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To : Lake Belt Mitigation Committee

From : Tom MacVicar and Jeff Rosenfeld
on behalf of the Miami-Dade Limestone Products Association

Date : September 30, 2011

Subject: L-31N Seepage Barrier Project

The Miami-Dade Limestone Products Association requests that the Lake Belt Mitigation Committee (LBMC) consider the construction of a 2-mile, 35-foot deep seepage barrier on the west side of the L-31N Canal as the next phase in the implementation of the L-31N Seepage Control Project identified mitigation plan submitted as part of the Lake Belt Supplemental Environmental Impact Statement.

The 1000-Foot Long, 18-Foot Deep Field Test

The L-31N 1000-foot seepage barrier field test was constructed in August 2009. The shallow seepage barrier was constructed by first excavating a 28-inch wide trench to a minimum depth of 18 feet and then refilling the trench with the cuttings from the trench. An excavator was then used to remove the cuttings while the cement-bentonite slurry was released into the trench. The depth of the trench was measured every ten feet during excavation to insure that the excavator had removed the cuttings to a depth equal to or greater than 18 feet prior to moving on to the next section of the barrier.

Analysis of the hydrologic data collected as part of the field test, including an extensive tracer test conducted in 2010, indicated a limited impact of the test barrier on the local groundwater flow[1]. However, the early detection of dye in the canal during the tracer test, and the findings of the in-situ slurry wall integrity testing (cone penetrometer and borings) showed that the cement-bentonite barrier did not meet the permeability specifications to the full design depth of 18 feet, with indications that in many places the flow barrier was not effective at depths below 14 feet. The presence of cuttings at depth and the absence of hardened slurry mixture at the bottom of the test borings suggest excessive fallback of cuttings during the excavation process. This prevented the proper formation of the slurry wall and led to dilution of the slurry to concentrations which did not allow for proper hardening.

A 2-Mile Long, 30-Foot Deep Seepage Barrier

The Biscayne Aquifer geology at the project site indicates a series of alternating high and low permeability layers to a depth of approximately 50 feet below land surface (Appendix A. modeling attachment Table A-1). The field test barrier was designed to a depth of 18 feet to tie into the first low permeability layer (Q4 marker) and block the easterly groundwater flow from Everglades National Park (ENP) into the L-31N Canal in the upper flow zone (Miami

[1] The following observations indicate the effect of the slurry wall: (1) water level differences upgradient and downgradient of the barrier, (2) the presence of dye upgradient of the barrier at the end of the test, (3) changes in stage vs. AVM flow data before and after construction of the barrier, (4) tracer test cumulative mass balance differences in the canal and well samples at the barrier site vs. the control site, and (5) changes in temperature at the barrier site vs. the control site.

Limestone). The depth of the L-31N Canal is approximately 22 to 24 feet below land surface (bls), indicating that the second flow zone, which extends from roughly 15 to 26 feet below land surface, also affects flow in the L-31N Canal.

A computer model, described in detail in Appendix A, developed for this analysis indicates that a 7-mile long (Tamiami Trail south to the 8.5 Square Mile Area Levee) seepage barrier constructed through the second low permeability layer (Q3 marker) would have a significant effect on the water level and sheetflow in ENP over a much larger area than a shallow barrier (**Figure 1**) In addition to the change in stage that would result from reducing seepage to the L-31N Canal, an increase in sheetflow through Northeast Shark River Slough would also occur. The change in sheetflow in Northeast Shark River Slough was estimated across the transect shown below for all the modeled scenarios (**Figure 2**). The change in net flow from NESRS for the average wet season, dry season and full year calculated for different model scenarios at the transect is summarized below (**Table 1**). The model estimates that the 7-mile long deep barrier could increase the average annual net flow from NESRS by almost 28% for the 2000 through 2008 hydrologic conditions.

Investigations by the USGS as well as additional well drilling for the pilot test indicated that the bottom of the second hard layer was at a depth of approximately 30 feet bls. The barrier for the next phase of the project is therefore being proposed to a depth of approximately 35 feet bls in order provide a reliable seal of the second flow zone and to allow for potential sedimentation at the bottom of the trench.

