APPENDIX A – ADDITIONAL FIGURES AND PHOTO EXAMPLES.

***Riverine Class Wetlands** occur in floodplains, or a riparian geomorphic setting associated with a stream channel (Brinson 1993). This wetland class is heavily influenced or linked to the channel and its floodplain and may include wetlands that develop below the ordinary high-water mark (OHWM) of the channel. The dominant water source is regular overbank flow from the channel (i.e., occurs every one to two years) but other sources include groundwater, subsurface hydraulic connections between the stream channel and the wetland, interflow, overland flow from adjacent uplands, tributary inflow, and precipitation. Many times, when overbank flow occurs, surface flows (i.e., flowthrough) may travel down the floodplain and dominate hydrodynamics, which is typically unidirectional and high in magnitude (i.e., energy). In headwater areas, riverine wetlands may intergrade with slope or depression wetlands as the channel disappears, or they may intergrade with poorly drained flats or uplands. MDWAM recognizes four riverine subclasses: a) active floodplain; b) floodplain features; c) riverine swamp forest; and d) lacustrine fringe.*

***Riverine Active Floodplain Subclass.** This subclass of riverine wetlands is located on nearly level floodplain areas adjacent to or within the channel and typically experiencing regular overbank flooding at 2-year intervals or less as described by Brinson (1993) and Smith et al (1995). Wetlands in this subclass may be identified as "active floodplain" by field observation of indicators of overbank flooding such as fine sediment coatings or deposits, scour, stratified layers, wrack lines, vertical zonation of plant communities, anastomose channels, and poorly developed soil profiles (Entisols). Additionally, reliable recorded data may be used as confirmation of an active floodplain wetlands.*

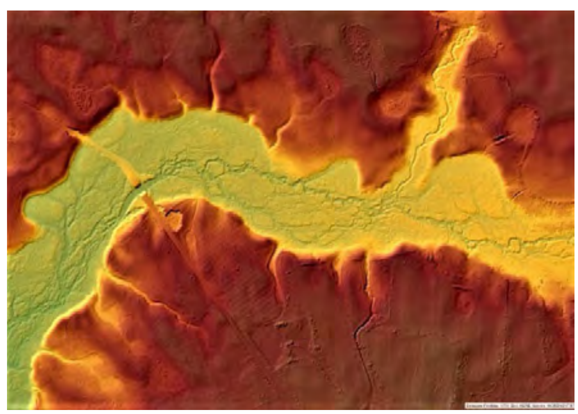
 

Figure A1 Active Floodplain Subclass. A common indicator of the active floodplain subclass is the presence of numerous secondary channels, which are often multithreaded, as illustrated in the aerial photo (left) and LiDAR (right) views of Cypress Branch in Kent County (CP ecoregion). Numerous groundwater discharges from the toe slope areas may be numerous but the dominant water source is overbank flooding from the primary channel.

Figure A2 Active Floodplain Subclass. Ground photos of two inundated secondary channels in the floodplain of Cypress Branch in Kent County (see Figure A1 above). Inundation of these channels may persist long after floodwaters recede back into the main channel. Flooding from the primary channel and the presence of flooding indicators (e.g., drainage patterns, sediment deposits or coatings, debris lines, etc.) across the entire floodplain typically separates this subclass from other riverine subclasses.

Figure A3 Active Floodplain Subclass. Ground photos of a riverine active floodplain subclass wetland. Flooding from the primary channel is apparent from the presence of flooding indicators (e.g., drainage patterns, sediment deposits or coatings, debris lines, etc.) across the entire floodplain.

Riverine Floodplain Features Subclass. *These wetlands are distinguished from the other subclasses by their location and landform. They are concave features typically located on abandoned (disconnected) floodplains or terraces but remain connected and are heavily influenced by the channel which continues to be a dominant water source. They receive regular overbank or backwater flooding which is generally limited to within the feature itself. The hydrodynamics are typically unidirectional but sometimes bidirectional between the stream and the feature. Floodplain features with groundwater input may be bidirectional, but the magnitude of water flow is typically not high energy as in the active floodplain wetlands. Flooding indicators are also typically limited to within the feature as well.*

