Issues	Potential Actions
Entire STA	
Design Deficiencies	STA-1E was designed and constructed by the USACE; however District is the local sponsor responsible for operating and maintaining STA-1E. Numerous design deficiencies that have been discovered since turnover have impacted the District's ability to properly operate the STA. Repairs are currently under way and will require continuing coordination with the USACE to allow operation within the current constraints.
Hydrilla die-off/ Hydrilla Control	SAV cells have high hydrilla coverage. There is ongoing concern that Hydrilla is not the optimal SAV in the STAs because it can top out and crash like *chara*. Strategy is to continue to monitor re-growth of Hydrilla, and potentially increase compartmentalization to provide functional redundancy (by lowering dry season stages to accommodate planting and establishment of emergent vegetation). **Science Plan** may need to tap into Hydrilla research work that is being done by Dr. Haller (UF) in the test cells and other areas.
Flow Pattern Reconfiguration	Evaluate reconfiguring overall flow pattern of STA-1E from current configuration (north to south), to east to west based on topography (i.e., generally much higher on east side compared to west side. This option assumes USACE fixes topography in Cells 5 and 7.
Flexibility to move water around inside STA	Proposed **Engineering Analysis** to evaluate addition of small (electric) supplemental pump stations to improve ability to move water around inside the STA. Could also evaluate adding concrete pads at several locations to facilitate use of temporary pumps (e.g. Gator pumps).
Water Quality Monitoring Improvements (need to convey to WQ sub-team)	S-361 - Request for improved passage from Cell 4S to the exterior levee, e.g. burial of the pipes or a walkway to S-361 (access issue only).
	S-362 - Evaluate location of autosampler/sampling platform (access issue and possible issue with collecting a more representative sample).
Western Flow-way	
Treatment Performance	As a result of various vegetation issues, this flow-way has had performance issues for several years. Recently USACE has begun various structural repairs throughout the entire STA, including this flow-way. Until all the repairs and topographic deficiencies are fixed, it will be difficult to develop this flow-way to a condition to provide the necessary performance.
Topographic problems	Highly uneven topography in Cells 5 and 7 impacts cattail communities' health. Waiting to see USACE plans for filling / grading Cell 5 (?) and 7.

Issues	Potential Actions
Cell 5 & Cell 7 Hydraulic short-circuiting	Vegetation Management has been implementing activities to reduce short-circuiting and improve performance in advance of USACE fixing the topography. Measures to eliminate the Cell 5 short-circuit included placement of bales of cattail across the short-circuit channel, degradation of the berm along outflow canal and planting of bulrush. FAV has established upstream of cattail bales. Bulrush was planted in the Cell 7 short-circuit. **Science Plan** could include qualitative evaluation of these bio-enhancements to document effectiveness, including trying to document improved conditions when an obvious short-circuit is reduced by increased cattail coverage in a short-circuit route.
Cell 5 Poor treatment performance	**Science Plan** could include studies to investigate the factors causing poor treatment performance. Could the high soil TP content be impacting this cell's treatment performance? **Science Plan** could include studies on the impacts of internal loading (soil TP) on treatment performance.
Cell 6 High velocities at inflow structures impacting vegetation	Energy dissipating riprap is included in the design of each structure repair as part of the ongoing USACE culvert repairs. Increase compartmentalization with emergent vegetation. Monitor and adaptively manage bulrush plantings and cattail recruitment.
Central longitudinal berm affects distribution of inflows from Cells 5 & 7	Investigate degrading berm (old farm road) to reduce impact on flow distribution. Could degrade partially to allow berm to serve as vegetation strip.
Hydrilla die-off/ Hydrilla Control	This cell has high percentage Hydrilla cover.
Cell 7 Topographic deficiencies resulting in deep water conditions and floating cattail tussocks	District has indicated that the topography needs to be fixed to provide depth conditions conducive to cattail sustainability. Until USACE fixes the topography, consider converting this cell to mixed marsh (SAV and EAV). Vegetation Management has ongoing bulrush planting in deep areas as interim measures to improve conditions. Also, in the interim until USACE fixes the topography, **Science Plan** can include studies to evaluate / document the impact of deep water on cattail sustainability and water quality performance. **Science Plan** can also include studies regarding the STA-1E EAV cell soil characteristics and potential impacts on cattail sustainability.
Central Flow-way	
Cells 4N & 4S SAV sustainability	Bulrush planting and increase compartmentalization in Cell 4S. Ongoing sculpting of the vegetation strips to maintain majority SAV. **Science Plan** could include evaluation of the potential impacts of S-361 inflows on Cell 4S performance, an SAV cell. Also, since S-361 contains runoff mixed with seepage, concentrations may be higher than desirable for optimal SAV performance. A potential improvement might be to plant a small zone of emergents (bulrush) in the SAV located immediately downstream of the S-361 pump station.
High velocities at inflow structures impacting vegetation	Energy dissipating riprap is included in the design of each structure repair as part of the ongoing USACE culvert repairs.

Issues	Potential Actions
<u>Cell 3</u> Hydraulic short-circuiting	Minor bulrush planting effort was implemented several years ago in short-circuit along west side of cell. Future potential strategy includes additional bulrush planting to further address this short-circuit. **Science Plan** could include qualitative evaluation of these bio-enhancements to document effectiveness, including trying to document improved conditions when an obvious short-circuit is reduced by increased cattail coverage in a short-circuit route.
Eastern Flow-way	
<u>Cell 2</u> PSTA demonstration project	Historically, this project restricted operations and prevented optimal distribution of flows and P loads among flow ways. The project has ended, however the infrastructure largely remains; a 500-foot cut in one of the PSTA project levees was made in 2012 to allow additional flow capacity through the flow-way, however until the remaining features are removed, full treatment capacity of the flow-way and conversion of this cell to SAV is impacted. Current schedule for removal of PSTA project: by or before May 31, 2013.

