APPENDIX 4

Lake Okeechobee TMDL TAC meeting - 2/15/00
West Palm Beach, FL

- Opening – Jerry Brooks
  Introduction of TAC members
  - Karl Havens – District employee, Lake Okeechobee Research division, nutrient littoral zone studies
  - Curtis Pollman – Tetra Tech, sediment phosphorus interactions, atmospheric deposition
  - Tony Federico – McVicor, Federico & Lamb – involved in development of models, primary author for technical pub. 81-2
  - Bill Walker – Everglades and Lake Okeechobee research, research across the nation on limnology and nutrient dynamics
  - Clair Schelske –Fisheries and Aquatic Sciences at University of Florida, research on large lake systems
  - Remish Reddy – University of Florida Soil Sciences, soil and nutrient interactions
  - Arnold Silverman – University of Montana – Retired professor, worked on committees for National Sciences Foundation (NSF)
  - Jerry Brooks – Deputy Division Director, FDEP's Water Resource Management Division

- Administrative Stuff
  - Sunshine Law – Jennifer Fitzwater
    - Quick and dirty version details
    - Major stuff will be taken care of by department
    - All meetings of TAC must be noticed
    - Discussions between TAC members have to be done in public
    - Members cannot have discussions related TAC outside the public arena
    - Information will be exchanged through Kim Shugar.

  - Question by Dr. Gray – How were TAC members chosen?
    Response (Jerry) – Members were chosen because of literature citations and knowledge of Lake Okeechobee
- TMDL Process
  - Lake O TMDL development process. Jerry handed out summary language on 303(d), CWA and 403.067, Florida Statutes with 2-page summary.
    - Federal Process
      - Impaired waters have to be listed on 303(d) list
      - TMDL must be determined for pollutant which causes impairment
      - Allocation of loads to point & nonpoint sources or groups/catagories of discharges
    - Department Process
      - Impaired waters – require the department to develop a process for identifying "impaired waters"

        - TMDL – is the amount of a pollutant a water body can assimilate
        - Allocation – (8) in statute, shall consider those things that have occurred prior to act, etc.
        - TMDL shall include allocation in conjunction with other restoration activities, TMDL/water quality standards will be attained.
        - Separate allowable load in the absence of outside perturbations (i.e., sediments, etc.), then add those into the process so that can understand overall restoration course.
    - EPA proposed a TMDL for phosphorus in Lake Okeechobee on 12/31/99. State's position was that a better understanding is needed. EPA will begin a series of public meetings next month on their proposal. Jerry hopes these 2 efforts will come together.
    - Current federal regs do not require an implementation strategy. State law requires added things. ID waters, adopt water as impaired by rule. DEP establish a TMDL for these waters. On p. 3 of handout. Item 2. Process can be linked to PLRGs. "Amount of a pollutant a water body can assimilate." Allocation process, factors to consider. Under #8, where allocating the load, shall consider loads outside of FL, discharges that have ceased. Sediments have considerable TP loads. Another difference, the TMDL shall include allocate, to consider together along with other restoration efforts. For example, sediment removal. Under state law, we are allowed to do more than focus on a number, but to look at other management strategies. Need to determine available level of control for each activity. Need to develop a restoration plan. Regulatory and non-regulatory. Some public works projects be part of the solution. Maybe some sediment removal from the lake.

- Approach to Lake Okeechobee phosphorus(TP) TMDL – Look at factors that must be considered. Legacy pollutants in the watershed. Resuspension of phosphorus is an issue. Changing lake levels. Phosphorus chemistry in the lake is complex. First, try to take out some of the factors that add to complexity. Start with establishing a baseline condition. Try to identify sediment conditions absent the perturbations that have occurred in the lake in the last 75 years. What it would have been like absent all the water flow alterations? What would the TP dynamics be under these conditions? Then, model to establish water level of TP loading could occur without causing impairment. Will need to define some endpoints to gage lake health. One could be water column TP concentrations that will allow lake to not have excessive algal levels. 40 ppb has been the number suggested. May consider invertebrate populations. Currently, may only have enough info to develop a solid link between TP and algal populations. Are the other links there? Recognize that there are complicating factors (sediments/legacy pollutants) that have resulted in an increased rate of degradation in the lake. Not a complete understanding of factors including lake stage and sediments. To determine specific variables that control phosphorus cycling of need to remove outside influences. Can we make a reasonable estimation of what would be the sediments and phosphorus without features (CSF, regulation schedule, etc.)

