

# PEPPERFIELD WETLAND ENHANCEMENT SUMMARY



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## Pepperfield Wetland Enhancement Project Summary

### Project Description:

The proposed project is located along Klej Grange Road in Worcester County, Maryland southwest of Snow Hill Maryland. The purpose of the project is to enhance and enlarge the current wetlands located near the project site by re-connecting the existing stream channel (Rayfield Ditch) to its floodplain. Figures 1 and 2 show the location map and site map respectively.

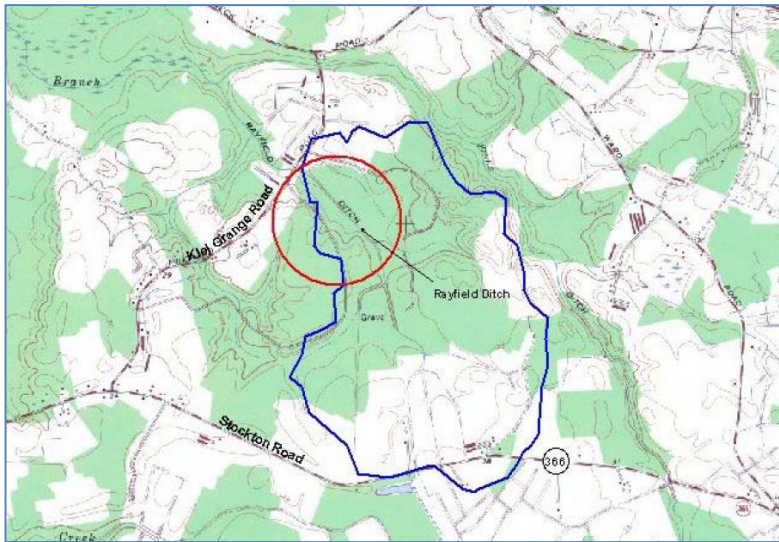


Figure 1: Location map and drainage area

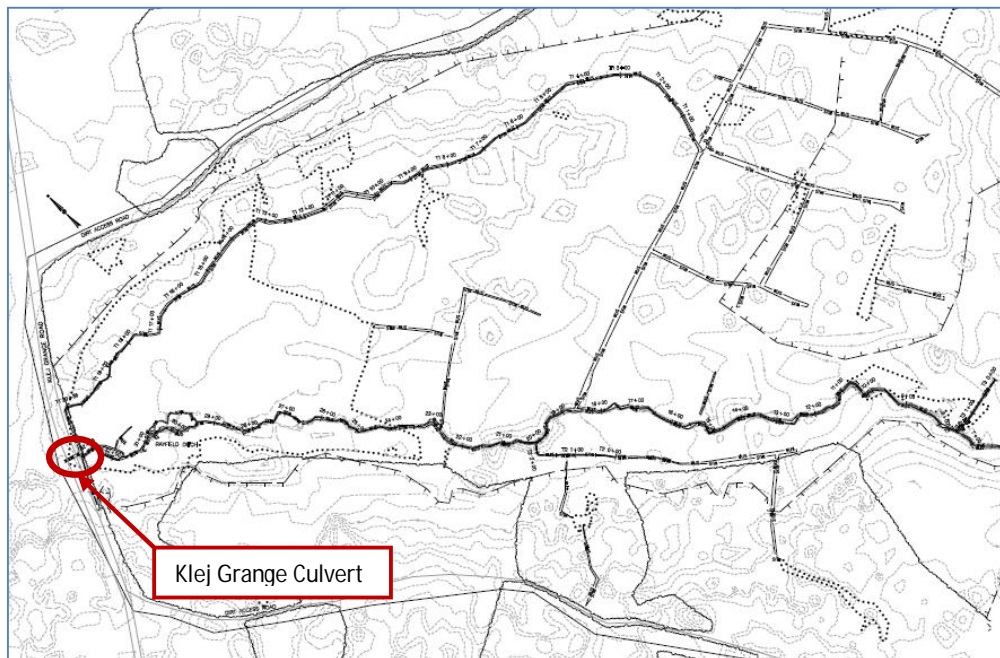


Figure 2: Site Map

### Existing Site Summary:

Rayfield Ditch is located in the Eastern Coastal Plain and has a drainage area of 1.1 square miles. GIS Hydro 2000 was used to determine the land use and soils information of the watershed. The watershed contains 21% A soils, 13% B soils, 23% C soils and 43% D soils. Cropland and forest are the primary land uses (35 and 59% respectively). Figure 3 shows the landuse distribution in the watershed.