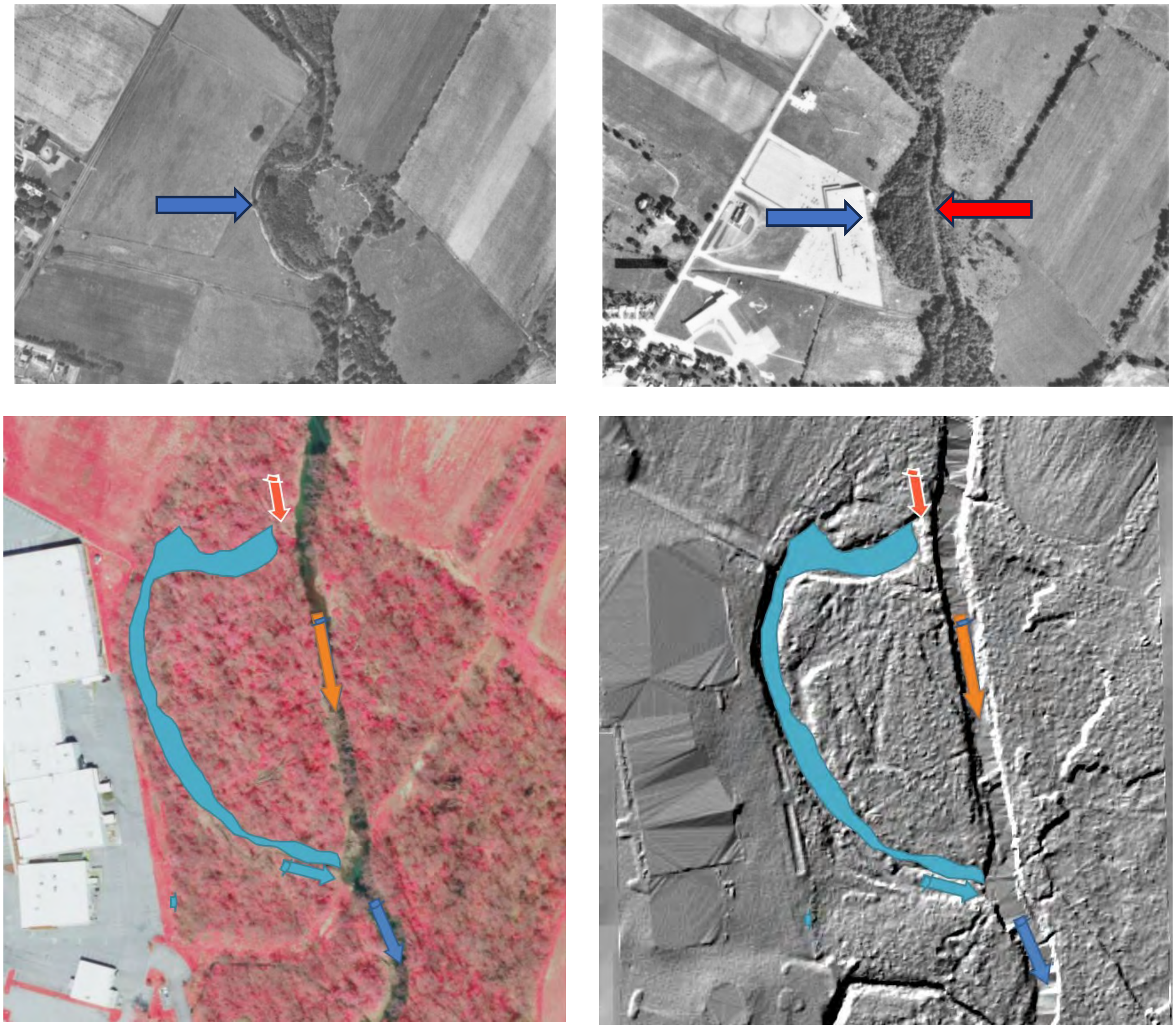


Figure A4 Floodplain Features Subclass. Historical aerial photography and LiDAR illustrating a floodplain feature wetland formed because of historic channel relocation. The 1938 photo (upper left) shows the location of the original channel (blue arrow). The lower left 2004 color infrared photo and lower right hill shade LiDAR indicate the location of the floodplain feature wetland (blue polygon) which was the original channel. The relocated channel and direction of flow is indicated by the orange arrow. The red arrow shows the location of the blockage to the upstream end of the original channel which facilitated the relocation. Only the downstream end of the wetland remains connected to the channel.

Figure A5 Floodplain Features Subclass. Three ground photos of the floodplain feature (original channel) depicted in Figure A4. The upper left photo is the upstream end of the feature which was totally blocked with fill and debris after the relocation. The photo in the upper right shows the downstream discharge channel which is regularly flooded by the primary channel as evidenced by numerous flooding indicators that were observed (not shown). The lower photo illustrates the core area of the wetland. Additionally, iron deposits emanating from groundwater discharge along the valley fringe are evident providing secondary inputs to this wetland. However, the dominant water source and influence on this wetland remains to be flooding from the primary channel.

Riverine Swamp Forest Subclass *– These wetlands are in floodplains and found primarily in the Coastal Plain Ecoregion of Maryland adjacent to or abutting streams of 2nd order or higher (Strahler 1952). Riverine swamp forest wetlands differ from other riverine subclasses as indicators of regular overbank flooding (< 2-year intervals) are often weak or absent. Nevertheless, these wetlands are heavily influenced by the adjacent channel through shallow subsurface hydraulic connections and backwater flooding. Bank full channel flow during wet periods typically results in backwater flooding of flows entering the floodplain from tributaries and or groundwater discharges which impede hydraulic head on and below the surface. As channel flows recede during the growing season in response to increased evapotranspiration, surface and shallow subsurface flows then move toward the channel. Therefore, the dominant hydrodynamics are bidirectional, horizontal, and low energy.*

Figure A6 Riverine Swamp Forest. The floodplain of Marshy Hope Creek in Caroline County is an example of this subclass in the CP ecoregion. These wetlands typically have low variation of the hydroperiod due to perennial saturation of the soils which are high in organic matter content. Alternating patches of dense herbaceous strata and sparsely vegetated areas are common.

Figure A7 Riverine Swamp Forest. Two examples of riverine swamp forest wetlands common in the Maryland CP ecoregion. Tuckahoe Creek in Queen Annes and Caroline Counties (left) and Nassawango Creek in Worchester County (right). The stream on the right is running bank full to slightly above. The floodplain is filling from a combination of inputs including the primary channel, tributaries, and groundwater input from the floodplain fringe.

Figure A8 Riverine Swamp Forest. Some typical soils of this subclass that are attributed to long term inundation / saturation. Habitats where these soils were characterized are above each. They can occur as organic soil, organic/dark mineral, or dark mineral surfaces (hydric soil indicators A1, A2, A3, A9, A11, A12, and F13). Chicone, Indiantown, Lenape, Longmarsh, Manahawkin, Potobac, Puckum, and Zekiah are common soil series of this subclass.

Figure A9 Riverine Swamp Forest. Two photos illustrating the typical topographic complexity of these floodplains which is often due to the elevated root systems (root wads) of trees and concave features associated with such a dynamic system. These areas typically have low variation of the hydroperiod expressed by having low species richness and thick dark mineral and or organic soil surfaces. The wettest areas are often dominated by bald cypress (*Taxodium distichum*).

***Lacustrine Fringe Wetlands** – This subclass is comprised of human impoundments and active beaver dams. Both have water levels that are dependent upon one or more tributary inputs which determine the height, duration, and frequency of inundation. Tributary input is responsible for the bidirectional movement of water in the impoundment. During periods of high water, fringe and delta wetlands are inundated or back flooded as surface and or subsurface movement to the open water of the impoundment is impeded. This process is reversed as water levels in the impoundment decrease causing flow back to open water. It should be noted that most Maryland impoundments, especially small ponds, are usually not managed and water levels are dependent upon seasonal volume and frequency of inputs. Many small ponds, particularly in the Eastern Mountains and Piedmont (EMP) ecoregion, are located "offline" (i.e., do not impound a stream) and are dependent upon groundwater inputs and thus, water levels are subject to significant seasonal fluctuation.*

Figure A10 Lacustrine Fringe Subclass. Ground view of a human impounded, lacustrine fringe wetland in Calvert Cliffs State Park (CP ecoregion). Most fringe wetlands are dominated by a few herbaceous species such as arrow arum (*Peltandra virginica*).

Figure A11 Lacustrine Fringe Subclass. Aerial views of a lacustrine fringe wetland (human impounded) on Gray's Creek in Calvert Cliffs State Park, Calvert County (Source: Watershed Resource Registry). Note the time of year change in vegetated communities. The use of multi-temporal aerial photography is recommended to determine the boundary between open waters (including true aquatics) and fringe wetlands. Subsequent ground truthing will be necessary to confirm the boundaries as they may intergrade with open water and other wetland types. The red arrow indicates the general direction of view in Figure A10 above.

Figure A12 Lacustrine Fringe Subclass (human impounded). This wetland was created by the impoundment of a small intermittent stream and groundwater discharges in the CP ecoregion. The water levels are entirely dependent upon these inputs. These wetlands are seasonally flooded from a stream that has been dammed in the far-left background. As the stream and potential groundwater inputs subside, water levels drop causing return flow to the open water areas. While herbaceous cover generally dominates fringe wetlands, some woody plants can adapt to the variable hydroperiod such as the trees in the center of the photo. This is only possible because of the drop in water level, otherwise, these trees would die.