    - Karl Havens Why determine allowable load without sediments.
    - Jerry Brooks will try to address that later. Establishment of a baseline condition – what is the optimal stage and what would be the phosphorus dynamics at that time? Try to establish what level of phosphorus could occur without causing "impairment."

- Curt Pollman What is the endpoint? Is it sediment phosphorus content? Or water column phosphorus concentrations.
- Jerry Brooks Discussion of endpoints. Is it 40 ppb? Should we be looking at invertebrate populations? Jerry feels that algal dynamics should be used as endpoint.
- Karl Havens provided a handout on paper coming out that identifies that historical condition of the lake.
- Jerry Brooks summarized. ID TP level w/o impairment under those baseline conditions. Then look at the effects of lake stage on the TP dynamics. Specify the internal contribution versus the external loads. Allow decisions makers to assess the role of the external sources and what can be done. Look at the feasibility of reducing the external loads. Need understanding of variables that control the processes.
- Curt Pollman agrees that it is good to break out the sediments, but need to add back in once steady state is defined. The rate of response of the system is tied to sediment flux. While working on the TMDL for mercury for Everglades, it may take 100 years to reach steady state. Society will have to decide rate of progress that is satisfactory.
- Jerry Brooks EPA had to do this for their TP TMDL as well. Had to pick a time frame for restoration. At some point, we may want the TAC to look at EPA's TMDL. One of the problems with EPA's approach is the validity of the model to predict into the future. Did not have TAC look at strengths and weaknesses at this meeting.

EPA handed out a public notice for their Lake Okeechobee TMDL public meeting on March 2. They also provided their website for anyone who would like to look at their TMDL. The address is http://www.epa.gov/region4/water/tmdl/florida/lake_o/index.htm

- Karl Havens Chapter of upcoming publication trying to look preconditions.
- Claire Schelske Will need to look at historic inputs at some point. How do we determine historical inputs?
- Jerry Brooks Agreed. But want to see what a natural lake could handle absent sediments. Check the allowable loading and compare it to today's loading to gage reductions. Then deal with other complications.
- Claire Schelske have to deal with the part that allows for losses. Inputs must equal outputs. P flux is neither.
- Curt Pollman Brezonik has done core work to establish historic sedimentation rates in the lake.
- Bill Walker what is the relationship between many factors can cause TAC to get bogged down. TAC does not have expertise to deal with what can be done in the way of fixes in the watershed.
- Jerry Brooks sources to be dealt with by policy makers, not the TAC. They need to know the amount of loading the lake could accept without causing impairment. Need to be able to find assimilative capacity absent confounding factors. We do have the ability to modify how that lake is regulated. But need to understand how the lake responds, to weigh options. Want to understand that external loads occurring now are not solely responsible for what is occurring in the lake at present.
- Bill Walker would like a summary of TP balances over time, water balances, etc. in a digestible form for the TAC to review. Pb210 studies show input/output rates are only ¼ the rate shown by cores.

