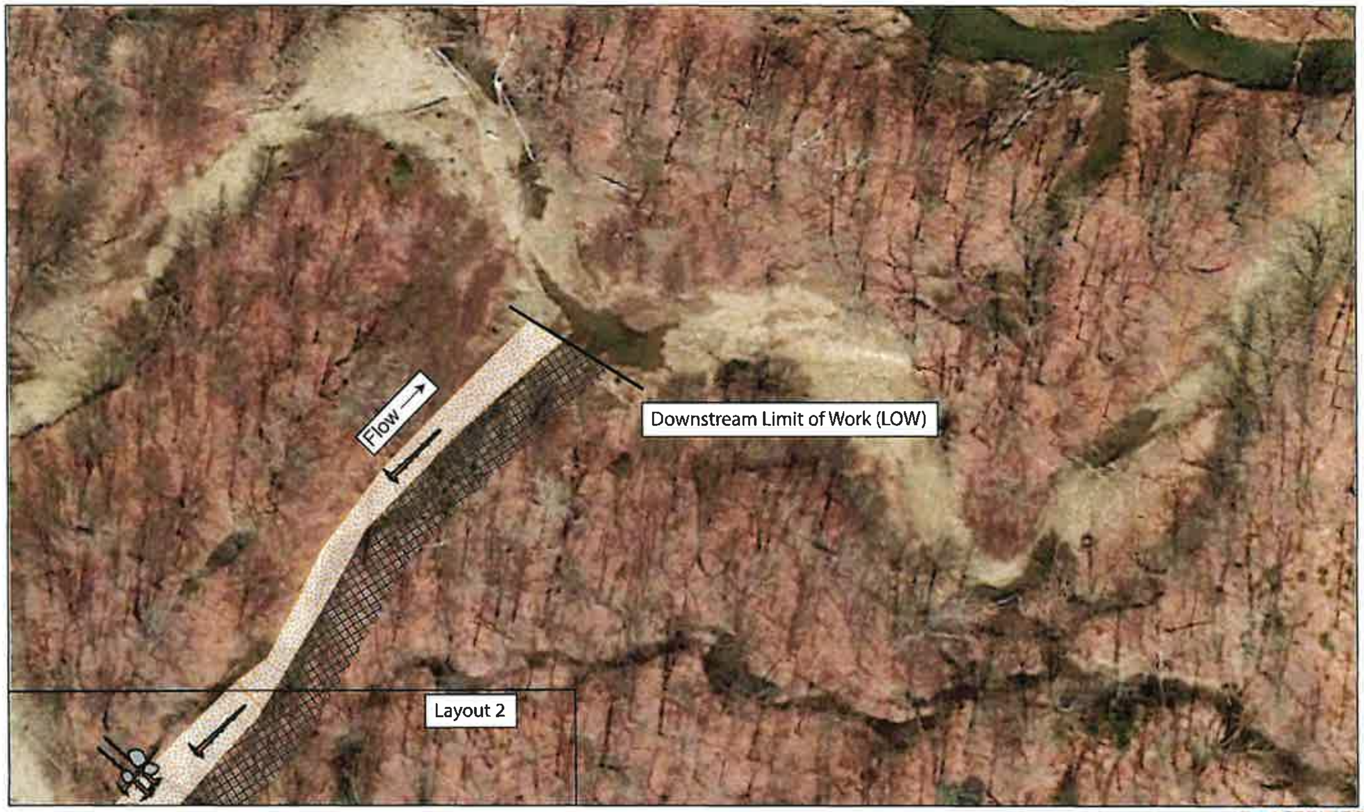
January 15, 2025



Isolated log

Boulder supported log jam

0 125 250 Feet

N

Passive restoration of side channel through berm removal

Proposed redistributed berm material

Proposed excavated material

Note: Structures are schematic and not to scale

Note: Imagery is from 2016 Google Earth data and does not show the changes in the river channel caused by the December 2023 flooding