Issues	Potential Actions
Entire STA	
High hydraulic and nutrient loading	This has been chronic situation for STA-1W hence the inclusion of STA-1W expansion and FEB in the Restoration Strategies. In the mean time, we will continue to try to optimize distribution of flows and loads from S-5A basin to STA-1E (to take some of the load off STA-1W) within the constraints of the USACE corrective actions in STA-1E.
STA Topographic Surveys	This information is used to monitor if topography changes over time (as a result of various causes), and if target stages need to be revised to ensure optimal water depths for vegetation health. This data is also used to develop and update STA hydraulic models. In 2010, four of the six STAs were re-surveyed (STA-1W, STA-2, STA-5 and STA-6). The 2010 topographic survey data was used to evaluate if changes to target stages were needed and changes to target stages in some cells were recommended and implemented in 2012. STA-3/4 was last surveyed in 2008 and we may want to consider resurveying it in 2013 (5 years since last survey). **Science Plan** may need to address the current recommended resurveying frequency of 5 years, as well as the number of data points collected (current recommendation is 500' x 1000' grid pattern).
USACE Corrective Actions in STA-1E restrict distribution of flows and loads from S5A basin	The USACE currently has repair work under way in STA-1E and more work is scheduled to occur into 2013. District will continue to coordinate with USACE to maintain operational flexibility between STA-1W and STA-1E within the constraints of the USACE repair work.
STA Modeling Activities	We need to review various past modeling efforts to determine if we need to refine modeling parameters through controlled studies. If controlled studies are found to be needed, **Science Plan** may include activities to gather the information needed for the modeling effort. Topics discussed included: Should we use Lake water (by obtaining regulation schedule deviation from USACE) to see how an STA responds in a more controlled way to a particular flow event. In lieu of subjecting an entire STA or flow-way to this additional Lake water, should we do some flow tests in the test cells? If decision is to use an entire STA or flow-way, suggest using STA-3/4 instead as it is generally performing better and vegetation is healthier compared to STA-1W current condition.

Issues	Potential Actions
EAV & SAV Performance Optimization	Need to investigate ways to further improve the performance of EAV and SAV cells. Need to review results from current mixed-vegetation studies in the STA-1W mesocosms. **Science Plan** could include pilot study to evaluate feasibility of establishing mixed community of *naiad, chara*, and other SAV. **Science Plan** could also include a pilot study to plant sawgrass and/ or water lilies at downstream end of SAV cells such as Cells 3, 4 and 5B, then monitor performance compared to other SAV cells. **Science Plan** may also include a study (or field test) on the feasibility of establishing sawgrass in cattail cells. Also does dominance of *chara* in SAV Cells create a vulnerable condition? *Chara* can “crash” thereby leaving little to no treatment capability after the crash. One proposed solution has been to increase compartmentalization and to provide **functional redundancy**. This can be done by allowing cattails to grow in portions of an SAV cell, but need to manage cattail expansion to maintain optimal cover of SAV. STA-3/4 Cell 3B, one of the best performing cells, is a mixed-marsh SAV cell with large cattail vegetation strips. **Science Plan** may need study to determine: What is the “optimal” split between EAV and SAV in a mixed marsh treatment cell? Is there a need to promote diversity of vegetation using inoculation program?
STA Inflow and Outflow Pumping Strategies	Is there an optimal flow regime for STA-1W that is needed but can’t be achieved with the current S-5A pump station configuration and pump sizes? Also, S-5A pumps are not flow adjustable. Should we retrofit this pump station to allow smaller pumping rates when upstream flooding is minimal, or to be able to run smaller pumps 24 hours a day versus 8- hour days? Should the **Science Plan** include a study to determine if there is a treatment benefit of 24-hour pumping versus 8-hour days? Note that this issue needs to consider S-5A pump station’s flood protection role.
Inflow and Outflow Canal Sediment Dredging	Canal sediment dredging could have long-term O&M implications, i.e., if (and where) canal sediment is found to be a contributing source of TP, may need to have an on-going canal sediment monitoring and maintenance dredging program, and would need to consider disposal methods and costs. An **Engineering Design** question that might be considered if canal dredging is found to be needed as part of an ongoing maintenance program: Should we evaluate canal lining that would make it easier to dredge when needed? What are the costs associated with canal lining, for example, per mile cost? What is the cost-effective length, i.e., some “x” distance closest to the discharge structure? Alternatively, could or should sediment traps be designed just upstream of discharge structures to allow settling and easier dredging, example, the sediment trap recently completed along the C-51 canal that discharges to the Lake Worth Lagoon. **Science Plan** could include review of existing STA water quality data as a first step to determine candidate locations for further study followed by implementation of canal sediment study in areas of potential concern. This effort would benefit from a review old dredging scopes of work and canal sediment studies.
STA Sediment Stability	**Science Plan** could include pilot studies to address ongoing concerns about the stability of the accrued sediment layer in the STA treatment cells. Pilot studies could include deep and/or shallow disking as cheaper alternatives to scraping the accrued layer and hauling away.

Issues	Potential Actions
STA Sediment Capping	**Science Plan** could include pilot studies to address the feasibility of capping muck in STA-1W in lieu of scraping to remove the high TP content (with flux potential) layer. This issue is more specific to STA-1W where the muck layer is much thicker than in STA-2 and STA-3/4. Pilot study might involve testing the appropriate depth of scraping and backfilling with limerock; determining how much settling occurs from the weight of the rock on the muck layer, and determining the thickness of the rock layer to effectively separate the muck layer from interacting with the water column. Test location(s) would likely be focused near the downstream ends of flow-ways.
Seepage Canals/Sub-Surface "Treatment"/Levee "Treatment"	We have limited recent seepage information for the STAs. Some previous focused seepage studies were conducted but more recent and STA-specific data is not currently available. We have wells in the STA-3/4 PSTA project levees where we are currently collecting seepage information (stages and water quality). STA-1W current seepage studies may be needed. **Science Plan** could include studies to evaluate the potential benefit of using seepage flows through STA exterior levees to achieve low-flow, subsurface flows and additional TP removal. (Walter Wilcox is the contact person for this item).
FEB Optimization	**Science Plan** could include studies on optimizing performance of the FEB, such as: 1. Feasibility and benefits of managing vegetation for optimal treatment. L-8 reservoir//FEB will be much deeper compared to the A1 FEB (approx. 4 feet deep). For L-8 may want to look at floating aquatic vegetation (FAV) while A1 FEB may want to look at EAV? 2. Chemical treatment could be potentially used to address first flush and/or large storms.
Eastern Flow-way	
Topographic issues	High elevations along the eastern side of the flow-way, i.e., highly uneven topography creates short-circuiting, water depth issues and reduced effective treatment area. A suggestion was made to scrape the excess material from the high areas in the Eastern flow-way and fill in low areas in STA-1W (e.g. Cell 5A).
Cell 1A Deep water impacts on cattail	Extended periods of higher than optimal water depths causing damage/die-off of cattail. This is partially due to way G-303 flows are conveyed through Cell 1A to G-255, the inflow to the Western flow-way. This is also due to the uneven topography and difficulty in achieving an optimal target stage to maximize effective treatment area (an issue common to the entire Eastern flow-way). One proposed solution has been to try to establish vegetation (bulrush) that can potentially tolerate extended periods of high water depths. Could consider dry season stage manipulations to encourage colonization of emergent vegetation. Is this flow-way a candidate for re-engineering or re-plumbing, i.e., reconfigure conveyance route to G-255. **Science Plan** needs to include study to evaluate the effects of "deep water" conditions on cattail cells, for example, is 2' deep (or more) all year round harmful to cattail (similar issue in STA-3/4).