Figure A13 Lacustrine Fringe Subclass (human impounded). This wetland was also created by the impoundment of small stream in the EMP ecoregion. Again, the water level in the impoundment is primarily dependent upon stream input and subsidized by groundwater discharge. This wetland also has bidirectional flow which is of low magnitude. The stream enters the impoundment (far background) causing seasonal inundation of the wetlands but as stream flow decreases during the growing season, water levels drop causing return flow to the open water areas. The fringe wetland intergrades with the open water dominated by SAV and floating aquatic plants and thereby, creates some difficulty in identifying the WAA boundary. The dotted line approximates the wetland (WAA) and open water boundary.

Figure A14 Lacustrine Fringe Subclass (human impounded). Ground (left) and aerial view (right) of Blairs Valley Lake, Washington County, a lacustrine fringe subclass (human impounded) in the EMP ecoregion. The dominant water source is uncontrolled and consists primarily of tributary input. For this reason, water level fluctuations can be quite dramatic seasonally. In this case, recent drought conditions may have significantly increased the extent of the fringe wetlands. Therefore, investigators should examine antecedent precipitation data in conjunction with the review of multi-temporal aerial photography to determine the WAA boundary. The wetlands on the left are a monoculture of creeping lovegrass (*Erigrostis hypnoides).* The size and density of this species and other hydrophytes in the exposed areas most likely increase and decrease dependent upon seasonal and annual variations. Note the stands of cattails near the tree line in both photos, these areas may be a better indicator of long-term water level conditions.

Figure A15 Lacustrine Fringe Subclass (human impounded). Three aerial views of a lacustrine fringe wetland over a five-year period (August, September, and March) showing the variable lake levels in summer and early spring. Investigators should review a range of aerial photography to determine the normal pattern and extent of fringe wetlands (left). Emergent vegetation may be flooded in the non-growing season or from extreme events (right). Conversely, herbaceous cover may be enlarged during abnormally dry periods or drawdown (center).

Depression Wetlands - *The depression class of wetlands in Maryland are both natural and man induced. They generally occur as topographic depressions with a closed elevation contour that leads to accumulation of surface water. Depression wetlands may lose water through evapotranspiration, intermittent or perennial outlets, or recharge to groundwater (Brinson 1993). The dominant water source is precipitation but may receive contributions from groundwater discharge, interflow, and overland flow from adjacent uplands. The direction of water movement is normally from the surrounding uplands (i.e., higher elevations) toward the center of the depression. Depression wetlands may have any combination of inlets and outlets or lack them completely. The predominant hydrodynamics are vertical fluctuations (primarily seasonal) which are low in magnitude. Delmarva Bay wetlands are an example of depression wetlands in the CP ecoregion. Colluvial deposits in karst depressions, oxbows on upland terraces and human excavated depressions are typical wetlands of this subclass in the EMP ecoregion.*

Figure A16 Depression Wetland. Aerial view and LiDAR of a depression wetland located on an upland terrace adjacent to the Potomac River in Montgomery County (EMP ecoregion). This depression has an outlet as indicated by the yellow arrow.

Figure A17 Depression Wetland. A ground photo of the depression wetland illustrated in Figure 16 above. This depression is seasonally inundated/saturated and dominated by red maple (*Acer rubrum*), pin oak (*Quercus palustris*), lizards' tail (*Saururus cernuum*) and hop sedge (*Carex lupulina)*.

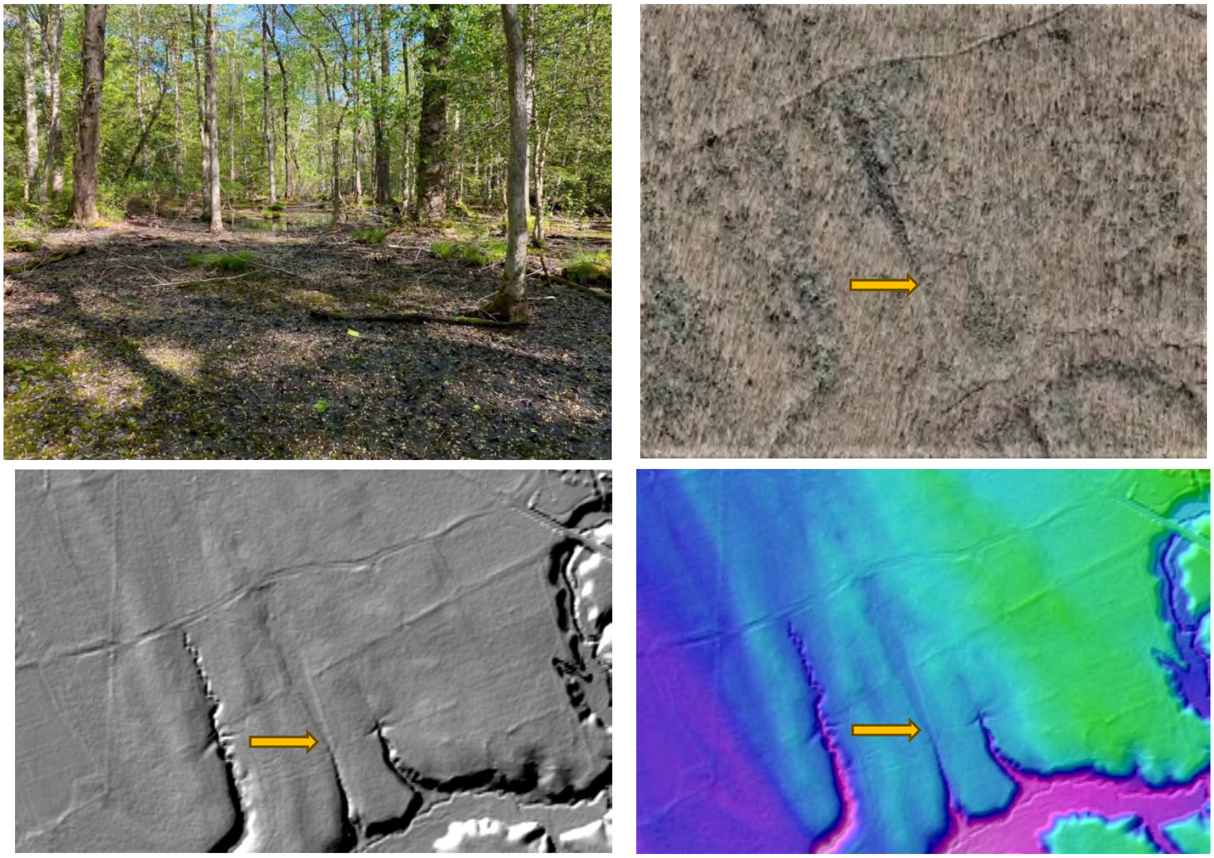


Figure A18 Depression Wetland. This depression wetland near Jug Bay in Anne Arundel County is seasonally saturated and has a distinct outlet which is in the background of the upper left photo and highlighted by the yellow arrow in the aerial photo on the upper right and by LiDAR in the lower photos.