- Karl Havens There are some papers with historical data (1973-1995).
- Bill Walker Budget doesn't mesh with the balance of input versus output compared to sediment accretion determined by Pb-210.
- Claire Schelske Can explain by fact that deposition rate varies throughout the lake. Cores are taken at the highest deposition rate areas to get a longer core.
- Curt Pollman Need to determine set endpoint, and look at endpoint of interest from some historical time.
- Jerry Brooks Need to look at algal production in the lake. The biological response needs to be considered.
- Curt Pollman Must maintain balance of Flora and Fauna. Standard does not care about what the inputs are. Need to look at chl a or some other biotic response metric. Can establish with some degree of uncertainty what the historical biotic acceptable levels, without knowing what the historic loads were. Look at a condition before the sediments were a factor. Need to start with a biological endpoint.
- Tony Federico What is the goal of restoration?
- Jerry Brooks TMDL process is not intended to return the lake to a pristine condition, but rather to set levels where unacceptable bloom conditions don't occur. Not pre-human condition.
- Karl Havens will be difficult to determine what historical would have been because the relationship between external loads and in-lake concentration is not real clear. Hard to distinguish when external or internal loads are large part of the budget. Maybe could use Vollenweider.
- Tony Federico thinks TAC must revisit the acceptable in-lake TP concentration. May not be 40 ppb.
- Jerry Brooks Sure. Once we agree on the approach, then set an appropriate target. May be something other than 40 ppb TP.
- Bill Walker Once we get past the in-lake target, then will look at loading to the lake and response to loading. Need model of the mass balance of the lake. Will take most of the time for the group. How will this "model" be done? Will resources be provided.
- Jerry Brooks Need to identify the party that can best run these analyses. May involve a contractual relationship.
- Bill Walker can do some limited explorations. Who will do more? DEP? WMD? Is there staff available to do model runs?
- Jerry Brooks Can't commit to this now. Department will work with SFWMD or whoever is necessary.
- Bill Walker It would be useful to know what models already exist.
- Karl Havens They (WMD) could run existing models, but if the request is to develop a model, then "No."
- Jerry Brooks Then the ability exists to model biological response, addressing internal and external loads?
- Karl Havens No, except if want to do chlorophyll only.
- Jerry Brooks Can we also address effect of lake stage? Stage has an effect on cycling in the lake, right?
- Karl Havens Have evidence for the last five years. Beyond that, data are scattered. Lake levels have an effect on where the TP is distributed. Maybe up to 30% of lake had SAV,

much of which has been lost. Also lost assimilative capacity with it. Higher water levels may increase circulation of TP to shallower waters.

- Jerry Brooks Is the transport of sediments from the pelagic zone a problem or other sediment dynamics a problem?
- Karl Havens Remesh Reddy has shown that there appears that more soluble phosphorus is occurring now from the sediments than may have in the past.
- Tony Federico Does the DEP have the option of establishing an interim TMDL? Such that restoration can begin, but allow more time to conduct studies/models.

- Jerry Brooks State law doesn't address an interim TMDL, but nothing prevents us revisiting things if new info is available. But, doesn't think the DEP is interested in developing an interim TMDL. Regardless of the number, measures will be taken to begin restoration.
- Karl Havens Have spoken in the past of doing the TMDL w/o doing a TMDL.
- Bill Walker What are our options/alternatives?
- Jerry Brooks Need to see what some of the agencies have been working on to assess assimilative capacity, like EPA and the WMD. EPA has taken a different approach. Could present at the next meeting.
- Curt Pollman Did the WMD run the Peter Shang's model? Hydrodynamics and WQ, included sediment flux.
- Karl Havens It was not selected for use. Used modified WASP.
- Tom James (SFWMD) The model is somewhere at the district.
- Remesh Reddy Peter is the only one who can run it.