Issues	Potential Actions
Cell 3 Canal Plug and Short-circuiting Issues	This issue related to hydraulic short-circuiting and impacts on performance. In 2011, a plug was installed in the canal along the western levee (that runs from G-308 to G-251) to reduce short-circuiting that was thought to be reducing treatment performance. Now that the plug has been in place for almost a year, we need to evaluate it. Note also that the finger canals were installed to convey water to the outflow pump station G-251; need to be able to show that the design flows can be conveyed through the eastern flow-way if the finger canals are eliminated. Should **Science Plan** include evaluation of this flowway in current condition and determine alternatives to improving hydraulics? The uneven topography in this cell likely exacerbates the short-circuiting situation. Ideally, the topography can be fixed.
G-251 Pump Station Trash Rake	Refurbishment of G-251 pump station trash rake is currently under way and is scheduled to be complete by end of 2012. Until this work is complete, flow through the Eastern flow-way is limited.
Western Flow-way	
Cell 2B SAV Performance Optimization	Does dominance of *chara* in this cell create a vulnerable condition? *Chara* can "crash" thereby leaving little to no treatment capability. One proposed solution has been to increase compartmentalization and to provide functional redundancy. This can be done by allowing cattails to grow in portions of an SAV cell, but will need to manage cattail expansion to maintain optimal cover of SAV. STA-3/4 Cell 3B, one of the best performing cells, is a mixed-marsh SAV cell with large cattail vegetation strips. **Science Plan** may need study to determine: What is the "optimal" split between EAV and SAV in a mixed-marsh treatment cell? Is there a need to promote diversity of SAV using inoculation program? **Science Plan** could also include pilot study to evaluate feasibility of establishing mixed community of *naiad, chara*, and other SAV, including potential study on behavioral characteristics of *chara* and diversity of vegetation.
Cell 2A Topographic issues	Hydraulic short-circuit along the eastern side of the cell, likely due to borrow canal and location of inflow structure (G-255) along far east side of cell. One proposed solution has been to try to implement bio-solutions such as installing cattail bails and earthen plugs in areas of obvious short-circuiting. Visual observations of pre- and post-installation can show if vegetation coverage has increased, thereby implying that the bails or plugs helped. **Science Plan** could include further evaluation of contribution from borrow canal versus inflow structure location (G-255) and/or both. Also could include effort to try to determine effectiveness of bio-solutions, like cattail bails and/or earthen plugs. Part of the long-term solution is the FEB which is intended to reduce or minimize the frequency and duration of peak flows in the STAs, thereby reducing deep water impacts on vegetation. **Science Plan** may also include a study to try to determine if there is a hydraulic loading rate that exacerbates the short-circuiting in this cell. Answers to this question could help with operations relating to the FEB.
Cell Layout and Flow Patterns	Should we look at re-plumbing and/or structural changes for performance improvements and/or operational flexibility? Is there potential benefit to adding structures and plumbing to allow movement of water from Cell 5B to Cell 2A? It could provide greater operational flexibility, but would need to evaluate feasibility and potential improved treatment performance. This could be a potential study under the **Science Plan**. Other options might include re-plumbing the connection between G-303 and the Western Flow-way (G-255).

Issues	Potential Actions
Northern Flow-way	
Cell 5A Deep water impacts on cattail	Deep water conditions and open water areas with no vegetation especially in the northeastern portion of cell; cattail coverage is poor with chronic cattail die-off in this cell. For the long-term, the FEB is intended to reduce or minimize the frequency and duration of peak flows in the STAs, thereby reducing deep water impacts on vegetation. **Science Plan** could address questions such as: Should we continue to try to establish vegetation (bulrush) that can tolerate high water depths? Should we implement dry season stage manipulations to facilitate planting and establishment of vegetation? Should we implement the long-term fix by filling the deep areas and grading the topography?
Hydraulic short-circuits	Hydraulic short-circuit along north portion of cell, i.e., water that goes through the G-304s encounters a berm (located immediately to the west of the G-304s), then re-directs to the deep areas in the northeast portion of the cell. **Science Plan** could address questions such as: Should we place cuts in the berm west of the G-304s, or should we remove the entire berm?
Cell 5B Hydrilla die-off/ Hydrilla Control	This cell has large Hydrilla cover however, there is ongoing concern that Hydrilla is not the optimal SAV in the STAs because it can top out and crash like *chara*. Strategy is to continue to monitor re-growth of Hydrilla, and potentially increase compartmentalization to provide functional redundancy (by lowering dry season stages to accommodate planting and establishment of emergent vegetation). **Science Plan** may need to tap into Hydrilla research work that is being done by Dr. Haller (UF) in the test cells and other areas.
Hydraulic short-circuits	Hydraulic short-circuits through old farm ditches parallel to flow and along northeast corner of cell appear to be impacting SAV growth. **Science Plan** may help address whether to implement long-term topography fix (fill ditches) or implement bio-solutions (cattail bails) and/or construction of earthen plugs.

