APPENDIX A

WALLKILL RIVER FLOOD MITIGATION PLAN
BLACK DIRT REGION, ORANGE COUNTY, NY
DATED AUGUST 16, 2013

Wallkill River Flood Mitigation Implementation Plan
Black Dirt Region, Orange County, NY

Summary of Further Investigations Regarding Flood Mitigation Study Areas
August 16, 2013

Introduction

Based on our July 10, 2013 meeting in Pine Island and on-going discussions with the Soil and Water Conservation District (SWCD) regarding the flood mitigation plan for the Black Dirt Region, we have explored several alternatives in further detail. The same modeling approach was used as previously discussed. We evaluated each alternative for the 2 year and 10 year storm events. For each alternative, we have summarized the advantages and disadvantages to allow the SWCD to make an informed decision on which alternatives to pursue with the current funding as well as potential future funding opportunities. The alternatives considered include:

- Cheechunk Canal Extension (1930's geometry)
- Cheechunk Canal Extension (Floodplain geometry)
- Dredging the Existing Cheechunk Canal to remove sediment
- Remove portion of Celery Ave Rock Ledge
- Remove portion of Pochuck Rock Ledge
- Remove portion of Wallkill Rock Ledge
- Impacts of Orange County Landfill

Cheechunk Canal Extension (1930's geometry)

This alternative looks at extending the Cheechunk Canal south from the end of the existing canal towards Oil City Road. The extension was modeled with the geometry laid out in the 1930's Army Corps of Engineers Project. This alternative would cost approximately $1,800-$2,000 per foot or $10 million per mile to construct.

Advantages/Benefits

- 3" decrease in 2-year storm upstream of the junction with Pochuck Creek
- 2" decrease in 10-year storm upstream of the junction with Pochuck Creek

Disadvantages/Considerations

- ½" increase in water elevations through the existing Cheechunk Canal for the 2-year storm
- minimal increase in peak flows for the 2-year and 10-year storm at the Orange County Landfill
- Minimal increase in water elevation through the existing Cheechunk Canal for the 10-year storm
- Impact to agricultural land, loss of land due to construction of the canal
- Regulatory (NYS DEC, US ACOE, FEMA, U.S. Fish Wildlife, NYSHPO)

Cheechunk Canal Extension (90' Floodplain Geometry)

This alternative extends the Cheechunk Canal south from the end of the existing canal towards Oil City Road, but in lieu of excavating a new channel, this alternative investigates adding capacity by creating a lower floodplain along the banks of the existing river. The floodplain was modeled as a 90 foot floodplain on either side of the main channel. As part of this alternative, the Mayjack Bridge was removed to accommodate the wider floodplain. The lower floodplain associated with this alternative provides storm storage. The cumulative benefit of this storage area is realized as the floodplain is progressed upstream. The lower water surface elevations at Oil City Road are a result of this increased storage area. This alternative would cost approximately $1800-$2,000 per foot or $10 million per mile to construct.

Advantages/Benefits

- 1"decrease in 2-year storm upstream of the junction with Pochuck Creek and increasing to 9" at Oil City Road
- 1" decrease in 10-year storm upstream of the junction with Pochuck Creek and increasing to 10" at Oil City Road
- minimal decrease in peak flows for the 2-year storm at the Orange County Landfill
- Suitable with various avenues of future funding
- Environmental Benefits may ease regulatory hurdles
- Costs may be considerably offset by incorporating value of soil in removal or relocation options.
- Relocation of usable soil could be used to offset adjacent agricultural subsidence.

Disadvantages/Considerations

- minimal increase in peak flows for the 10-year storm at the Orange County Landfill
- Impact to agricultural land, loss of land due to construction of the canal
- Regulatory (NYS DEC, FEMA, US ACOE) although potential benefits over canal extension alone.

Cheechunk Canal Extension (200' Floodplain Geometry)

This alternative is similar to the alternative above, except the floodplain was expanded to 200 feet either side of the channel. This results in an increased benefit, but also increases the extent of the impact. The water surface changes from the model are summarized below and the remaining advantages/disadvantages are similar to those listed above.

- 3"decrease in 2-year storm upstream of the junction with Pochuck Creek and increasing to 14" at Oil City Road
- 2" decrease in 10-year storm upstream of the junction with Pochuck Creek and increasing to 18" at Oil City Road

Comparison of Cheechunk Canal Extension - 1930's vs Floodplain Configuration

Impact	1930's Geometry	90' Floodplain Geometry	200' Floodplain Geometry
Cost	$10M/mile	$10M/mile	$12M/mile
2-year drop in Water Surface Near Pochuck Creek Near Oil City Road	 3" 3"	 1" 9"	 3" 14"
10-year drop in Water Surface Near Pochuck Creek Near Oil City Road	 2" 2"	 1" 10"	 2" 18"
Active agricultural land impacted by construction	55-60 acres (approx.)	40-45 acres (approx.)	45-50 acres (approx.)
Regulatory hurdles	High	Moderate	Moderate
Funding Opportunities	Few	Several	Several

Dredging the Existing Cheechunk Canal to remove sediment

This alternative evaluates removing the sediment from the bottom of the Cheechunk Canal to increase conveyance of the Canal. This alternative assumed approximately 2' of sediment build up that would be removed through the length of the canal. The excavation of sediment would be transitioned at either end to match the streambed elevation of the Wallkill River upstream and downstream of the canal. The modeling results of this alternative are similar to adding a floodplain bench to the canal which was previously investigated. This alternative also presents a few negative factors that must be considered. The cost to dredge the entire length of the canal would be $4,000,000-$5,000,000. This cost could increase if the dredged material is found to include contaminated material. This cost does not include the future maintenance cost associated with repeating this operation in the future as the canal will accumulate silt in the future.

