Overview of Project Credit Guidance for the Indian River Lagoon Basin Management Action Plans

September 20, 2012

Muck Removal Credit Guidance

Overview

- Issues with muck in the Indian River Lagoon (IRL) Basin:
  - Muck deposits contain nutrients that flux into the water column, increasing the abundance of phytoplankton, drift macroalgae, and epiphytes that attenuate light and constrain seagrass growth and extent.
  - Seagrass cannot grow in areas with mucky substrate, further limiting the locations where they can exist.
  - When muck is suspended within the water column, these suspended solids limit light availability and suppress seagrass growth.

Overview, continued

- Most of the IRL Basin muck comes from upland soils. Stringent land-based source control measures are needed.
  - Muck removal projects should be performed in conjunction with soil and vegetation retention programs and public awareness activities that limit the amount of material deposited into the IRL.
- Muck removal projects are required to meet applicable permitting requirements and any associated evaluation and tests of the muck as specified by state and federal regulatory agencies.
- This guidance is only applicable to the IRL Basin.

Requirements for Credit

- Credit for muck removal in the IRL Basin Management Action Plans (BMAPs) is assigned for environmental ***restoration*** dredging.
  - This type of dredging is different than navigational or maintenance dredging projects.
- The goal of restoration dredging is to remove as much muck as possible in an area to reduce nutrient loading to the lagoon.
- The guidance document for restoration dredging is best applied to lower or marine tributary reaches or canals that are open to the IRL.

Requirement – Muck Thickness

- Definition of muck: Black in color, contains clay/silt greater or equal to 50% of the sample by volume, and contains greater or equal to 5% organic matter by volume.
- Average minimum thickness of 30 centimeters (about 1 foot) of muck is recommended as a significant deposit technically feasible for removal and eligible for credit.
- An estimate of the area of material to be removed that meets the above definition is needed.
- Credit can be assigned for removing muck deposits between 5 to 30 cm in depth if dredging is to the natural substrate.

Requirement – Removal

- Muck must be completely removed to the natural substrate to the maximum areal extent possible.
- Even a small layer (2-5 centimeters) of muck may continue to flux if there is a gradient of nutrient in the sediment and a carbon source.
- It may not be possible to remove sediment close to structures, stream banks, and canal walls.
  - In general, the areas not dredged are not included in the area requested for credit.
- The more muck that is not removed increases the likelihood that the bottom will be recovered by the muck left behind, negating the benefit of its initial removal and losing the project credit awarded for the initial dredging.

Requirement – Upstream Limit

- Measurable salinity or presence of a dam or other control structure that bisects a waterway is a reasonable upstream boundary for dredging credits.
- Sediment material and nutrients fluxed from muck in the most upstream reaches may not reach the IRL.
- Finer-grained cohesive sedimentary material and organic matter suspended in the water column will start to flocculate as salt concentration increases.
  - These larger flocs settle out of the water column as sediment deposits at about 1 part per thousand of salinity.

Requirement – Storage and Flux

- Muck must be completely removed from contact with surface waters and disposed of in a location where they cannot enter the lagoon or its drainage conveyances.
- The distance from surface waters for storage will be determined on a case-by-case basis.
  - Permit requirements may dictate the storage and handling of removed muck.
- Post-project deposition rates must be measured every 5 years and reported to FDEP.
- The amount of credit in future years may be reduced based on the rate of new deposition.

Flux Rates

- Literature-based net flux rates will be applied to muck removal project areas for the purpose of calculating credit.
  - Site-specific flux rates can be used if available and the methods for establishing those rates have been accepted by FDEP.
- The net flux rate is the flux rate from the muck minus the flux rate from the normal sandy substrate.