Issues	Potential Actions
Entire STA	
High hydraulic and nutrient loading	STA-2 has recently performed very well, however it is expected that further improvement in performance can be achieved. One factor that may improve STA-2 performance is a reduction in the flows and loads to the original Cells 1-3. The key proposed strategy to reduce loading to STA-2 is the Compartment B expansion. The A1 FEB in the Restoration Strategies effort will also provide opportunities for improving performance of the new STA-2/Compartment B complex. In the mean time, we will continue to monitor flows and loads to the various flow-ways, and try to optimize and balance the distribution of flows and loads among the internal flow-ways when possible. **Science Plan** could include evaluation of how to best utilize FEB and Compartment B to balance flows and loads to entire STA-2 complex.
Inflow and Outflow Canal Sediment Dredging	This is an issue that could apply to STA inflow canals where there is a long canal between the inflow compliance site and the inflow structures to the individual treatment cells, and there appears to be an increase in phosphorus concentration occurring along the canal. Example is the TP concentrations at the S-6 pump station are lower than the TP concentrations at the individual inflow structures for STA-2 Cells 1 - 3. This would lead us to think the inflow canal may be serving as an internal source of TP to the STA. This issue can also apply to STA discharge canals, in which individual treatment cells are performing well but as the discharges travel along the discharge canal, the water may be picking up phosphorus before the water enters the compliance discharge structure. Prior inflow canal sediment studies have been conducted, and in the case of STA-5, the results pointed toward a dredging project which was then implemented in 2008. STA-5 inflow TP concentrations since that time have generally improved but it is not known for certain how much of the improvement was due to the sediment dredging, and how much may have been due to improvements in C-139 Basin BMPs or other factors. Intuitively, it would appear that the canal sediment removal was beneficial. This question could have long-term O&M implications, i.e., if (and where) canal sediment is found to be a contributing source of TP, may need to have an on-going canal sediment monitoring and maintenance dredging program, and would need to consider disposal methods and costs. An **Engineering Design** question that might be considered if canal dredging is found to be needed as part of an ongoing maintenance program: Should we evaluate canal lining that would make it easier to dredge when needed? What are the costs associated with canal lining, for example, per mile cost? What is the cost-effective length, i.e., some “x” distance closest to the discharge structure? Alternatively, could or should sediment traps be designed just upstream of discharge structures to allow settling and easier dredging, example, the sediment trap recently completed along the C-51 canal that discharges to the Lake Worth Lagoon. **Science Plan** could include review of existing STA water quality data as a first step to determine candidate locations for further study followed by implementation of canal sediment study in areas of potential concern. This effort would benefit from a review old dredging scopes of work and canal sediment studies.

Issues	Potential Actions
STA Topographic Surveys	This information is used to monitor if topography changes over time (as a result of various causes), and if target stages need to be revised to ensure optimal water depths for vegetation health. This data is also used to develop and update STA hydraulic models. In 2010, four of the six STAs were re-surveyed (STA-1W, STA-2, STA-5 and STA-6). The 2010 topographic survey data was used to evaluate if changes to target stages were needed and changes to target stages in some cells were recommended and implemented in 2012. STA-3/4 was last surveyed in 2008 and we may want to consider resurveying it in 2013 (5 years since last survey). **Science Plan** may need to address the current recommended resurveying frequency of 5 years, as well as the number of data points collected (current recommendation is 500' x 1000' grid pattern).
Structure Designs and Water Quality	This issue relates to questions about the potential negative water quality impacts of certain structure designs; i.e., do some structures have flow patterns that can have an impact on water quality? For example, some structures may produce more turbid flows than others. Also, do gated spillways and gated culverts that flow "from the bottom" allow sediments to easily suspend and mix in the water column compared to overflow weirs that "flow over the top"? How effective are double-leafed gates at addressing this concern? Several double-leafed gates were installed in the STA-5/6 expansion area in 2006. Do we know if these structures are operating as intended? Are the operators able to achieve the intended flow conditions (ease of operation?) Do these types of structures require ongoing maintenance dredging immediately upstream to remove accumulated sediments to avoid future discharge when both gates are opened in response to high flow events? **Science Plan** could have a pilot scale side-by-side study of two (or more) different types of STA structures to see if we can determine the water quality impact of one versus another.
Cell Layout and Flow Patterns	This is a TOTBOX "thinking outside the box" concept. The topography of STA-2 Cells 1-3 is such that a better flow pattern might be to flow from east to west –as opposed to current pattern of north to south – i.e., more along the natural gradient. **Engineering Design** group could evaluate cost and feasibility to retrofit the STA for east to west flow pattern.
Polishing Cell Design	**Science Plan** could include pilot scale implementation of various "polishing cell" designs. This is proposed in support of the hypothesis that slow shallow flows at the downstream end of an STA might further improve STA outflow performance by breaking down the remaining organic material.

Issues	Potential Actions
Cell 1/Flow-way 1	
<u>Cell 1</u> Prone to Dry-out	Cell 1 is more prone to dry-out in comparison to Cells 2 and 3 for various reasons, such as the stair-stepped topography that exists going from east (Cell 1) to west (Cell 3), the corresponding differences in target stages across the three cells, and the resulting seepage gradient. The average ground elevation of Cell 1 is 12.0' NGVD, Cell 2 is 10.5' NGVD, and Cell 3 is 9.5' NGVD. Also, during dry periods, when supplemental water deliveries are being made to STA-2, it is harder to convey water into Cell 1 compared to Cells 2 and 3 especially when stages in the STA cells and canals are low. A potential engineering analysis might address the hydraulics along the STA-2 inflow canal and ways to improve the ability to flow water into the cell during dry periods (or potential forward pumps). The extent and duration of dry-out can impact the ability to achieve the effluent limit. This is a potential subject of study under the **Science Plan**. Another potential study might try to determine the role seepage plays in this cell's performance, i.e., this cell discharges quite a bit less water than it receives via the inflow structures. And yet another study might be to try to determine the role that carbon (since this area was previously inhabited with numerous upland trees) plays in the performance of this cell.
One of best performing STA cells	Cell 1 is one of the best performing cells among all the STAs. One suggested reason is that this cell was never farmed, and it is not know if the performance of this cell can be duplicated in other treatment cells with previously farmed muck soils. The **Science Plan** can include studies to address these types of questions. Since first becoming operational, this cell has developed more cattail over time and has produced accrued sediment with high P content (compared to the Pre-STA condition). Other questions include: Are there other factors besides the unfarmed soil that are contributing to the good performance? Are the outflow weirs contributing in any way to the very low outflow TP concentrations?
Cell 2/Flow-way 2	
<u>Cell 2</u> Hydraulic Short-Circuiting	This cell has several obvious hydraulic short-circuits, such as the borrow canal along the east side of the cell, a berm downstream of the inflow structures, and a 500-acre deep area in the NW corner of the cell. As part of the original STA-2 design and construction, the borrow canal was plugged at regular interval, however, many years of operational experience and field observations have shown that the plugs have eroded and are not effectively reducing the short-circuiting. Another feature in Cell 2 that contributes to non-uniform hydraulics and problems maintaining the target emergent vegetation is a 500-acre area in the NW corner of the cell that about 2' deeper than the rest of the cell and is generally filled with Hydrilla (see Hydrilla and FAV issues below). Another feature that contributes to short-circuiting is the berm downstream of the eastern inflow structures; inflows to the cell are channeled through constricted gaps in this berm. Previous enhancement proposals that have been considered and warrant additional consideration and/or **engineering analysis** include filling the 500-acre deep area in the NW corner, degrading the berm downstream of the inflow structures, modifying (fortifying) the N-S berm that runs along the east side of the 500-acre deep area, and filling the borrow canal along the east side of the cell.