Figure A19 Depression Wetland. This large, restored Delmarva Bay wetland in the CP ecoregion (Caroline County) is perennially inundated. Two distinct vegetative communities surround open water which includes SAV and floating vegetation. The wetland has low variation of the hydroperiod which was expressed by thick dark soil surfaces and low species richness. This depression is completely closed lacking inlets and outlets.

***Slope Wetlands** occur where groundwater outcrops and results in a discharge of water to the land surface. They normally occur on sloping land with elevation gradients ranging from steep to slight. Slope wetlands lack closed contours, so they are generally incapable of much surface storage differentiating them from depression wetlands. The dominant water sources are groundwater supplemented by overland flow and interflow from surrounding uplands but may also include precipitation. Hydrodynamics are dominated by downslope unidirectional water flow, but slope wetlands can also occur in nearly flat landscapes if groundwater discharge is a dominant source to the wetland surface. Slope wetlands may develop channels, but the channels serve only to convey water away from the slope wetland. MDWAM recognizes two subclasses of slope wetlands, backslope and toe slope.*

***Backslope wetlands** usually occur in headwaters on the steeper, linear portion of a hillslope usually above the foot slope position which generally delineates the valley wall or fringe. Backslope wetlands often sustain perennial discharge as evidenced by the presence of dark mineral and/or organic surfaces. Backslope wetlands exhibit a strong downslope movement of water to a channel or intergrade with toe slope wetlands. Occasionally, these wetlands reenter the ground surface especially in karst geology, talus slopes and due to human-induced disturbances, for example, excessive sandy deposits along the fall line of coastal plain. Water-stained leaves, abundant micro topography, iron (Fe) deposits, oxidized rhizospheres, sphagnum, and drainage patterns (groundwater discharges) are common field indicators observed in backslope wetlands. Examples of backslope wetlands include headwater forested slopes and open or shrubby fens.*

Figure A20 Backslope Wetlands. Aerial views of a backslope wetland in the Garrett State Forest, Garrett County EMP ecoregion). Groundwater discharges arising on the linear portion of the hillslope combine to create a seasonally and perennially saturated area, eventually forming the headwaters of Glade Run. The central area of the wetland is a fen characterized by low variation of the hydroperiod, organic carbon storage (histic epipedon) and low species richness as shown in Figure 22. (Source: Watershed Resource Registry)

Figure A21 Backslope Wetlands. Ground view of the backslope wetland in Figure A20. Groundwater discharges arising in the wooded areas in the background move downslope to the center of the photo forming a perennially saturated fen with organic soil surfaces (histic epipedon) and low species richness

Figure A22 Backslope Wetlands. Ground view of the backslope wetland looking downslope to the fen in Figure 21 above. The hydroperiod here flips from low variation to high variation moving upslope from the fen into this forested perimeter. There is a corresponding change from organic to a dark mineral surface, increase in redoximorphic features (concentrations), and an increase in species richness of the plant community.

Figure A23 Backslope Wetlands. Photos of a backslope wetland in Carroll County (EMP ecoregion). These wetlands can be very small and threadlike formed from groundwater discharges emanating from the linear position of a hillslope. These wetlands occur on moderate to steep slopes and often form the headwaters of small streams. The hydrodynamics are low to moderate magnitude and unidirectional flowing to a channel usually at the lower end of the slope.

***Toe slope wetlands** generally occur on the concave portion of hillslopes but also on the concave portion (backswamps) or nearly level areas of terraces (riparian forests) often at the valley fringe below foot slope positions. As stated, toe slope wetlands are often located at the valley fringe but may also be associated with streams greater than 2nd order, often these are abandoned floodplains disconnected from the stream channel. This is generally due to historic human-induced disturbance where overbank flooding is usually no longer an important water source or influence on the wetland (Pruitt and Rheinhardt 2023). For example, in some urban areas of Maryland, stream channels have become so incised that adjacent wetlands have been reduced in size or eliminated. Channel incision severely reduces the frequency and duration of wetland hydrology resulting in a change to ecosystem processes.*

Figure A24 Toe Slope Wetlands. This toe slope wetland occurs at the valley fringe and floodplain of Morgan Run in Carroll County (EMP ecoregion). Groundwater discharge from the foot slope is the dominant water source. The hydrodynamics are unidirectional towards the stream channel and have low to moderate intensity.

Figure A25 Toe Slope Wetlands. Despite its geomorphic setting, this wetland is placed in the toe slope subclass because the channel of the stream is incised and disconnected from its floodplain. That is, it no longer floods at regular intervals of 1-2 years, and the dominant water source is groundwater discharge. This is common in Maryland especially in many urban and agricultural settings.

Figure A26 Toe Slope Wetlands. This photo illustrates a toe slope subclass wetland in the CP ecoregion. Groundwater discharges at the valley fringe are the primary water source to the wetlands. The hydrodynamics are unidirectional and of low magnitude toward the small channel near the center of the photo.

Figure A27 Toe Slope Wetlands. This photo illustrates another toe slope subclass wetland in the coastal plain ecoregion. The geomorphic setting and hydrodynamics are very similar to the wetland conditions described in Figure 26 above. However, in this case, disturbances in the watershed just upslope of this area have caused periodic deposits of sand and debris in the channel and the wetland surface over time. This is evident in the soil profile in the right photo. This soil profile meets the stratified layers hydric soil indicator (A5)

***Mineral Flat Wetlands** arguably constitute the largest percentage of non tidal wetlands in Maryland. They are limited to the Coastal Plain Ecoregion and most commonly located on interfluves (interstream flats), broad flats on large floodplain terraces, and occasionally in the headwaters of coastal plain streams. Precipitation is the dominant water source to mineral flats and rarely receive groundwater inputs but may be seasonally connected to a water table. Vertical fluctuations are the dominant hydrodynamics but seasonal ephemeral discharges may occur during the wet season and as a result of extreme precipitation events. Other sources of water are groundwater, overland flow and interflow. They are distinguished from flat upland areas by their poor vertical drainage due to impermeable layers (e.g., hardpans), slow lateral drainage, and therefore, have low hydraulic gradients mainly losing water through evapotranspiration.*

The hydroperiod is characterized by frequent wetting and drying making them very important for temporary water storage and nutrient cycling. The soils are primarily composed of mineral material but some shallow depressions may develop thin organic mantles or thin dark mineral surfaces, especially where high concentrations of evergreen vegetation are found. Mineral flats in Maryland occur as hardwood, pine or mixed flats. Pine flats may reflect incidents of past anthropogenic disturbance to former hardwood and mixed flats (Rheinhardt et al. 2002). Lastly, while mineral flats may have areas that are seasonally inundated, water depths are usually very shallow and of short duration. They are distinguished from depressions and slopes by their geomorphic setting, and lack of groundwater inputs.

Figure A28 Mineral Flat Wetlands. The photo on the left depicts a seasonally inundated/perennially saturated hardwood flat wetland in Caroline County (CP ecoregion). Flats such as this typically have little or no understory vegetation except for occasional breaks where windthrows or anthropogenic disturbance occurs. The umbric surface (organic mantle and thick dark mineral layer) and extensive *Sphagnum* carpet indicates low variation of the hydroperiod (right). In some years, flats like this one are saturated perennially and periodically contact ground water, especially in the winter. Organic carbon storage is a notable function of this wetland.