- Public comments:
  - Paul Grey (Audubon Society) More to biological impairment. Also look at benthic invertebrates. What about bird populations? Snail kites. Alligators. Suggest add more members. Someone who has a historical perspective and/or benthic invertebrate experience. He is willing, but may have a bias. Perhaps an environmental representative.
  - Jerry Brooks Arnold Silverman is the rep that David Guest selected. Anyone certainly can provide input and give the TAC any info. Include anyone else, as well. Will consider additional members. If you have any data on biological responses to phosphorus for the lake, we would like to have it.
  - Paul Gray Add invertebrate perspective.
  - Phil Mancusiungarro (EPA) We are currently in public comment period on EPA's Lake O TMDL (to March 17). These do not constitute official comments just because he and Richard Harvey are present. Public meeting is on March 2nd in Okeechobee. Has a copy of the notice, which gives a web site for the EPA TMDL. We will continue to participate in the State's process.
  - Jerry Brooks EPA was invited to be on the TAC, but he understands why they declined. Could they send a rep to these meeting?
  - Phil Mancusiungarro Could not do so until after March 17th.
  - Al Steinman (SFWMD) WMD's role is to support the process, but are resource limited. Want to have input on steps to be taken if WMD is to be committed. Second, frustrated by listening. Make sure everyone is on the same page. Proposes a

brief presentation to the TAC to catch everyone up. Perhaps even this afternoon. Third, no established relationship between TP and invertebrates. No point in going there. Links to TP and micro and macro algae.

- Larry Harris (Friends of Lake O) Not technical person. 30 years of observing and fishing the lake. Tasks laid out to TAC will take 3-5 years. 30 years of changes has resulted in 2/3 to ¾ of vegetation lost. Vegetation that does come back is not desirable. Fishing is now limited to a 3 x 1 mile strip near Fishingeating Creek area and one other smaller area. Used to be the whole lake was available. Lake is deteriorating rapidly. SWIM plan from 15 years ago said 180 ppb in would get you to 40 ppb in lake in 5 years. Now you need 50 ppb and 200 years to get there (by EPA's TMDL). Develop a detailed road map to get near 50 ppb. Assimilative capacity was determined by the Lake Okeechobee SWIM plan to be infinite. In 15 m/h winds, 3 foot waves in 10 ft of water, looks like thin mud rather than water.

- Lunch (Max 12 in audience)

- What has been done to establish an endpoint?
  - Karl Havens Developed an in-lake TP goal. Overheads presented. Benthic invert community has changed due to algal growth causing organic matter accumulating in the bottom of the lake. Oligochaetes are more prolific and there are less chronomids. Species than can handle low dissolve oxygen levels are more abundant. However, difficult to make connection between phosphorus and invertebrates. 1950-1960, very little cattail. Now there is quite a bit. Fueled by phosphorus transport to the area in the littoral-pelagic interface. But TP role is not defined. Water lily population is expanding in area where phosphorus-laden waters are coming in, but link not shown. Bulrush loss has occurred, but may be due to water levels. Nearly a complete loss of SAV. Due to water depth, turbidity, phosphorus levels? What TP levels should be based on Chlrophyll A? Ed Phlips data would be good for determining what portion of turbidity is algal vs. inorganic?
  - Bill Walker What is the source of the turbidity? Live algae? Dead algae? Suspended sediments?
  - Karl Havens Range of role attributed to light blocking can be all algae to all sediments, depending on water levels and other factors. Set in-lake goal based on what causes nuisance algal blooms. High TP correlates to lower chlorophyll, because wind suspends TP, but mix phytoplankton into the aphotic zone. Active area of the lake where fishing occurs matches up with the areas where SAV occurs. In those areas, there is a strong relationship between Chl and TP. 40 ug/L for chlorophyll to define a bloom. This is pretty high and would cause most folks who swim to say there's a problem. In the South End littoral region, 40 ppb TP yields 20% frequency of bloom levels of chlorophyll. North End 40 ppb TP yields only 5% frequency of blooms. At 50 ppb, get about 40% of the blooms exceeds bloom conditions, lake wide. Historically, know that 80-90 ppb led to massive blooms in the lake. Methods in Havens and James.
  - Bill Walker Appears that there is a similar relationship as determined for the nearshore waters as the same for the pelagic waters (not as strong for the pelagic). Does high TP and Chlorophyll A lead to high fishery yields? Where is lake on the

fisheries scale? What is the relationship between increasing TP and fish yield and community structure?