Issues	Potential Actions
Hydrilla die-off/ Hydrilla Control	The NW corner (500-acre area) of this cell is predominantly Hydrilla however, there is ongoing concern that Hydrilla is not the optimal SAV in the STAs because it can top out and crash like *chara*. Ideally this area could be filled to bring the bottom elevation up to the same level as the rest of the cell; however other less expensive options such as encouraging alternative vegetation communities (e.g. bulrush) could be evaluated. Field observations suggest that the soil thickness in this area is very shallow compared to other areas that we have planted. If so, it could be problematic to establish and sustain emergent plant (root systems, etc) in such shallow soil. **Science Plan** could include collection of more detailed soil depth information in this area, if the strategy for this area includes an attempt to establish emergents. The **Science Plan** may need to tap into Hydrilla research work that is being done by Dr. Haller (UF) in the test cells and other areas. Another potential enhancement that might be beneficial if this low area does not get filled would be to isolate the area along eastern side with a north-south berm – so flows would not go west into this deep area.
FAV Performance	This is an STA-wide issue. Once FAV (water lettuce, water hyacinth) gets established in a treatment cell, it can be very difficult to eradicate. It is not currently known if FAV provides any sustainable treatment (or if harvesting is needed to result in net TP removal). One long-standing issue is disposal of the harvested material. Currently there is no market for the material. FAV could also have negative impacts on performance by crowding or out-competing adjacent desirable vegetation. S**cience Plan** may need to include evaluation of the pros/cons of allowing FAV to colonize the open water areas in emergent cells. Need to monitor potential impacts on adjacent stands of cattail.
Conversion of southern half of cell from EAV to SAV	As part of the Long-Term Plan, the southern portion of this cell is undergoing a conversion from EAV to SAV. Current efforts include continuing to monitor success of aerial inoculations in establishing SAV and manage re-growth of emergent vegetation to maintain functional redundancy. Another proposed action is to increase this cell's target stage during the dry season to sustain SAV beds. **Science Plan** could include studies to determine the optimal mix of EAV and SAV along the treatment train, as well as the acceptable percentage of EAV in an SAV cell (mixed marsh) that provides optimal treatment performance with functional redundancy. FY2013 includes funding for conversion of additional 300 acres from EAV to SAV. **Science Plan** could include input on this proposed additional conversion.
Cell 3/Flow-way 3	
Cell 3 Hydrilla die-off/ Hydrilla Control	The northern portion of this cell is predominantly Hydrilla; there is ongoing concern that Hydrilla is not the optimal SAV in the STAs because it can top out and crash like *chara*. Proposed strategies include providing functional redundancy. **Science Plan** may need to tap into Hydrilla research work that is being done by Dr. Haller (UF) in the test cells and other areas.
Compartmentalization with Vegetation Strips	FY2013 funding is available for bulrush planting to create north-south vegetation strips and add further compartmentalization to protect existing desirable SAV. **Science Plan** could include evaluation and documentation of the bulrush planting effort.

Issues	Potential Actions
Outflow P consists primarily of fractions (particulate and dissolved organic) that cannot be removed by existing uptake mechanisms	**Science Plan** could include studies to evaluate effectiveness, value and feasibility of introducing plant species that are capable of removing particulate and dissolved organic phosphorus (STA-1W Mesocosms studies). **Science Plan** could include pilot study to plant sawgrass at downstream end of this SAV cell. Note, Cell 3 already has some water lilies.
Flow-ways 4 and 5 (Compartment B)	
Topographic Data	Evaluate topographic data for Compartment B; develop Digital Elevation Models and stage-area/stage-volume relationships for North and South Build-outs.
Vegetation	Conduct preliminary vegetation surveys. Plan and implement startup management measures (e.g., herbicide treatments, fire) to prepare cells for establishing target plant community. Currently in initial phases of SAV conversion and creation of “checkerboard” vegetation strips in the North Build-out SAV areas including Cell 4. Need to develop and evaluate vegetation composition options for South Build-out.