Flux Rates, continued

Source	Muck Ammonia Flux Rate ($kg/km^2/yr$)	Natural Substrate Ammonia Flux Rate ($kg/km^2/yr$)	Net Ammonia Flux Rate ($kg/km^2/yr$)	Muck Phosphorus Flux Rate ($kg/km^2/yr$)	Natural Substrate Phosphorus Flux Rate ($kg/km^2/yr$)	Net Phosphorus Flux Rate ($kg/km^2/yr$)
Trefry et al., 1992	9,811	1,226	N/A	2,172	407	N/A
Reddy et al., 2001	N/A	4,730	N/A	N/A	38	N/A
Montgomery et al., 1979	N/A	220	N/A	N/A	N/A	N/A
Average	***9,811***	***2,059***	***7,752***	***2,172***	***222***	***1,950***

Time Limitation

- Credit is time limited to a maximum of 10 years.
- This initial time limit can be increased 1 year for each 30 cm depth increment above the first 30 cm up to 5 additional years for very thick deposits.
- The initial time limit can be extended an additional 10 years if the stakeholder can demonstrate that effective upland source controls are in place, and the muck deposition rate averages ≤0.25 cm/year or ≤4 cm/10 year over the affected project area.
- If deposition rates are greater than the above, the credit will end unless the muck is re-dredged.

Past Projects

- Credit is limited to projects initiated on or after January 1, 2000.
- Credit for past projects can be counted only if detailed information is available to calculate credit, including the amount of post-project deposition.
- The amount of credit applied in this BMAP iteration may be discounted if new deposition is significant over 10 years.

New Deposition Amount	0-4 cm	5 cm	6-7 cm	8-9 cm	≥10cm
Discounted benefit of project	No discount applied	50%	65%	80%	No credit applied

Source Control Requirements

- Source control actions or programs that can be considered as a minimum for credit include:
  - Erosion and sediment control ordinance;
  - Landscaping ordinance;
  - Street sweeping; and
  - Maintaining a vegetative cover on banks of drainage features, whenever possible.
- The implementation of additional best management practices or educational activities that address erosion of upland soils is encouraged.
- Vegetated buffers may be one of the most effective practices to use to remove sediment and nutrients.

Muck Collection and Characterization

- Samples of muck can be collected using several different pieces of equipment including corers, scoops, and dredge/grab samplers.
  - FDEP protocols are available at: http://publicfiles.dep.state.fl.us/dear/sas/sopdoc/2008sops/fs4000.pdf.
- The U.S. Army Corps of Engineers identifies several laboratory methods for characterizing the physical properties of muck.
  - Grain size standard sieve test, grain size hydrometer test, grain size pipette test, and organic content/matter.

Muck Project Surveys

- Phase 1 – Physical survey for preliminary determinations
- Phase 2 – Detailed construction and permitting surveys (physical, chemical, site plans)

Muck Project Surveys

Phase 1 – Physical survey for preliminary determinations

- Delineate a dredge footprint in the project area.
- Make a rapid determination of whether the project:
  - will qualify for BMAP credit;
  - and if so, approximately how much (NOT FINAL); and
  - is it feasible as assessed by stakeholder (cost/benefit criteria).
- Final credit determination will be made following submittal of Phase 2 plan survey details.

Phase 1 - Stream Reach & Morphometry

- Estuarine reaches of streams and canals open to the lagoon; downstream of control structures.
- Most project areas will consist of one or more linear or quasi-rectangular.

Phase 1 - Field Data & Sediment Sampling

- Purpose: delineate, verify and calculate muck area, average muck depth, and approximate muck.
- Measurement and verification by metal rod/probe and representative sediment cores or grab samples.
- Grab samples of muck sediment archived in sealable jars; core samples capped and sealed.