Figure A29 Mineral Flat Wetlands. The photo on the left depicts a seasonally saturated pine flat wetland in Dorchester County (CP ecoregion). This type of flat has very short alternating periods of wetting and drying as seen in the soil profile (right). The lack of organic carbon in the surface layer and common redoximorphic concentrations observed near the soil surface suggest that biogeochemical cycling is potentially an important function of this wetland. It should be noted that some pine flats may have thick duff layers (pine straw) and organic mantles indicating lower variation of the hydroperiod. This wetland type also lacks understory but is attributed more to canopy closure and not wetness. The inundation in the left photo is temporary but may occur frequently.

Determining the WAA. *This section provides additional photos and figures intended to demonstrate some of the issues discussed in Table 1 of the MDWAM Guidebook: “Guidelines for determining the Wetland Assessment Area.”*

Figure A30 Determining the WAA (past disturbance with hydrologic change). This aerial photo of a riverine wetland in Kent County (CP ecoregion) illustrates a common situation where hydrologic processes in a wetland have changed. The linear fill associated with the road crossing has affected the floodplain and the hydroperiod of the wetlands on both sides of the road. The wetlands to the right of the road have an increased hydroperiod whereas the wetlands on the left have experienced a decrease. Additionally, the flow and circulation of waters have been permanently changed due to the road fill. In this case, two separate WAAs are necessary.

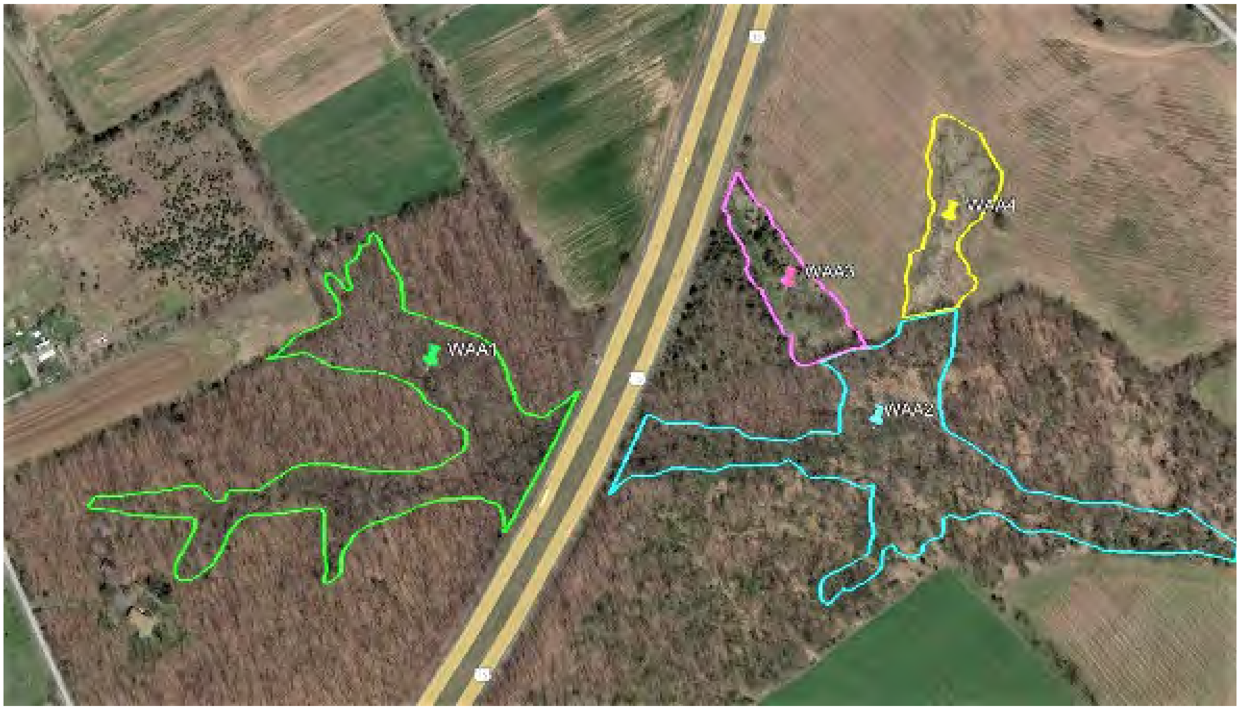


Figure A31 Determining the WAA (past disturbance). Aerial view of a historically contiguous slope wetland in the EMP ecoregion. This wetland has been fragmented because of the highway fill and adjacent agricultural use. The disturbance associated with the highway would require separate WAAs along the main stem of the wetland (WAAs 1-2) as the hydrology has been changed, particularly the flow and circulation of waters like the example in Figure 30 above. Because WAA 3 is active cropland it would require a separate evaluation due to the current and past disturbance. WAA4 has been idle (abandoned) for an extended period and would require a separate evaluation also due to past disturbance to the soils and vegetation. This wetland in in the early stages of recovery.

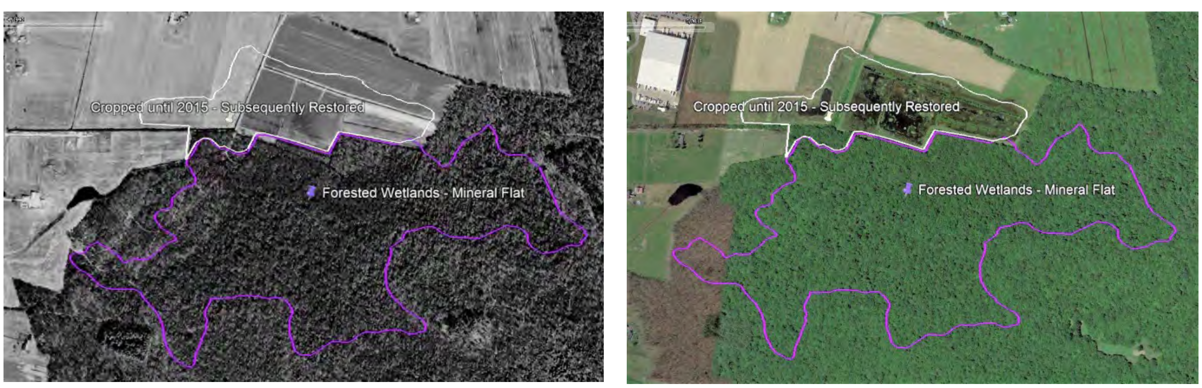


Figure A32 Determining the WAA (past disturbance). Aerial views of a mineral flat wetland in the CP ecoregion that was historically contiguous. However, past disturbances necessitate establishing two separate WAAs. The white and purple polygons in these photos shared uniform hydrologic processes with precipitation as the principle water source and vertical hydrodynamics. The white polygon has been a historically cropped area (left) but has been subsequently restored to wetland conditions. However, the restoration has permanently changed the hydrology and the vegetative community (right). These alterations dictate that the wetlands are evaluated as two separate WAAs.