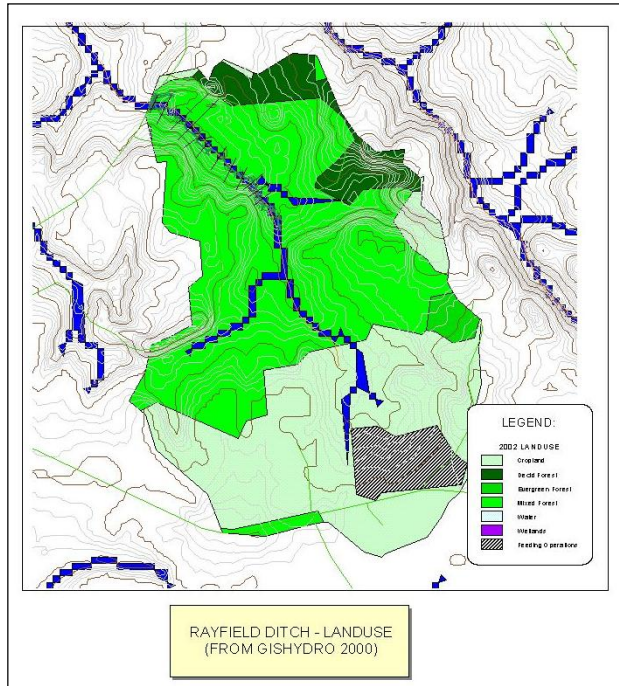


Figure 3: Landuse map

The project site is composed entirely of Forest and Forested Wetlands. A 4' by 6' elliptical corrugated metal pipe located at the downstream end of the study area carries the Rayfield Ditch flow beneath Klej Grange Road. It appears that the culvert has caused a backwater condition which has led to the creation of a forested wetland immediately upstream of the roadway. (Stations 27+50 to 30+50) Figure 4 shows a picture of the forested wetland area.



Figure 4: Klej Grange Wetland approximately 300 feet upstream of culvert (February 2005)

Approximately 400 feet upstream of Klej Grange Road, there is a more defined channel with significantly fewer floodplain wetlands. This area experiences overbank flood flows, however, they do not occur as frequently as in the downstream reach. Figure 6 shows a typical reach within this area.



Figure 5: Approximately 600 feet upstream of Klej Grange Road (February 2005)

The channel becomes more entrenched and less connected to the floodplain as it moves upstream. The channel narrows and frequently has vertical or undercut stream banks. Figures 6 through 9 show the progression of channel incision and disconnection to the floodplain as the channel moves away from the Klej Grange culvert.



Figure 6: Approximately 900 feet upstream of Klej Grange Road (February 2005)



Figure 7: Approximately 1600 feet upstream of Klej Grange Road (February 2005)



Figure 8: Approximately 1,900 feet upstream of Klej Grange Road (February 2005)



Figure 9: Approximately 2,350 feet upstream of Klej Grange Road (February 2005)

The Rayfield Ditch Tributary flows north of the Rayfield Ditch and joins the mainstem just prior to Klej Grange Road. The tributary has better connection to the floodplain than the mainstem, it was determined that the installation of a series of log drop structures could encourage the development of forested wetlands in the area similar to those near Klej Grange Road.



Figure 10: Existing conditions of Rayfield Ditch Tributary (August 2009)

#### Hydrology:

The hydrology for the Rayfield Ditch and associated tributaries was determined based on GIS Hydro 2000. The fixed region regression equations and TR-20 were used to determine the discharges at the site. Table 1 shows a comparison of discharges computed at the site. The Fixed Region Regression Estimates plus one standard deviation were chosen for design purposes.

At the upstream end of the project, Rayfield Ditch has a drainage area of approximately 0.7 square miles. At the end of the study area, Rayfield Ditch has a drainage area of 1.1 square miles.

**Table 1: Rayfield Ditch Hydrology**

Return Period	Fixed Region	Fixed + SD	TR-20
1	14.69	19.54	-
1.25	18.4	24.7	-
1.5	22	29.4	-
1.75	24.5	32.9	-
2	26.6	35.9	37
5	42.6	58.3	65
10	57.8	79.8	91
100	140	202	323

## Wetland Enhancement Goals:

There were three primary goals for the Pepperfield Wetland Enhancement project which included:

1. Restore Rayfield Ditch floodplain connection for the maximum length possible
2. Create and enhance forested wetlands adjacent to the ditch to help reduce nutrient loads within the stream channel
3. Reduce channel shear stresses and bank erosion

The proposed design utilized a series of log cross vanes and log drops to locally raise stream bed elevations encouraging deposition of sediments and ultimately raising the stream bed. In addition, a level spreader was designed to block off flow from an unnamed tributary approximately 1,300 feet upstream of the Klej Grange culvert.

## Construction:

Construction on this project began in the Summer of 2009 and was completed in multiple phases. A construction crew from the Maryland Department of Natural Resources completed the work. Log vane and log drop structures were installed on Rayfield Ditch 675 feet upstream of Klej Grange Road to 2200 feet upstream of Klej Grange Road. Modified log drop structures were also installed on the tributary 600 feet upstream of Klej Grange Road to 1500 feet upstream of Klej Grange Road. The structures on the tributary were modified by removing the footer logs to minimize impacts to existing adjacent wetlands.

## *Rayfield Ditch – Post Construction*

The following photos show images of the Rayfield Ditch taken in April 2010, approximately 8 months after completion of construction. Sediment accumulation is actively occurring upstream of the structures as designed and there are many examples of flood flows leaving the stream channel throughout the project area.

Table 2 shows the structures and their approximate positions in relation to Klej Grange Road. An as-built survey was not conducted, so locations are approximate.