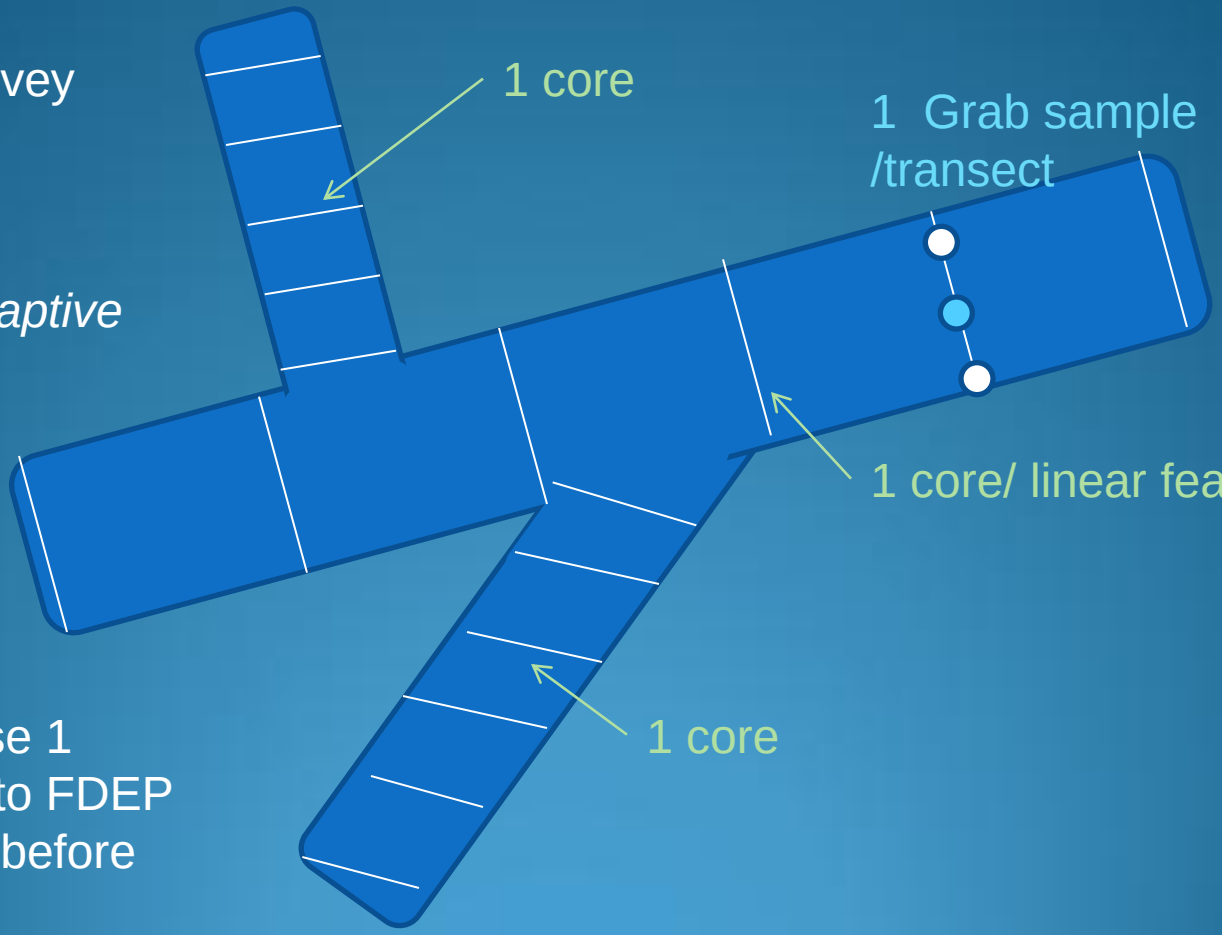
Phase 1 - Field Data & Sediment Sampling

- Probe measurements to detect muck and measure muck thickness from at least 3 points, equidistant, along every transect – 2 at perimeter edges and 1 mid-point.
- At minimum, each transect shall be placed at equidistant 1/5 intervals along length of each linear feature i.e., 6 transects, 18 points of measure per linear feature .
- 1 grab sample per transect, 1 intact muck core (top to bottom) collected per 6 transects or linear feature.

Phase 1 - Transects

General survey *guidance*

Flexible, adaptive



Submit Phase 1 survey plan to FDEP for approval before you begin

Phase 1 - Lab Work

- For each transect grab sample (or core):
  - Sediment color will be noted as indicated by the Munsell soil color chart.
  - Percent of total sample that has a grain size <4 microns (clay, >8 phi scale) and between 4 and 63 microns (silt, 8 to 4 phi scale).
- Color and grain size can be determined by any certified soils lab or a university with a soils, limnological, or oceanographic lab.