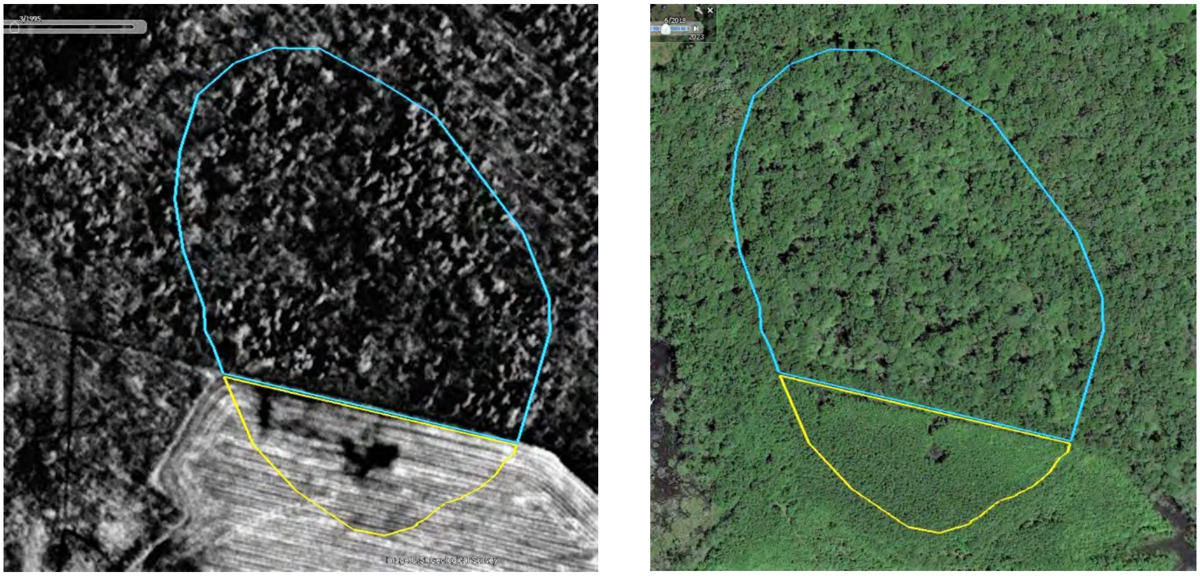


Figure A33 Determining the WAA (past disturbance). Aerial views of a Delmarva Bay depression in the CP ecoregion before and after restoration. The yellow polygons were historically cropped (left photo) prior to restoration efforts that plugged an excavated ditch (right). The areas within the blue polygons were not subject to cropping but were hydrologically impacted to varying degrees by the ditch. The ditch was subsequently plugged restoring the hydrology to both areas. However, because of the severity of the vegetative alterations from cropping history and associated disturbances, separate WAAs were evaluated. Despite similar hydrologic processes, the yellow polygon is a low diversity forest versus the blue polygon which is mature mixed forest. See Figure 34 for photos of both areas.

Figure A34 Determining the WAA (past disturbance). Photos of the mineral flat wetlands shown in Figure 33 above. The upper photo is a low diversity sapling stage forest consisting primarily of sapling stage sweet gum, *Liquidambar styraciflua*) and red maple (*Acer rubrum*) which is the yellow polygon in Figure 33. The lower photo is a mature to late-stage forest dominated by the same species and American holly (*Ilex opaca)* and various oak (*Quercus*) species which is the blue polygon in Figure 33.

Figure A35 Determining the WAA (past disturbance with multiple plant communities.). A portion of the adjacent forested wetland has been converted into pastureland. Due to the vegetative alterations, this wetland would be evaluated as a separate WAA despite similar hydrologic processes.

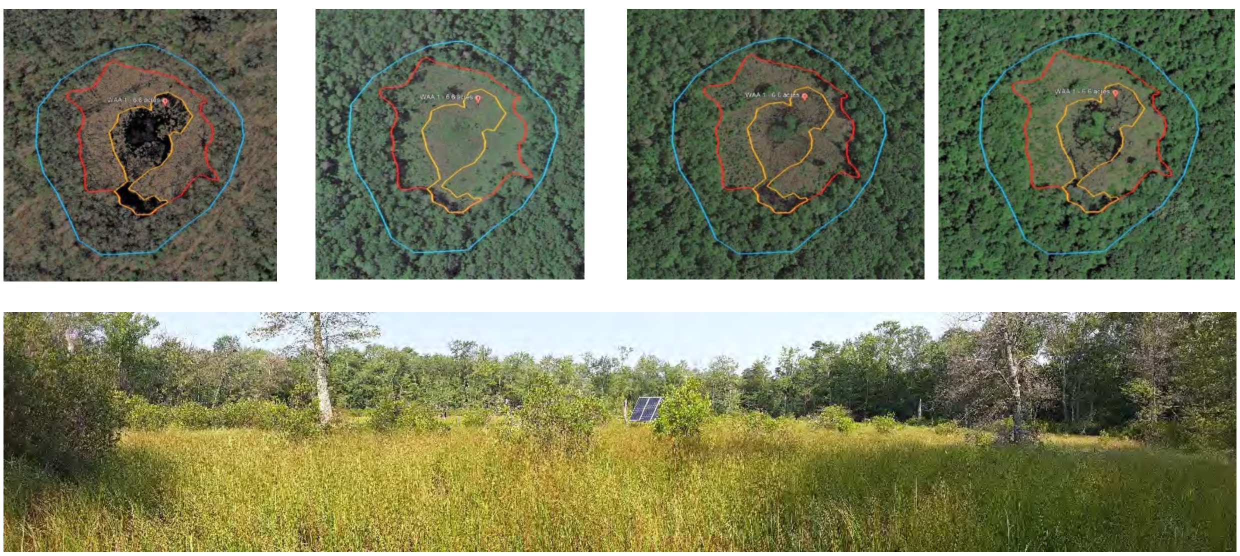


Figure A36 Determining the WAA (with multiple vegetation communities). Aerial photos in four different years of a Delmarva Bay wetland (CP ecoregion) with multiple vegetation communities (blue-red-orange polygons); forested perimeter, herbaceous community and a variable open water/SAV component (orange polygon). Depending on timing of observation, the acreage of the herbaceous community and open water components may vary highlighting the importance of aerial photo review. The communities share the same water source (precipitation), hydrodynamics (vertical), and geomorphic setting (closed depression) so it is evaluated as one WAA1 with two distinct communities. There is no evidence of past disturbance.

Figure A37 Determining the WAA (multiple plant communities). Ground view of a large slope wetland (toe slope subclass), Wolf Swamp, Garrett County (EMP ecoregion). The primary water source is groundwater discharge originating along the foot slope positions and moving unidirectionally toward the small tributary meandering through the valley. Despite the three different communities, the hydrologic interaction is the same requiring one WAA.