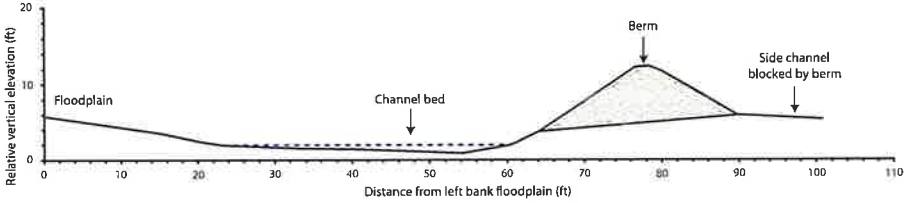
Bennett/Sylvestre

Proposed Planview/Site Layout 3
South Branch Sandy River Restoration
Phillips, ME

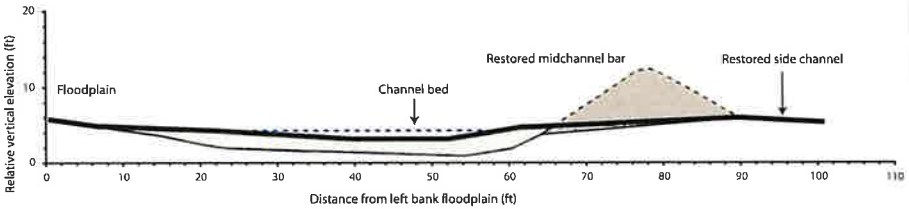
Prepared by:
Field Geology Services

Bennett/Silvestre Site - Cross Section 1

Existing Condition

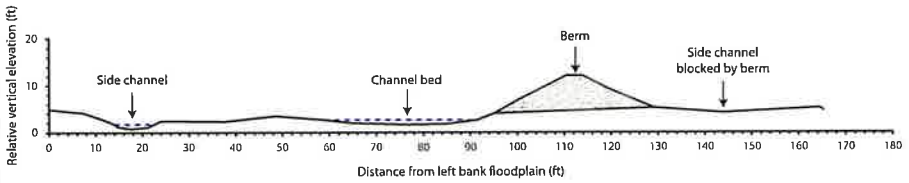


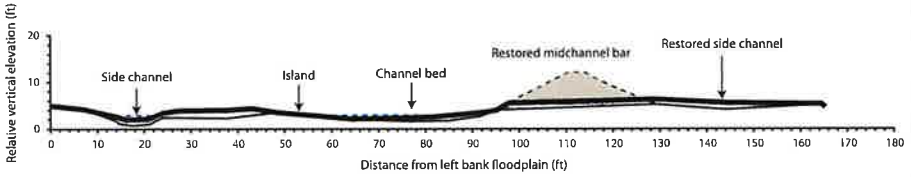
Proposed Condition



Note: Approximately 100 sq.ft. of gravel re-distributed to create proposed condition cross section

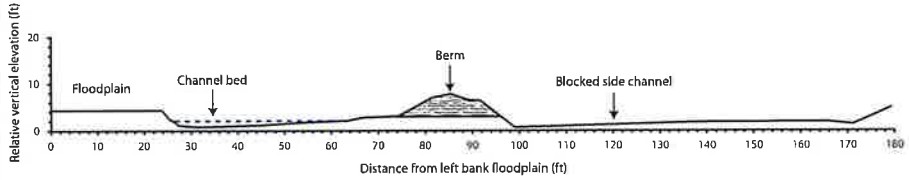
Bennett/Silvestre Site - Cross Section 2

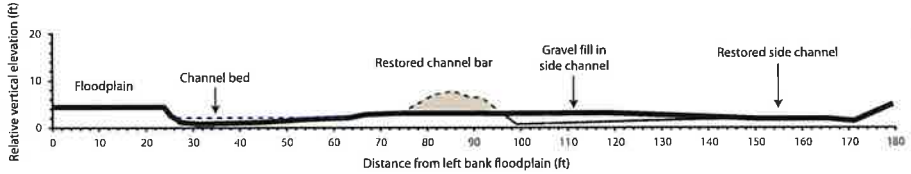




Note: Approximately 92 sq.ft. of gravel re-distributed to create proposed condition cross section