**Table 2: Rayfield Ditch Structure Table**

Structure Name	Approximate Distance From Klej Grange Road (ft)
Log Drop #3	675
Log Drop #2	800
Log Drop #1	1,020
Log Drop #14	1,120
Log Vane #7	1,275
Log Vane #6	1,420
Log Vane #5	1,630
Log Vane #4	1,835
Log Vane #3	1,960
Log Vane #2	2,080
Log Vane #1	2,210

*Log Drops*



Figure 11: Log drops #3 and #14 (April 2010)





Figure 12: (a) Looking at left floodplain between log drop #2 and #3. Notice sediment deposition along left banks indicating frequent overbank flows. (b) looking downstream between log drops #14 and #1. Notice sediment in overbanks and depth of flow in channel. (April 2010)

Log vane #3 was converted to a log drop in the field because of the large trees in the vicinity of the channel. Several large trees would have needed to be removed to install the vane and it was determined that installing a log drop in this location would meet the design intent of the plan while preserving the mature trees.



Figure 13: "Log vane 3" converted to log drop (April 2010 on left and August 2009 on right)

### *Log Vanes*

Figure 14 shows the downstream most log vane (#7). The figure shows that the vane is submerged due to the backwater from the downstream log drops. Although this structure is not functioning as designed, it was left in place because it will still help control grade and direct flows during larger storm events.



Figure 14: Log vane #7 is buried due to back water from downstream log drops. (August 2010)



Figure 15: Log vane #6 (a. looking upstream, b. looking downstream), notice the significant amount of deposition in the floodplain. (April 2010)



Figure 16: Bar formation and channel deposition between log vanes #6 and #7 (April 2010).



Figure 17: Looking downstream at log vane #4. Notice deposition along both stream banks.



Figure 18: Debris jam between log vanes #2 and #3. Notice the height of debris above the flow. This indicates the flows are frequently overtopping the banks. (April 2010)

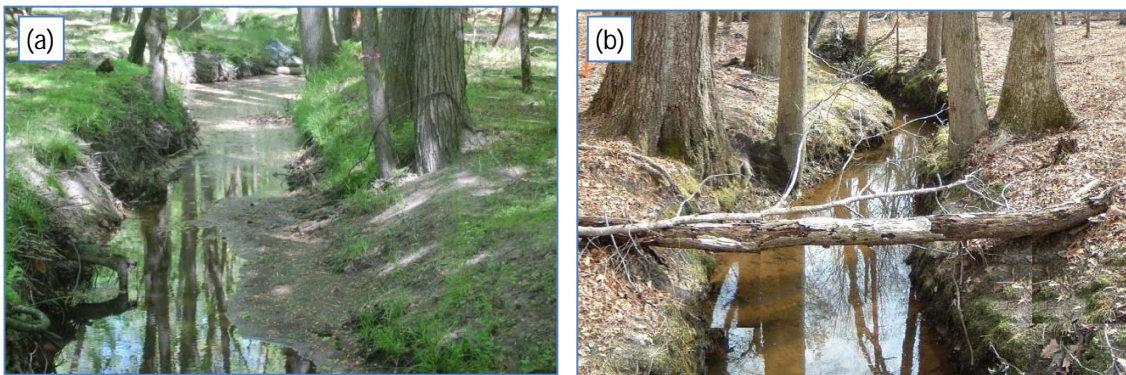


Figure 19: (a) Bar formation and deposition between log vanes #1 and #2 in April 2010. (b) Same section of stream in 2005.



Figure 20: Looking downstream at modified log vane #1. Notice deposition along banks. (April 2010)

#### *Unnamed Tributary with Level Spreader – Post Construction*

A level spreader was installed on an unnamed tributary to disperse flows before reaching Rayfield Ditch. Figures 21 and 22 show examples of the forested wetlands that have developed as a result of the flow blockage.



Figure 21: Forested wetland upstream of level spreader (April 2010).

#### *Rayfield Ditch Tributary – Post Construction*

The proposed log drop structures were modified to minimize disturbance of existing wetlands during construction. By eliminating the footer and drop logs in many cases and utilizing smaller diameter logs, smaller equipment was able to be used which allowed the contractor to stay away from adjacent wetlands. The number of proposed structures remained the same (10 log drops); however, the structures were field located rather than at the stations noted in the design plans.

Construction on the Rayfield Ditch Tributary was completed in January 2010. Work was delayed until winter so that the ground would be more solid and it would be easier for construction equipment to access the area.



**Figure 22: Downstream most log drops (April 2010)**



**Figure 23: Upstream log drops (April 2010)**

Recommendations: After an 8 month period, the stream and tributaries are functioning as designed. Sediment is building up in the stream channel (depositional bars and depositional areas immediately upstream of structures) and flood flows are getting out of bank on a regular basis as evidenced by significant areas of deposition along the floodplain. As sediments continue to deposit in the stream channel, this process will continue to enhance the enhancement and creation of forested floodplain wetlands. Annual monitoring is recommended to visually track the progress of wetland enhancement and expansion.