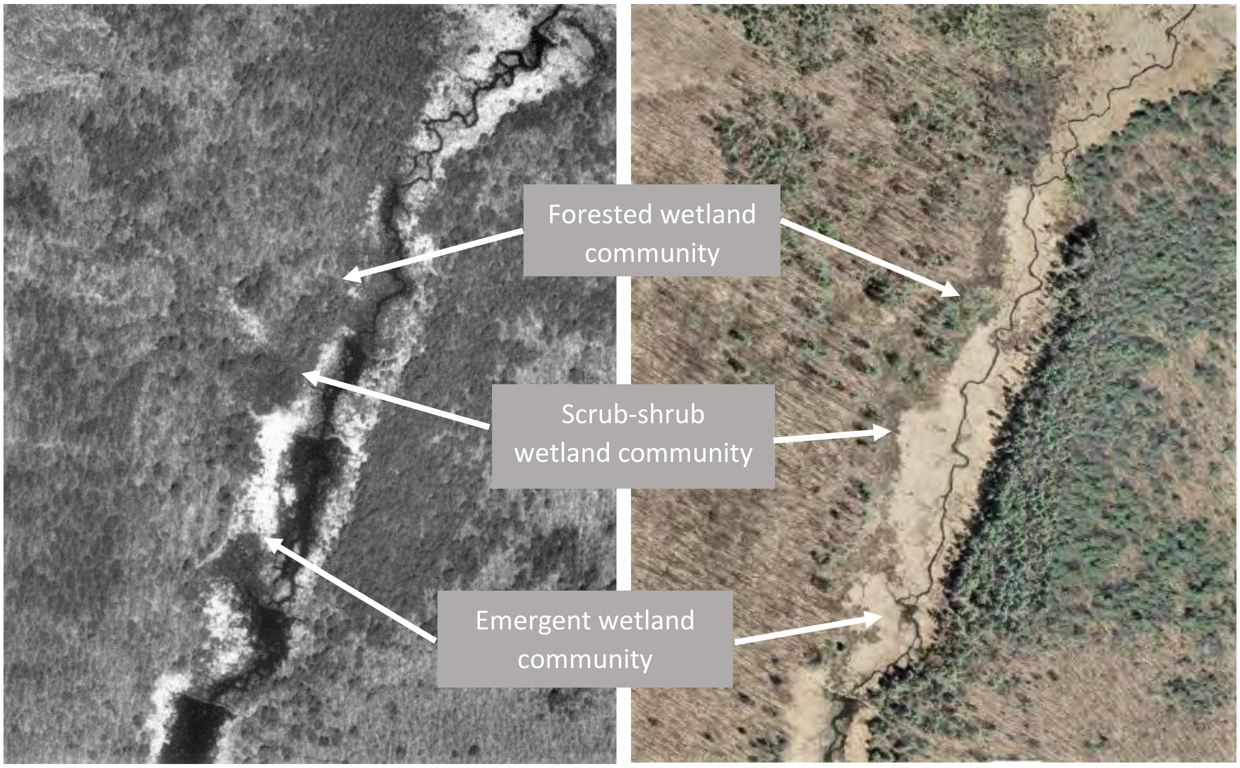


Figure A38 Determining the WAA (multiple plant communities). Aerial views of a slope wetland (toe slope subclass), Wolf Swamp, Garrett County (Source: Watershed Resource Registry). Historically, this wetland has been subject to periodic beaver activity along the stream as shown in the left photo. However, the wetlands are no longer impounded, and the primary water source is groundwater discharge entering the system from the valley fringe to the east and west (right). This wetland would be evaluated as one WAA with three distinct plant communities.

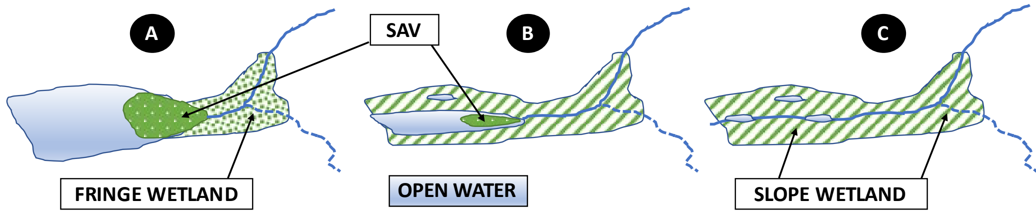


Figure A39 Determining wetland class (beaver activity). Examples A-C illustrate the changes to wetland class in a beaver impoundment. When beaver abandon their impoundments, the dams typically fail quickly without active maintenance and often transform from one wetland class to another. In the example (A), the lacustrine fringe wetland changes over time to a toe slope wetland (C). This time frame for this transition is variable, and depending on the time of observation, two wetland types may exist (B) as shown in the following examples which may present difficulty in determining the WAA.