Bennett/Silvestre Site - Cross Section 3





Note: Approximately 64 sq.ft. of gravel re-distributed to create proposed condition cross section

Existing fill
Proposed cut
Proposed fill
Final ground surface

Vertical exaggeration = 1.0x

Note: Area of proposed fill equals area of proposed cut

Note: View looking downstream

Bennett/Sylvestre Site

Prepared by:

Field Geology Services

Existing/Proposed Condition Cross Sections
South Branch Sandy River Restoration
Phillips, ME

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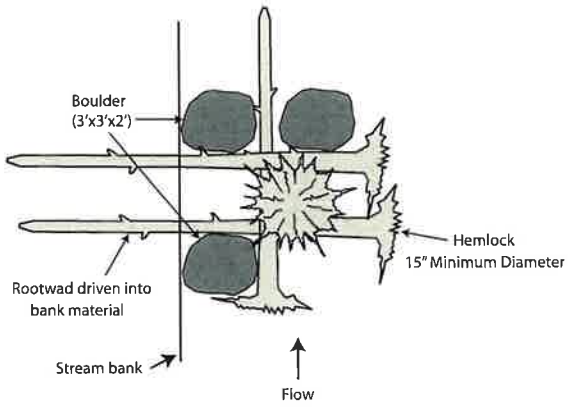
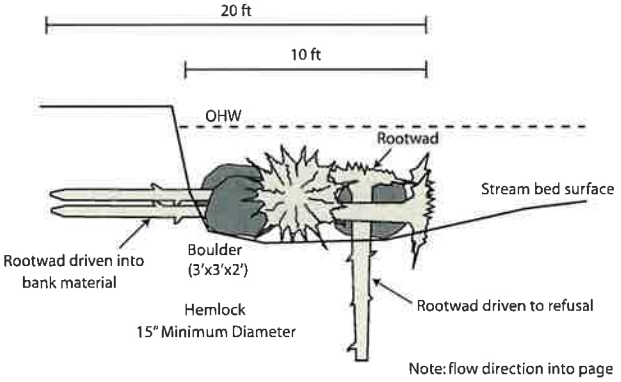
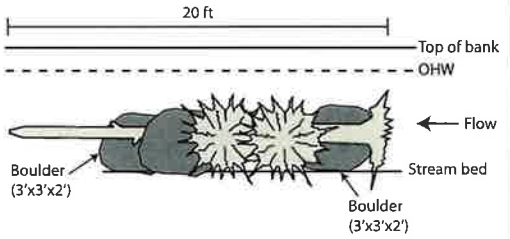