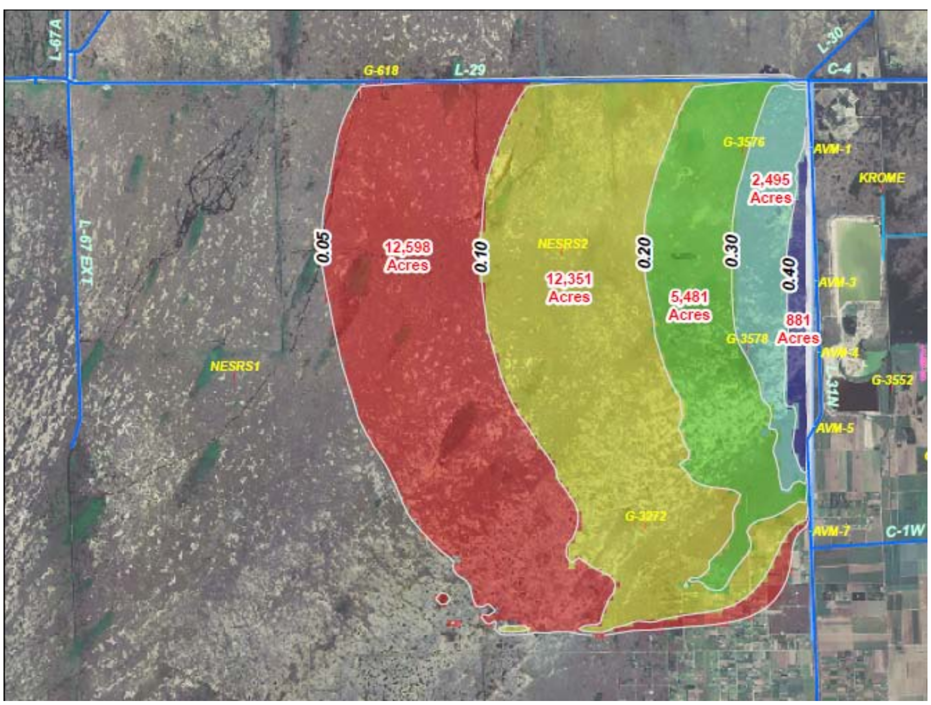

Figure 1. Area within Everglades National Park affected by a 7-mile long, 30 foot deep barrier during a typical wet season (average daily stage data from 7/1/2008 through 10/31/2008).

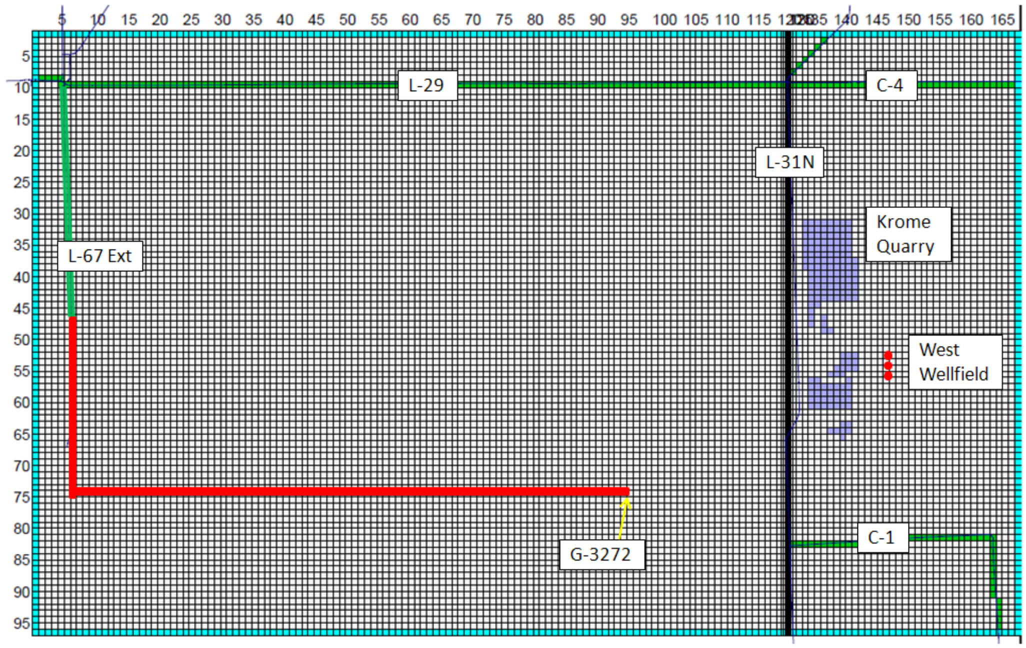

Figure 2. The flow transects used for estimating change in sheetflow as a result of the seepage barrier are shown in red.

Table 1. Change in flow through Northeast Shark River Slough, as a percentage of the base flow, at the transect in **Figure 2**. For the column headings, shallow indicates a barrier depth of 18 feet and deep indicates a depth of 30 feet. The numbers following the depth designations refers to the length of the barrier, in miles, from Tamiami Trail to the south.