Phase 1 - Submittals

- Before any field work, a Phase 1 survey design plan should be submitted to FDEP/BMAP for approval.
- Final Phase 1 report submittal should include:
  - Map of project area;
  - Brief report on findings: muck area, average muck thickness, rough estimate of muck volume, and physical properties (color and grain size);
  - Copy of raw field data;
  - Copy of lab data report; and
  - Copy of the lab's certification or qualification.

Phase 2 - Detailed Technical Surveys & Planning

- Physical and chemical surveys required to design, permit, construct, and fully complete a muck removal project.
- A final muck dredge footprint required by FDEP to issue a final BMAP credit determination for the project.
- Consultant services for survey s and planning will likely be needed.

Sediment and Erosion Control

- FDEP is planning to hold a sediment and erosion control workshop in the IRL area in early 2013.
- Topics identified to date:
  - Addressing runoff from construction sites, unpaved roads, and larger developments.
  - Educating contractors and staff of requirements.
  - Identifying better way to use vegetative covers for controlling erosion.
  - Identifying cost efficient and practical methods to address erosion and sediment control.
- Potential use of Google Maps/Earth to identify locations for field visits associated with the workshop.

Sediment and Erosion Control, con't

- Proposed workshop format:
  - 1.5 days of the standard training, with field demonstration, followed by;
  - 1 day workshop focused on erosion control:
    - Case studies and/or site visits;
    - New products; and
    - Better practices for revegetating a site.

Sediment and Erosion Control, con't

- Because of the basin length, want to hold 2 workshops:
- Possible locations:
  - Titusville, Merritt Island Refuge;
  - Palm Bay; or
  - Vero Beach.
- Possible to hold a workshop before end of 2012:
  - Tentative dates November 13-15, or early December.

Questions on the Muck Removal Credit Guidance

Aquatic Vegetation Harvesting Credit Guidance

Overview

- What are we trying to do?
  - Harvest of aquatic vegetation to remove nutrients rather than recycle them through decomposition and sedimentation of plant material.
  - Plants take nutrients from the sediment and water column and then recycle the nutrient when the plant dies or as leaves are shed.

Definition

- Aquatic vegetation definition: For our purposes freshwater plants that live within the water column or on the surface of water. These plants are more likely to obtain nutrients from the aquatic environment via sediment or water. Includes both native and invasive (non-native) plants.
  - Predominately angiosperms or flowering plants.
  - For our purposes herbaceous-not woody-plants (green not brown).
  - Algae are an aquatic plant- there are the larger algae (not phytoplankton) that may be free floating or attached to a surface (including the surface of plants).

Water lettuce

Water hyacinth

Hydrilla

Plant Growth Factors

- Aquatic plants are largely water.
  - Water hyacinth as live plant can weigh 200-300 tons per acre, but are 90-95% water weight.
- Factors that influence growth and nutrient content of plants:
  - Light and water clarity;
  - Nutrient availability;
  - Organic matter;
  - Sediment fertility, composition, and stability; and
  - Age of plant.

Crediting Plant Removal

- Need the following pieces of information:
  - Type of plant or mix of plants present.
    - Abundance of each plant. Survey to decide if it is predominately a monoculture or if there are other plants in the mixture.
  - Mass of wet plant material – example:
    - Bucket load of plant material drained and weighed; count the number of buckets removed.
  - Percent dry matter.
  - TN and TP content (usually reported on a dry weight basis).

Surveying Plant Material

- Propose different methods of determining composition of plants that will be harvested.
- Transects and quadrats are commonly used for surveying plant communities to estimate the cover of individual species.
  - Transect involves taking measurements along a line.
  - Quadrats provide an estimate of coverage in a given area.
    - 1 square meter is typically used for herbaceous plants.
    - Constructed out of PVC pipe.

Surveying Plants, cont.