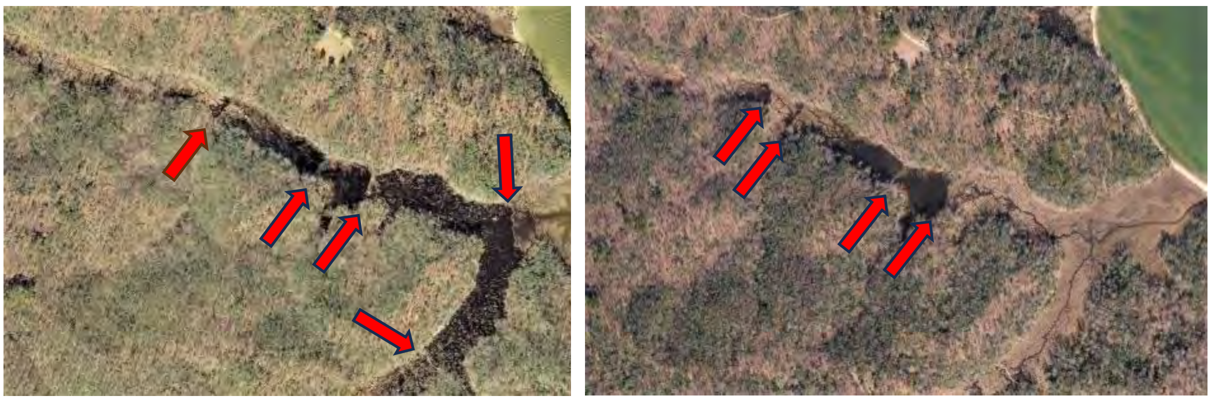
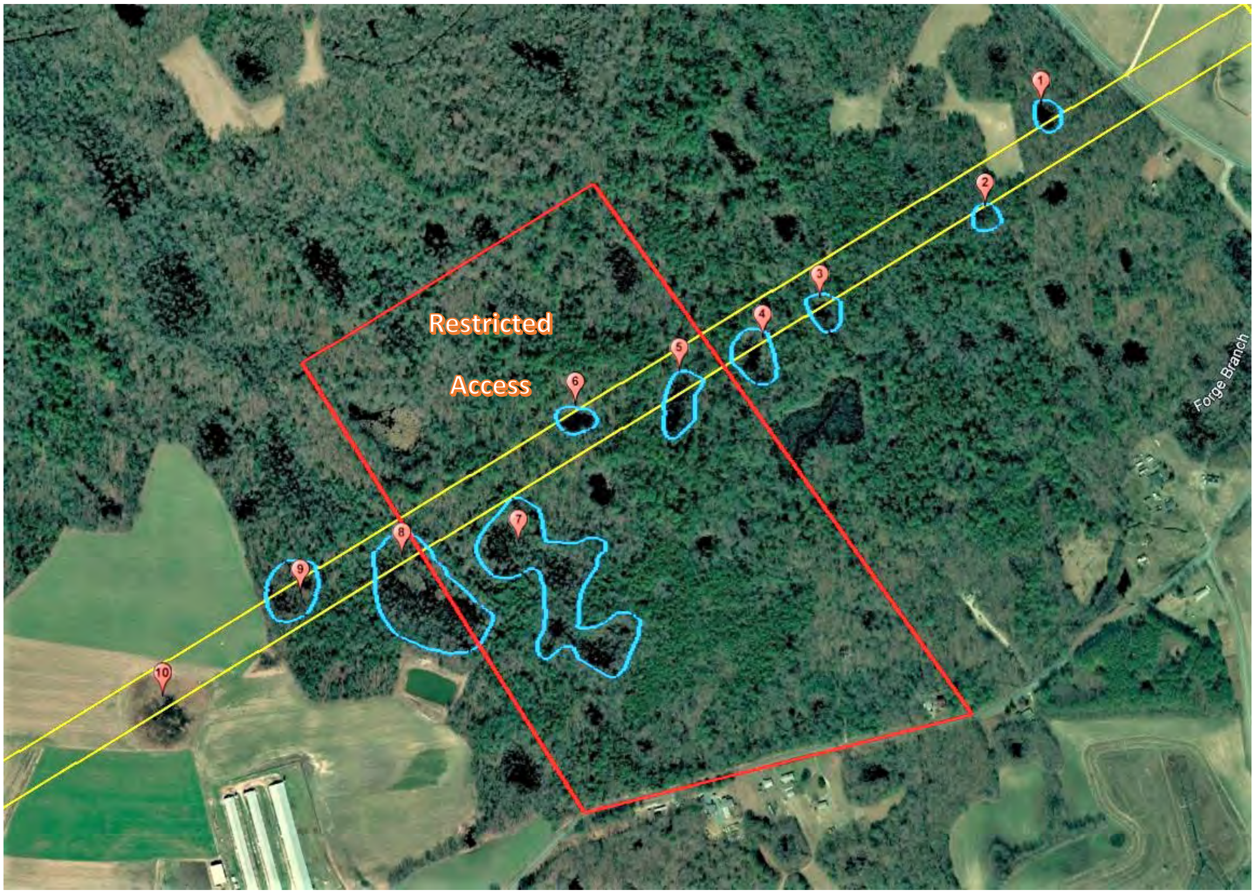


Figure A40 Determining wetland class (current and historic beaver activity). Aerial views of riverine lacustrine fringe subclass wetlands (beaver impounded) on Grover Creek, and Thomas Branch in Calvert Cliffs State Park, Calvert County (Source: Watershed Resource Registry). Note the change in the size and number of beaver dams impounding both tributaries in a short time frame when comparing these photos. The red arrows highlight a few of the dams. The use of multi-temporal aerial photography will be necessary to distinguish between open waters (including true aquatics) and fringe wetlands. Ground truthing will be necessary to confirm wetland class and the boundaries.

Figure A41 Determining wetland class (historic beaver activity). Two photos of abandoned beaver impoundments as evidenced by the invasion of woody plants. In both cases, the wetlands are now classified in the toe slope subclass as the dominant water source is groundwater discharge from the valley fringe and the hydrodynamics are unidirectional towards the channel of 2nd order streams. The photo on the left is from the EMP ecoregion and the right is from the CP ecoregion.

Figure A42 Determining wetland class (beaver activity). Examples of a recently abandoned beaver impoundment. Despite some remnant areas of open water, most of the area has emergent vegetation shifting the classification to the toe slope wetland subclass as the dominant water source is now groundwater discharge.

FigureA43 Determining the WAA (inferring scores). This aerial view of a once contiguous wetland depression in the CP ecoregion illustrates the potential option to infer scores from WAA1 to WAA2. The elevated roadbed and ditching necessitate separating the two very similar wetland polygons. When is the case, the score from WAA1 may be inferred to WAA2. See Section 2.2.7.2 of the MDWAM Guidebook for *Inferring Scores.*



FigureA44 Determining the WAA (inferring scores). An aerial view of clustered depression wetlands, many of which are Delmarva Bays. The yellow polygon is a fictitious utility line right-of-way proposal that will encroach on 10 separate WAAs determined by supporting information. Often, this is one of several alternatives for linear projects such as this and MDWAM can be used to determine the least damaging alternative. Because WAAs 5-8 have restricted access to all or part of the wetlands, inferring scores may be necessary. Using the protocol in Section 2.2.7.2 of the MDWAM Guidebook (*Inferring Scores),* a single or subset of wetlands may be used as a reference to infer the scores of other wetlands of the same class that have similar characteristics. In this case, WAAs 1-6 are nearly identical depression wetlands. WAAs 5-6 are in the restricted access area and can be scored using the average score inferred from WAAs 3-4. Scores from WAAs 1-2 are not used due to the presence of agricultural lands and a road barrier within the buffer and aquatic context polygons which will likely result in different scores for the landscape core element. Therefore Wetlands 1-2 and 7-10 will be scored individually.

Figure 45 Determining the WAA. This aerial photo (top) illustrates a toe slope subclass wetland in Carroll County. Two separate polygons are present and bisected by Morgan Run which is 3rd order and was potentially an active floodplain historically. However, the damming effect of the road fill (bottom photo) and constricted outlet now funnel flows through an incised channel which is likely the result of past disturbance (the road and or upstream agricultural use). Furthermore, historic stream relocations in the watershed upstream have contributed to channel incision and sediment buildup along the current channel. This has caused the elimination of wetlands along the channel separating it into two distinct areas. The wetlands (blue polygons) are now driven by groundwater discharge from the valley slopes as the primary water source. The wetlands have similar hydrologic processes and are now separated by the stream and upland levee. Because the combination of the levee and the stream are less than 100 linear feet in width, they are assessed as a single WAA.

Figure 46 Determining the WAA. Additional ground photos of Morgan Run and its incised and over widened channel. The left photo illustrates how an incised channel can impact the water table of a wetland in addition to channel migration. Further downstream (right), an abandoned crossing and its floodplain fill force flow through a narrow opening which impacts flow and circulation in the wetland.