Average Percent Change in Flow for Various Barrier Configurations				
	Season	Deep-7	Shallow-7	Deep-2
Net Change for NESRS	Annual	27.8%	8.7%	8.2%
	Wet	37.5%	12.2%	11.0%
	Dry	19.3%	5.6%	5.6%

The Lake Belt Mitigation Committee has sponsored meetings of the technical staff at the various agencies involved in the Lake Belt to review both the results of the monitoring effort for the initial field test and the geologic and modeling investigations supporting the proposal for the next phase of the project. Concerns have been expressed about uncertainties in the constructability and effectiveness of a deeper barrier and the review staff has suggested construction of a shorter length test barrier to demonstrate that a barrier without the flaws seen in the first filed test can be constructed. Modeling was performed for different barrier lengths and a 2-mile long barrier shows the best balance between the projected benefits and cost effectiveness. The change in wet season water level is shown in **Figure 3**.

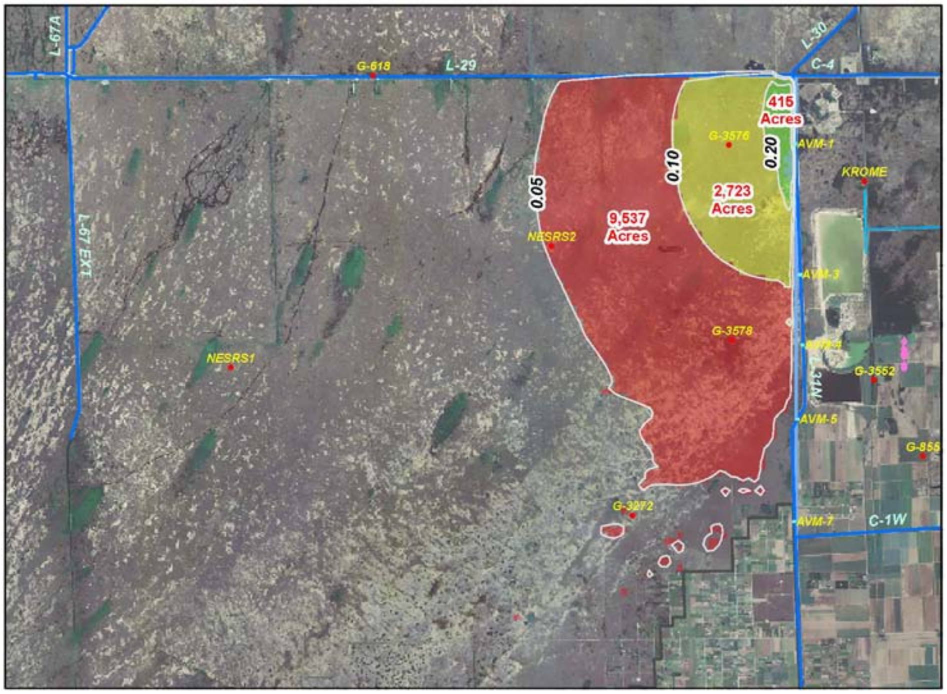

Figure 3. Water level change within Everglades National Park expected with a 2-mile long, 30 foot deep barrier during a typical wet season (average daily stage data from 7/1/2008 through 10/31/2008).

Geo-Solutions, the seepage barrier construction contractor, has proposed a modified cement-bentonite slurry and the use of an air lift system in coordination with the excavator during slurry placement to keep sediment from building up on the bottom of the trench. AMEC-BCI, the design engineer and onsite inspection and testing firm, has developed enhanced quality assurance testing during construction to ensure the barrier meets design specifications to the design depth. Extensive testing will be performed during construction of the initial 1000 feet of barrier to demonstrate the constructability of the deeper barrier, before proceeding with the remainder of the 2-mile length.

A WRAP scoring approach (attached) was developed for the seepage barrier utilizing the model-estimated increased water level areas in the Park. After two meetings of the agency technical team involved in this process, the group agreed that the preliminary summary below (Table 2) would be presented to the LBMC for consideration. Modeling for the project indicated that sheetflow was increased as far west as the L-67 Extension, considerably farther than the area shown to be enhanced by 0.05 to 0.1 ft. increased water levels. For that reason, a modest positive hydrology score was included for the 0.05 – 0.1 water level increase, as a proxy to represent that measurable flow improvements extend much farther.