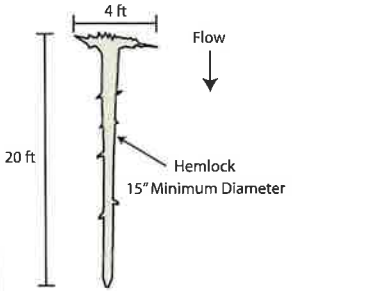
BOULDER-SUPPORTED LOG JAM (A)
PLAN VIEW



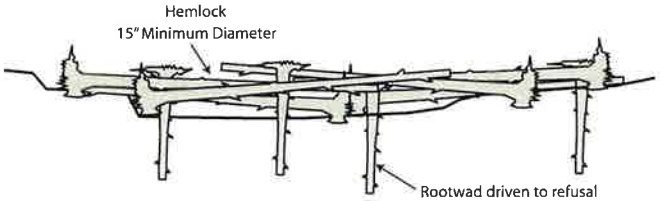
BOULDER-SUPPORTED LOG JAM (B)
TYPICAL SECTION VIEW



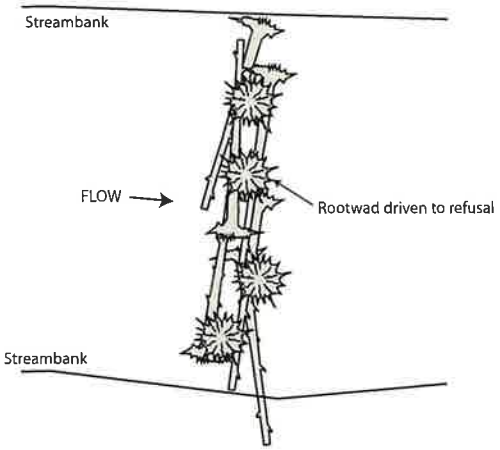
BOULDER-SUPPORTED LOG JAM (C)
LONGITUDINAL VIEW



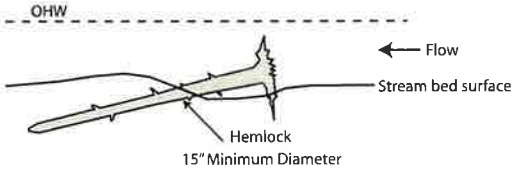
ISOLATED LOG (D)
PLAN VIEW



CHANNEL-SPANNING LOG JAM (F)
TYPICAL SECTION VIEW



CHANNEL-SPANNING LOG JAM (G)
PLAN VIEW



ISOLATED LOG (E)
LONGITUDINAL VIEW

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Details 1
South Branch Sandy River Restoration
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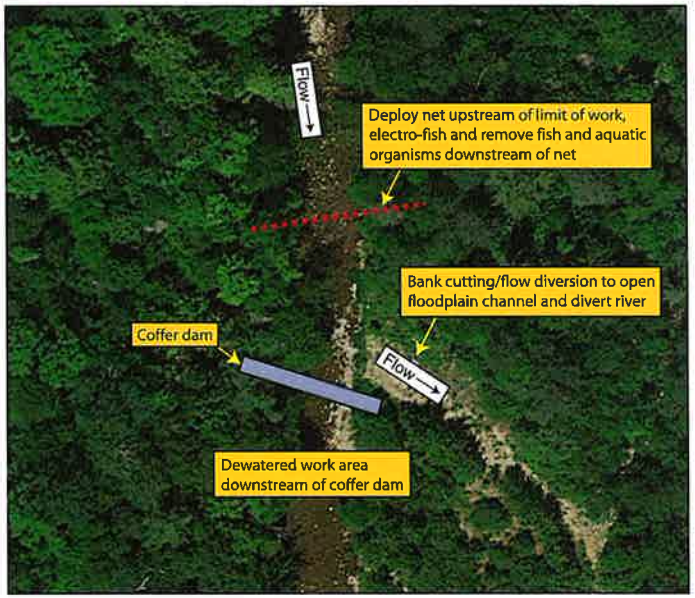
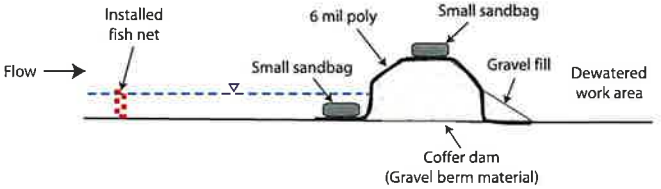
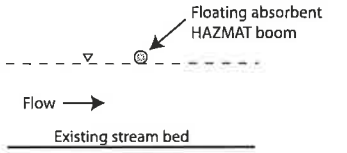


Design schematic - not to scale

WATER BYPASS DETAILS
PLAN VIEW
A



WATER BYPASS DETAILS
LONGITUDINAL VIEW
B



Channel-spanning floating HAZMAT boom deployed downstream of work area prior to commencement of instream work and maintained until completion of instream work.