Issues	Potential Actions
Entire STA	
Lake Okeechobee Regulatory Releases	STA-3/4 is the current intended recipient of Lake Okeechobee Regulatory Releases; however, the available capacity in STA-3/4 to treat Lake O Regulatory Releases has decreased over the years for a variety of reasons. The current assumptions about the amount of Lake O Regulatory Releases that can be treated in STA-3/4 on an average annual basis will be based on the assumptions used during the Restoration Strategies modeling (i.e., contact Jeremy or Walter.) The **Science Plan** may include a study to evaluate impacts of treating Lake Okeechobee Regulatory Releases in STA-3/4 (similar to the project on this same issue in the Long-Term Plan). Notes: 1. This does not refer to additional Lake Okeechobee releases referred to as “restoration” or “increased environmental flows” to the Everglades/WCAs which are part of the Central Everglades Planning Process (CEPP). 2. This does not refer to the delivery of Lake Okeechobee supplemental water to the STAs to maintain minimum stages during dry periods.
G-383 Divide Structure	Evaluate potential changes to the G-383 divide structure located in the STA-3/4 inflow canal such as increased capacity (or removal) to (1) improve operational flexibility in the immediate future and (2) allow optimization of a future connected A1 FEB and STA-3/4. **Science Plan** may include an evaluation (and/or modeling) of this issue. This issue needs to be addressed sooner rather than later because it can impact the design of the gravity structures that will deliver water from the A1 FEB to STA-3/4.
Deep water impacts on cattail	The long-term solution is the FEB which is intended to reduce or minimize the frequency and duration of peak flows in the STAs, and thereby reducing deep water impacts on vegetation. **Science Plan** should include studies to define criteria on depth and duration of water levels on emergent cells to avoid substantial damage – how deep is too deep and how long is too long – what are the signs of damage or loss? This relates to language in the new permits (i.e., diversion to prevent substantial damage to the treatment system.) Coordinate with the sub-team working on the write-up defining substantial damage to STA treatment vegetation.
Hydraulic short-circuits/Flow distribution	The emergent cells (in particular Cells 1A and 2A) have areas of obvious short-circuiting routes downstream of the inflow culverts. One question that was discussed: Is there a better way to deliver inflows to the cattail cells compared to the current design consisting of box culverts and a spreader canal? For example would a sinusoidal shaped broad-crested weir help spread out the flows in more even flow pattern, thereby minimizing short-circuiting? Also, see above regarding Science Plan questions relating to the benefits of bulrush planting and bio-solutions to reduce short-circuiting.

Issues	Potential Actions
STA Topographic Surveys	This information is used to monitor if topography changes over time (as a result of various causes), and if target stages need to be revised to ensure optimal water depths for vegetation health. This data is also used to develop and update STA hydraulic models. In 2010, four of the six STAs were re-surveyed (STA-1W, STA-2, STA-5 and STA-6). STA-3/4 was last surveyed in 2008 and we may want to consider resurveying it in 2013 (5 years since last survey). **Science Plan** may need to address the current recommended resurveying frequency of 5 years, as well as the number of data points collected (current recommendation is 500' x 1000' grid pattern).
SAV Forward Pumps	The existing forward pumps between the emergent cells and SAV cells may be undersized and operational challenges exist at times. Additional pump capacity may be needed for drawdown of emergent cells and hydration of SAV cells during dry periods. Need to determine the appropriate additional pump capacity for the forward pumps, as well as optimal locations within cells, i.e., mid-levee and/or near northern portions of EAV cells.
SAV Performance Optimization	Need to investigate ways to further improve the performance of SAV cells. Need to review results from current mixed-vegetation studies in the STA-1W mesocosms. **Science Plan** could include pilot study to evaluate feasibility of establishing mixed community of *naiad, chara*, and other SAV. **Science Plan** could also include a pilot study to plant sawgrass and/ or water lilies at downstream end of SAV then monitor performance compared to other SAV cells. Also does dominance of *chara* in SAV Cells create a vulnerable condition? *Chara* can "crash" thereby leaving little to no treatment capability after the crash. One proposed solution has been to increase compartmentalization and to provide **functional redundancy**. This can be done by allowing cattails to grow in portions of an SAV cell, but need to manage cattail expansion to maintain optimal cover of SAV. STA-3/4 Cell 3B, one of the best performing cells, is a mixed-marsh SAV cell with large cattail vegetation strips. **Science Plan** may need study to determine: What is the "optimal" split between EAV and SAV in a mixed marsh treatment cell? Is there a need to promote diversity of vegetation using inoculation program?
FAV Performance	Need to evaluate the pros/cons of allowing FAV to colonize the open water areas in emergent cells.
STA Inflow and Outflow Pumping Strategies	Should the **Science Plan** include a study to determine if there is a treatment benefit of 24-hour pumping versus 8-hour shifts?
Optimal Flow Rates and Depths	**Science Plan** can include studies to determine if better treatment performance achieved by managing to achieve a target stage (between flow events) or is a constant shallow flow better for treatment performance?
STA Modeling Activities	Can a coupled 2D and water quality model be developed quickly enough to help us predict what we need to do to get from 20 ppb to 10 ppb? Models depend on knowledge of the system and need to know the process trying to be simulated. Work that is going to be completed as part of the **Science Plan** may help. May need to conduct research to get the parameters for the model(s).

Issues	Potential Actions
Lab Analytical Methods	A suggestion was made about the potential to have the lab conduct analyses to obtain a more direct measurement of the different forms of particulate phosphorus (PP) and organic P at the outflow, compared to the current lab method. This might tell us where we might better focus our efforts at removal at low P concentrations or this type of study might tells us if most or all of the remaining phosphorus can't be reduced. For example, use different filters and/or methods? This could be a potential **Science Plan** study.
STA inflow water quality/chemistry	Should the **Science Plan** include studies to answer questions about tailoring STA designs and/or operations based on the water source/basin? Should the FEB and/or STA designs include flexibility for blending/recirculation of water?
PSTA Feasibility Study	On the basis of the good performance to date of the PSTA cell, should **Science Plan** include (on parallel path with ongoing PSTA research) the start of a feasibility study to look at the potential construction of additional PSTA acreage in STA-3/4 downstream cells and the other STA downstream cells?
Eastern Flow-Way	
Cell 1A Deep water impacts on cattail	This cell has experienced chronic deep water conditions near the inflow structures and north portion of the cell, including open water areas and lack of vegetation. For this reason, two draw-downs were completed (2010 and 2011). Anecdotal/qualitative analysis suggests benefits were achieved. May need to include **Science Plan** studies to document success of periodic drawdown on vegetation health and sustainability. Also, see above regarding Science Plan questions relating to deep water impacts on cattail.
Hydraulic short-circuits	This cell has obvious short-circuiting routes downstream of the inflow culverts.
FAV Performance	This cell has FAV growing in pockets, i.e., in open water areas of the emergent vegetation. Need to continue to monitor condition and potentially implement control program if the FAV appears to become problematic.
Hydrilla die-off/ Hydrilla Control	Hydrilla beds near G-375 outflow structures. Focused herbicide treatments to prevent export to downstream SAV cell. Need to continue monitoring and apply herbicide as needed to reduce invasion.
Cell 1B Ongoing conversion to SAV	Cell 1B has been undergoing a gradual conversion to SAV since start-up. Need to continue to monitor establishment of SAV, and to consider adding compartmentalization with emergent vegetation to provide functional redundancy (similar to STA-3/4 Cell 3B).
Hydraulic short-circuits	Hydraulic short circuit in southwest portion of cell. Potential use of bio-solutions (cattail bails) or operational strategy - prioritize discharge from eastern structures (G-376A-D).