- For linear features like a stream or canal with large quantities of plant material.
- Measure off 100 meter length transect.
  - Walk the transect to determine if there is zonation or change in plant type along transect.
  - Or if plants are mixed together and randomly distributed.
- If there is zonation, estimate percent cover of plants for each grouping of plants. Final percent cover is an estimate of the cover based on the entire area of the canal.

Surveying Plants, cont.

- For mixed plants, mark the transect at 10 meter increments.
- At each 10 meter mark, use the 1 square meter quadrat to estimate percent cover of different plants.
  - Throw the quadrat into the canal or hold in front of you facing the canal.
  - Marking the quadrat in 20 centimeter squares with string to create a grid will aide in determining percent cover.
  - Estimate the percent cover of each plant species within each grid cell.

Surveying Plants, cont.

- Plants that have less than 1 percent cover, exert little influence and their effect on estimates of nutrient calculation and can be ignored.
- The previous method of using a transect and quadrat may also work once plants have been removed and are spread out.
- Ideally, samples for lab analysis should be taken prior to removal, but practical issues may limit the sampling until after the material is out of the waterbody.

Protocol for Obtaining Weight

- This technique works best for smaller amounts of plant material, but may be adaptable to larger amounts.
- Take a sample of plant material and place in a water tight container of known tare weight and known volume.
- Weigh sample. Also record starting volume of material.
- Transfer the sample to a container of known tare weight that will allow drainage of water. Examples are a large colander or 5 gallon bucket with holes drilled in it to allow water to escape.
- Take weight of sample and colander after transferring to colander.

Protocol for Obtaining Weight

- Continue to take weights of sample and colander until the weight stabilizes to a constant weight. The constant weight will still fluctuate, but try to get within 5-10% of a constant weight.
- Once at a constant weight, that is the weight of the wet plant material.
- This sample goes to the lab for analysis. The lab will dry it further before analyses are run.
- Take replicate samples for obtaining a weight.
- Drying time will vary by type of plant, its size, and leaf shape. Start at 15 minute intervals for recording weights. Some experimentation may be needed.

Nutrient Content

- Method 1: Collect samples from harvest site and send to lab for analysis. Material should be representative of plants harvested. Total number of samples to be collected to be determined.
  - Harvest from many different locations.
  - Mixed stand of plants.
  - Only one harvest per year.
- Method 2: Library of locally collected and literature values for TN, TP, and percent dry matter.
  - Multiple harvests from same area. Expect similar results.
  - Limited number (monoculture) of species or recurring species composition.

Calculating Nutrient

- Mass of wet plant material * percent of dry matter * TN or TP as mg or g/kg
  - Example: 5,000 lbs of water lettuce * 0.057 (average % dry matter) * 25 g/kg TN = 7.1 lbs TN

- Method 2: Mass of wet plant material * percent of dry matter * percent of TN on a dry weight basis
  - Example: 5,000 lbs of water lettuce * 0.057 (average % dry matter) * 2.5% (.025) nitrogen = 7.1 pounds TN

Amount of Credit

- Credit applied where plant removal is not part of a permit or contained within another BMP.
- Credits provided with each harvest event with an annual average for BMAP credit.
- Watershed BMPs that control nutrient loading applied as appropriate and to the extent possible.
- Material should be spread out to expedite decomposition.

Amount of Credit, continued

- Where plant material is disposed of will effect credits.
  - 100% credit of nutrient removed – disposal at a landfill or other location outside waterbody drainage area or far enough away from waterbody to prevent re-entry.
  - >5% - <100% - credit increased by distance from waterbody. Evaluated case-by-case.
  - 0%-5% credit - Disposal on bank or within a few feet of water.

Buffers

- Reviewed literature and in general the following is accepted:
  - Wider the buffer strip the greater the benefit, but not the only reason for effectiveness;
  - Riparian forest vegetation and wetlands most effective;
  - Buffer strips can be effective in treating both surface and subsurface discharges; and
  - Ground water flow paths, soil characteristics, seasonal, and climate may impact the rate and magnitude of subsurface nitrate removal.

Questions on the Aquatic Vegetation Harvesting Credit Guidance