HAZMAT BOOM DETAIL
LONGITUDINAL VIEW
C

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Details 2
South Branch Sandy River Restoration
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South Branch Sandy River - Phillips, ME
Estimated Construction Costs

Task / Material / Description	Unit / notes	Cost
Materials		
Rootwads/Trees (35 ft long) (140 trees at $500 per tree)	Includes timber cruising, harvest, forest access and site rehab, invasives screening and proper harvest techniques by licensed foresters, harvest permits, scarification of forest floor to promote regeneration, and trucking to site	$70,000.00
Boulders - medium (72 at $250 each)	Includes trucking to site	$18,000.00
Materials subtotal		**$88,000.00**
Heavy Equipment		
Mobilization	Mobilization and delivery of all equipment	$18,500
Excavator and operator	Includes 2 - 35 ton excavators, dedicated operators, insurance, diesel, hydraulic fluid, and maintenance	$128,000
D8 dozer and operator	Includes 2 - D8 dozers, dedicated operators, insurance, diesel, hydraulic fluid, and maintenance	$64,000
Rock truck and operator	Includes 1 - rock truck, dedicated operator, insurance, diesel, hydraulic fluid, and maintenance	$32,000
Miscellaneous equipment	Includes trucks, field tractor with attachments, ATV with attachments, etc.	$14,000
Insurance and overhead expenses		$12,000
Heavy Equipment subtotal		**$268,500.00**
General Contracting Labor and Supplies		
Labor	Includes project foreman, sawyers, and general labor	$50,000
Travel, lodging, per diem		$7,200
Supplies	Includes cable, cable clamps, saws, safety equipment, drill bits, epoxy, etc.	$4,500
Coffer dams		$70,000
Erosion control	Includes seed mix, mulch, and willows	$7,300
Hazmat boom		$2,500
General Contracting Labor and Supplies subtotal		**$141,500.00**
Add 15% construction contingency		**$74,700.00**
Construction oversight	Provided by Field Geology Services	**$35,000.00**
Permitting assistance	Provided by Field Geology Services	**$30,000.00**
Pre-construction and as-built monitoring surveys	Provided by Field Geology Services	**$20,000.00**
Post-construction monitoring (2026-2030)	Provided by Field Geology Services	**$33,800.00**
Total		**$691,500.00**

South Branch Sandy River - Phillips, ME
Estimated Materials List

Structure Type	Number of structures	Quantity per structure	Material (description)	Diameter (dimensions)	Total Count
Hutchinson Site					
Boulder-supported	8	4	Rootwads	15+ in	32
log jam		3	Medium boulders	3 ft	24
Isolated log	9	1	Rootwads	15+ in	9
Material		Total			
Rootwads (tree length - 35 ft long)		41			
Medium boulders (3 foot diameter)		24			

Structure Type	Number of structures	Quantity per structure	Material (description)	Diameter (dimensions)	Total Count
Rollins/Tooker Site					
Boulder-supported	5	4	Rootwads	15+ in	20
log jam		3	Medium boulders	3 ft	15
Isolated log	3	1	Rootwads	15+ in	3
Material		Total			
Rootwads (tree length - 35 ft long)		23			
Medium boulders (2 foot diameter)		15			

Structure Type	Number of structures	Quantity per structure	Material (description)	Diameter (dimensions)	Total Count
Langdon/Hodges/Bubier Site					
Boulder-supported	7	4	Rootwads	15+ in	28
log jam		3	Medium boulders	3 ft	21
Isolated log	5	1	Rootwads	15+ in	5
Material		Total			
Rootwads (tree length - 35 ft long)		33			
Medium boulders (2 foot diameter)		21			

Structure Type	Number of structures	Quantity per structure	Material (description)	Diameter (dimensions)	Total Count
Bennet/Sylvestre Site					
Boulder-supported	4	4	Rootwads	15+ in	16
log jam		3	Medium boulders	3 ft	12
Channel-spanning log jam	2	10	Rootwads	15+ in	20
Isolated log	7	1	Rootwads	15+ in	7
Material		Total			
Rootwads (tree length - 35 ft long)		43			
Medium boulders (3 foot diameter)		12			

Material Totals	
Rootwads (tree length - 35 ft long)	140
Medium boulders (3 foot diameter)	72

Prepared by:
Field Geology Services

Estimated costs and materials lists
South Branch Sandy River Restoration
Phillips, ME

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