Issues	Potential Actions
Hydrilla Control	There is ongoing concern that Hydrilla is not the optimal SAV in the STAs because it can top out and crash like *chara*. Hydrilla beds in northern portion of cell. Focused herbicide treatments to prevent export to downstream SAV cell. Continual monitoring and apply herbicide as needed to reduce invasion.
Central Flow-Way	
Cell 2A Deep water impacts on cattail	This cell has experienced chronic deep water conditions near the inflow structures and north portion of the cell, including open water areas and lack of vegetation. May need to include **Science Plan** studies to document success of periodic drawdown on vegetation health and sustainability. Also, see above regarding Science Plan questions relating to deep water impacts on cattail.
Cell 2B Hydrilla Control	There is ongoing concern that Hydrilla is not the optimal SAV in the STAs because it can top out and crash like *chara*. Limited invasion of Hydrilla in this cell. Focused herbicide treatments to reduce invasion.
Western Flow-Way	
Cell 3A Cattail Density	Cattail in this cell is very healthy and has dense growth condition, but there is an unknown about whether or not the high density can become problematic down the road. Continue to monitor health and density looking for signs of decline. Should **Science Plan** include a study or pilot scale effort to look at potential management measures to reduce density if and when needed, e.g., fire or mechanical removal?
Cell 3B SAV Performance Optimization	This cell is a mixed marsh/SAV cell with vegetation strips therefore good functional redundancy. This is one of the best performing STA cells. **Science Plan** can include studies to try to understand what makes this cell perform so well compared to other mixed-marsh/SAV cells. Is this cell a good model for creating mixed marsh environment in other STA cells? Does dominance of *chara* in this SAV cell create a vulnerable condition?

Issues	Potential Actions
Entire STA-5	
Prone to dryout	C-139 Basin runoff is more “flashy” (temporally) in nature compared to EAA runoff. As a result, it has been very difficult to maintain target stages in STA-5 year round, especially in the emergent (A) cells which are prone to dryout. This has been a concern because inadequate water (during low flow or dry periods) makes it difficult to maintain optimum conditions for sustained P uptake, and dryout can lead to TP spikes upon re-hydration. The strategy has been to try to manage the distribution of inflows between the flow-ways to maintain treatment capability. Also, we generally have been able to keep the SAV cells (1B and 2B) at or above minimum stages by delivering supplemental water from the Miami Canal (via the STA-5 Discharge Canal) with pump station G-507. Additional STA acreage (Compartment C) will likely result in even more competition for dry season supplemental water; it is anticipated that maintaining minimum depths in the SAV cells in Compartment C will be problematic. Proposed **Engineering Analysis** of additional infrastructure (small pump stations?) to allow recirculation of water among the flow-ways of STA-5/6/Compartment C to try to minimize impacts of dryout. Potential **Science Plan** studies: Evaluate potential benefit of increasing dry season target stages to ensure continuous hydration, i.e., trying to conserve additional water going into the dry season. Evaluate operational strategies and/or structural improvements for the interim period (before the FEB is complete) to address the issue of limited availability of water for this STA complex. For example, some flow-ways could be prioritized to receive inflows and be used for flow-through treatment and some flow-ways could hold water (e.g. up to 2’ deep) but not discharge; this approach would need to include evaluation of trade-offs between holding back water and not discharging while ensuring adequate water is delivered to the downstream receiving areas. Also, could some EAA runoff be moved from east to west for delivery to the STA-5/6 inflow structures (ex. Manley ditch improvements)? Evaluation could also include options for new infrastructure (canals and pumps) to deliver S-4 Basin water and/or supplemental water from Lake Okeechobee i.e., along the L-1/L-2/L-3 canal (to augment current path along the Miami Canal and the STA-5 Discharge Canal).
Poor performance in early years, but good performance recently	In the early years, STA-5 outflow concentrations were typically the highest of the 6 STAs. Numerous factors were thought to have contributed to this condition including high inflow TP concentrations. More recent performance (e.g., past 2 years), performance has improved noticeably. This is thought to be the result of various factors, including reduced inflow concentrations, internal (LTP) enhancements, and rehabilitation efforts (slough filling, non-effective treatment area scraping) that were implemented between 2004-2009. Some efforts are continuing today such as vegetation plantings. Potential **Science Plan** efforts include continuing to determine and evaluate effectiveness of enhancements, and continuing to evaluate and implement operational/vegetation/structural enhancements to further improve performance. One example is to evaluate potential changes to target stages taking into account field observations and the results of 2010 topographic surveys.
Operations	We are currently in the early stages of starting to operate Compartment C STAs cells. We will need to integrate operation of the new Compartment C cells with STA- 5 and STA-6 to optimize distribution of flows and loads for maximum sustained P uptake especially in light of concerns about limited inflow water and above-described dryout issues.