Advantages/Benefits

- 6"decrease in 2-year storm immediately through the canal, transitioning to less than an inch at Oil City Road.
- 5" decrease in 10-year storm immediately through the canal, transitioning to less than ½ inch at Oil City Road.

Disadvantages/Considerations

- Minimal increase in peak flows for the 2-year and 10-year storms at the Orange County Landfill
- Sediment has potential for containing hazardous waste.
- Lowering invert of the canal would further entrench the river and result in streambank erosion. This option would require transitioning the invert elevation to upstream and downstream and

may require grade control in these areas to prevent incision and streambank erosion from traveling upstream.

- Lowering the invert may cause undermining issues at bridge crossings
- Lowering the invert would lower the groundwater table in the adjacent areas.
- Regulatory (NYS DEC, US ACOE, FEMA, NYSHPO)
- Although deliberated, it has not been confirmed that deposition has occurred in the canal since the original construction. Prior to progressing with this alternative, the extent and rate of deposition should be verified by field measurements to validate that the proposed modeled alternative agrees with the actual field conditions.
- Sediment removal may provide some temporary relief, as shown by the alternative modeled, but the returns will diminish as sediment will likely redeposit over time, requiring future repetitive maintenance.

Remove Portion of the Celery Avenue Rock Ledge

This alternative evaluates lowering the elevation of the rock ledge to increase conveyance. The removal would consist of a 40 foot wide by 4 foot deep notch in the ledge. The streambed immediately upstream of the ledge would be regraded to transition the lower rock ledge to the existing streambed elevation in addition streambed stabilization methods would be employed above the rock cut to prevent future erosion of the stream. This alternative would cost approximately $220,000 to construct.

Advantages/Benefits

- 3-4"decrease in 2-year storm immediately upstream of the rock ledge, transitioning to no benefits upstream of the confluence with Quaker/Black Walnut Creek
- ½" decrease in 10-year storm immediately upstream of the rock ledge, no benefits through the rest of the model.
- Minimal decrease in peak flows for the 2-year storm at the Orange County Landfill

Disadvantages/Considerations

- Minimal increase in peak flows for the 10-year storm at the Orange County Landfill
- Requires soil boring(s) to evaluate effect on ground water levels
- Regulatory (NYS DEC, US ACOE, FEMA)
- Lowering the channel elevation may further entrench the river and result in streambank erosion. May require grade control and/or streambank stabilization
- Must maintain bankfull channel dimensions to maintain sediment conveyance
- Removal of rock ledges impacts smaller storms more than large events. During the larger storm events the rock ledge is submerged, therefore removing a portion of the ledge has decreased benefit.

Remove Portion of the Pochuck Rock Ledge

This alternative evaluates lowering the elevation of the rock ledge to increase conveyance. The removal would consist of a 40 foot wide by 3 foot deep notch in the ledge. The streambed immediately upstream of the ledge would be regraded to transition the lower rock ledge to the existing streambed elevation. In addition streambed stabilization methods would be employed above the rock cut to prevent future erosion of the stream. This alternative would cost approximately $200,000 to construct.

Advantages/Benefits

- 4"decrease in 2-year storm immediately upstream of the rock ledge, transitioning to a 2" decrease at Glenwood Road
- 8"decrease in 10-year storm immediately upstream of the rock ledge, transitioning to a 2" decrease at Glenwood Road

Disadvantages/Considerations

- Minimal increase in peak flows for the 2-year and 10-year storms at the Orange County Landfill
- Lowering the channel elevation may further entrench the river and result in streambank erosion. May require grade control and/or streambank stabilization.
- Regulatory (NYS DEC, US ACOE, FEMA, NYSHPO)

Remove Portion of the Wallkill Rock Ledges

This alternative evaluates the lowering of the rock ledges on the Wallkill River downstream of Oil City Road. There was not sufficient geometry to accurately model this alternative. Based on approximations in the model, we expect small 1-2" benefits upstream of the rock ledges only. In addition streambed stabilization methods would be employed above the rock cut to prevent future erosion of the stream. This alternative would cost approximately $200,000 to construct.

Advantages/Benefits

- Minor decrease in water elevations upstream of the rock ledge

Disadvantages/Considerations

- Only impacts areas upstream of the ledge
- Potential impacts to Federal Wetlands/Duck Ponds upstream
- Lowering the channel elevation may further entrench the river and result in streambank erosion. May require grade control and/or streambank stabilization.
- Regulatory (NYS DEC, US ACOE, FEMA, NYSHPO)
- Removal of rock ledges impacts smaller storms more than large events. During larger storm events the rock ledge is submerged, therefore removing a portion of the ledge has decreased benefit.

Impacts of Orange County Landfill

While it is understood that the construction of the Landfill may have resulted in some alteration of the river channel in the vicinity of the landfill, there appears to be no evidence or data that would support the theory that the current configuration impedes flows. Reviews of the County's records from the Landfill's slope failure indicate that it was at an isolated location and the damage was predominately rectified. Again, there is no evidence or data that supports the supposition that the minor change in landfill shape and size due to the failure impacts the capacity of the Wallkill River to convey water through the Black Dirt Region.