Table 2. WRAP scoring summary table for a 7-mile and 2-mile seepage barriers, 30 feet deep. The Scoring Categories are: WU – Wildlife Utilization, WC – Wetland Canopy, GC – Wetland Ground Cover, HSB – Habitat Support/Buffer, HYD – Hydrology, WQ – Water Quality and Treatment.

Stage Change	Scoring Categories						WRAP		Acreage		Mitigation Credits	
	WU	WC	GC	HSB	HYD	WQ	Score	Lift	7-mile	2-mile	7-mile	2-mile
Baseline	2.00	0.00	2.00	3.00	2.00	3.00	0.80	N/A	N/A	N/A	N/A	N/A
>0.3 ft.	2.50	0.00	2.50	3.00	2.67	3.00	0.91	0.111	3,376	**0**	**376**	**0**
0.2 to 0.3 ft.	2.33	0.00	2.33	3.00	2.50	3.00	0.88	0.077	5,429	415	**420**	**32**
0.1 to 0.2 ft.	2.17	0.00	2.17	3.00	2.33	3.00	0.84	0.045	11,930	2,723	**533**	**122**
0.05 to 0.1 ft.	2.00	0.00	2.00	3.00	2.17	3.00	0.81	0.011	12,242	9,537	**139**	**108**
										Totals	**1467**	**262**

The WRAP scoring group also suggested that due to the uncertainty in the constructability and effectiveness of the proposed 2-mile deep barrier that a risk factor be applied to the calculated WRAP scores. WRAP, as originally developed, did not include a risk factor, but the later developed UMAM scoring system, which is now used, includes risk adjustment in its scoring methodology. The scoring group suggested applying a 1.75 risk factor for the proposed 2-mile project. This resulted in a score of 150 WRAP units (262 /1.75) for the 2-mile project. The group discussed that if construction and monitoring results indicate that the 2-mile project was successful, then a lower risk factor, or no risk factor at all, could be used in the scoring for the full 7-mile project.

Hydrologic Monitoring

The modeling results indicate that there will be measurable changes in water level and L-31N canal flow with a 2-mile deep barrier. Due to the multiple variables that influence water level and flow, such as local rainfall, evaporation, and operation of the adjacent canal system, actual changes in the field attributed solely to the barrier may be difficult to quantify. This calls for a network of hydrologic data gathering sites to provide the necessary information to evaluate the performance of the barrier. As shown below, there is already an extensive USGS and SFWMD water level and canal flow monitoring network in the vicinity of the project with years of historical data. The existing network will be supplemented with new flowmeter stations in the L-31N and L-29 canals and 11 new shallow (Miami Limestone) monitoring wells located upgradient and downgradient of the barrier on the L-31N levee (see the attached Monitoring Plan for details).

Figure 4. Monitoring Plan location map. The green line represents the 2-mile seepage barrier and the blue squares represent the proposed shallow upgradient and downgradient monitoring wells.

The MDLPA is requesting that the Lake Belt Mitigation Committee consider the proposal to construct a 2-mile, 35-foot deep seepage barrier on the west side of the L-31N Canal. The barrier will start just south of the Tamiami Trail, with the center of the barrier located at the existing SFWMD north monitoring well cluster and the USGS AVM-1 flowmeter. The barrier will be constructed through the footprint of the existing pilot project adjacent to the eastern toe of the L-31N levee, using a coordinated excavator / air lift approach and slurry with approximately 30% more cement and bentonite. Additional quality assurance cone penetrometer testing will be conducted during construction to confirm that the barrier meets the design specifications to the full depth. Water level and canal flow data will be collected prior to and after construction of the barrier.

The estimated cost for the proposed 2-mile, 35-foot deep seepage barrier construction includes:

Geosolutions (Slurry wall construction, mobilization, site preparation/restoration, security)	$5,405,000
Chapman Pipeline Construction (trenching, mobilization)	$1,190,000
AMEC-BCI (Specifications/construction plans and field monitoring/inspection/testing services)	$ 320,000
MDLPA (Coordination, monitoring well and flowmeter stations, hydrologic monitoring, backfill material, transportation, and cone penetrometer testing)	$ 521,000
Subtotal	$7,436,000
5% construction contingency	$ 372,000
Total project cost	**$7,808,000**

Attachments

1. Modeling results – Appendix A. Results and Analysis of Computer Simulation of Various Seepage Barrier Configurations (August 29, 2011)
2. L-31N Seepage Barrier – WRAP Scoring Approach Update (September 23, 2011)
3. Construction Quality Control/Quality Assurance Plan (September, 2011)
4. Monitoring Plan (September 30, 2011)
5. Cost proposals