Issues	Potential Actions
STA Topographic Surveys	This information is used to monitor if topography changes over time (as a result of various causes), and if target stages need to be revised to ensure optimal water depths for vegetation health. This data is also used to develop and update STA hydraulic models. In 2010, four of the six STAs were re-surveyed (STA-1W, STA-2, STA-5 and STA-6). The 2010 topographic survey data was used to evaluate if changes to target stages were needed and changes to target stages in some cells (but not STA-5, see above) were recommended and implemented in 2012. **Science Plan** may need to address the current recommended resurveying frequency of 5 years, as well as the number of data points collected (current recommendation is 500' x 1000' grid pattern).
Water Quality Monitoring Network	The design of STA-5/6 creates 20 distinct outflow points, the majority of which must be monitored to meet compliance with the current permit. Consequently, significant resources must be expended in order to maintain the highest possible quality water quality and quantity data at a very large number of stations. Alternatives to monitoring all of the discharge points should be explored and evaluated. Analysis should include the cost-benefits and risks of using surrogate stations, grab samples instead of autosamplers, suspending monitoring when a flow-way is not in use, or building new structures to use as compliance points in the discharge collection canal.
Wildlife Impacts on Operations	Snail kite nesting/usage has impacted operation of this STA (refer to "Wildlife" sub-team).
STA-5 Northern Flow-way	
<u>Cell 1A</u> Deep water impacts on cattail	In 2009, the non-effective treatment area (300 acres on far west end) of Cell 1A was scraped and the material was used to fill a portion of a remnant deep slough area that ran through the cell. This slough area was too deep to support cattail growth and was a short-circuit route. Time and money at that time did not allow filling of the entire slough. Since then, extensive bulrush plantings were done in the SE portion of the cell and have established well, and bulrush plantings upstream of the interior structures have done a good job of blocking FAV transport to the structure (also planted a row of bulrush immediately downstream in Cell 1B, which blocks anything that gets through the culverts). In the near term, potential performance improvement strategies include: Identify other deep areas in emergent cells and plant bulrush. Could also consider lowering dry season stages to provide favorable conditions for establishment of cattail seedlings. Potential **Science Plan** activities include: Monitor distribution of flow and P uptake along internal water quality transects during wet season to try to determine effects of the deep areas on treatment performance (difficult). Should we try to quantify the effects of filling the remnant slough on flow distribution and P uptake (difficult)?
Expansion of primrose willow	Vegetation management staff currently considering an aerial herbicide treatment. Annual dry-outs of these cells are problematic and will encourage continual colonization of primrose. May be use of limited resources to continually have to spray these areas.

Issues	Potential Actions
Cell 1B Hydrilla die-off/ Hydrilla Control	This does not appear to be a major issue currently. Field observations indicate that productivity of Hydrilla in these cells slows during the winter dry season and they are subjected to extensive herbivory by waterfowl. Historically Hydrilla was pervasive in this cell but more recent observations indicate a shift to more desirable SAV (partially as a result of the improved inflow TP concentrations). Recommend continued monitoring and application of herbicide as needed to reduce invasion. Evaluate new measures to manage or eliminate Hydrilla and establish more desirable SAV species. Efforts are underway to compartmentalize with more emergent vegetation strips to provide functional redundancy.
Gaps in emergent vegetation strips facilitate hydraulic short circuits.	Work has been underway to address this issue, including planting of emergent vegetation (cattail, bulrush and Thalia) to close gaps in May 2010 except for deep borrow canal adjacent south levee. Some gaps have already been filled, and recently Vegetation Management staff has requested the Clewiston Field Station to use excess fill from recent levee degradation at STA-6 Cell 5 to fill other gaps this dry season. Ideally, funding can be obtained to complete the filling of the remaining gaps.
STA-5 Central Flow-way	
Cell 2A Expansion of primrose willow	Vegetation management staff currently considering an aerial herbicide treatment. Annual dryouts of these cells are problematic and will encourage continual colonization of primrose. May be use of limited resources to continually have to spray these areas.
Wildlife Impacts on Operations	2 years ago, snail kite nesting impacted operation of this cell.
Cell 2B: Hydrilla die-off/ Hydrilla Control	This does not appear to be a major issue currently. Field observations indicate that productivity of Hydrilla in these cells slows during the winter dry season and they are subjected to extensive herbivory by waterfowl (see above for similar info as Cell 1B).
STA-5 Southern Flow-way	
Cell 3A: Topographic issues	Highly uneven topography, including very high elevations in western portion of the cell and short circuiting results in reduced effective treatment area. This area is slated for grading as part of the Restoration Strategies effort. Currently considering potential planting of this area either Oct-Nov 2012, or Mar-May 2013.
Cell 3B: SAV Optimization	A culvert (G-715) was recently installed between Cell 2B and 3B to assist in the delivery of supplemental water to this cell. Efforts are underway to encourage more SAV growth in this cell. Vegetation strips can add compartmentalization and functional redundancy similar to the vegetation strips in Cells 1B and 2B.

Issues	Potential Actions
Entire STA-6	
Prone to Dryout	Similar issues and recommendations as shown above for STA-5 regarding dryout. Note that historically STA-6 dried out many years (for approx 1-2 months?) and performance was good (15-20 ppb) however in the new design, STA-6 receives a new source of water (C-139 Basin) compared to the earlier times, and for various reasons, including Compartment C construction activities, STA-6 has experienced extended and severe dryouts (6 or more months) for the past several years that have significantly impacted outflow concentrations.
Operations	We are currently in the early stages of starting to operate Compartment C STAs cells. We will need to integrate operation of Compartment C with STA- 5 and STA-6 to optimize distribution of flows and loads for maximum sustained P uptake.
STA-6 Section 2	
Very deep unvegetated areas (borrow pits)	This is a relatively small percentage of the overall cell. Need to evaluate potential cost-benefit of filling these deep areas.
Hydrilla is primary SAV species present	Evaluate new measures to manage or eliminate hydrilla and establish more desirable SAV species.
Vegetation Conversion	Current plan is for this cell to be maintained as an SAV cell, however limited water availability makes achieving this goal extremely difficult. Need to evaluate potential interim vegetation strategy for this cell, while ensuring consistency with Restoration Strategies modeling work and assumptions.
STA-6 Cell 5	
Prone to Dryout	See above
STA-6 Cell 3	
Prone to Dryout	See above
Expansion of primrose willow	Use herbicide applications to control growth and expansion
Entire Compartment C	
Start-up Activities	Soil Cores collected in 2010; data loaded in ERDP and summarized in 2012 SFER. (Should **Science Plan** evaluate the current recommendation to have soil cores every 3 years?).
Topographic Data	Evaluate topographic data for Compartment C; develop Digital Elevation Models and stage-area/stage-volume relationships for new cells.
Vegetation	Conduct preliminary vegetation surveys. Plan and implement startup management measures (e.g., herbicide treatments, fire) to prepare cells for establishing target plant community.
Operations	Begin operating according to the new STA-5/6/Compartment C Operation Plan. In general, we will need to start operating these new areas in order to determine options for optimizing performance.