- Karl Havens Lake O falls in range of lakes studied for Florida. Noted that the ratio of rough fish to game fish increases with higher fish yields in many cases. Also, pH (low pH) lowers productivity as well.
- Curt pollman There might be a unique threshold for chlorophyll having an impact in Lake O. Are there fisheries data to do correlations?
- Jerry Brooks We'll try to track this down. Anyone else have them? Are fisheries more sensitive then Chlorophyll A?
- Tony Federico Is 40 really a bloom? 40 is a subjective value for Chlorophyll A.
- Jerry Brooks Requested thoughts from TAC on whether 40 ug/L is a good level for a bloom condition?
- Bill Walker Don't expect corresponding reduction in Chlorophyll A to reduction in TP. Whether you call 40 or 60 ug/L for bloom condition, you start at the same 30-50 ppb TP levels. Have to reach a TP target (40 mg/L) before you will see reductions in Chlorophyll A.
- Jerry Brooks Phosphorus/algal relationships seem to be the most sensitive. Add to next agenda – Total Phosphorus and possibility of using fisheries data as a more sensitive indicator of phosphorus loading.
- Bill Walker Is there a spatial distribution that can be determined instead of lake-wide coverage? Wants more data on spatial heterogenity of the lake.
- Karl Havens Spatial differences change depending on water levels.
- Jerry Brooks Are you saying the TP goal should be lower than 40 ppb.
- Claire Schelske This lake is more nitrogen limited than anything else.
- Karl Havens Center (pelagic portion) of the lake is light limited in the winter and N limited in the summer.
- Jerry Brooks His sense is that 40 ppb in-lake target is one the TAC is comfortable with. Not set, because we may want to come back and examine again after the fish data are checked. Is comfortable with TP and algal link. Doesn't know if there's a similar link to macrophytes. Please bring thoughts on this next time. Will be an agenda item.
- Bill Walker Thinks you should have differing goals for different parts of the lake. Can't expect the biology to improve until you get the TP down below 40.
- Jerry Brooks How can you apply that in a model or a regulatory application? How to let a higher phosphorus load in somewhere and then know what it does to another part of the lake.
- Karl Havens Note, the lake is very homogenous now. Deep and muddy everywhere. Has been for the last 6 years. 1 box model and the 5 box model have the same limitations.
- Bill Walker Trends data?
- Karl Havens Last paper looking at this with data through 1993. No update since.
- Jerry Brooks get article on the effects of lake level changes
- Karl Haven data ends in 1995.
- Jerry Brooks Share the data with the TAC from the database.

- Karl Havens Many of the papers he has are by Ramesh.
- Jerry Brooks Do you want the raw data?
- Bill Walker Yes, just to avoid chasing around if he wants to look at things.
- Karl Havens Define what data you want to limit what he must produce. All data at all stations?
- Bill Walker and Curt Pollman Yes.
- Curt Pollman And annual nutrient budget info and water levels. Look and Dan Canfield and Hoyer papers? Somewhat controversial, but TAC should look at these things.
- Jerry Brooks Curt Pollman send out sediment fluxes paper?
- Curt Pollman OK, never had it peer reviewed.
- Karl Havens Has a couple of other papers not on the list. Provided copies to TAC. On phosphorus goals in the lake and an assessment of the lake models.
- Kim will collect and distribute a list of the available data. Send out what the TAC wants to see. Will also send out copies of the papers.

➢ Next Meeting

- Larry has offered to take the TAC out on the lake in the next two weeks while the water levels are still high. Or can't get back into the marsh. 2 guests per boat. Or can go on a pontoon boat with Audubon, all as a group.Richard Harvey Tie next meeting to the March 2nd EPA public workshop?
- Jennifer Fitzwater Must wait until at least March 10th to get a notice out.
- Greg Knecht/Curt Pollman Tie boat tour to next TAC.
- Jerry Brooks How does week of March 13th? ½ day lake tour (March 15th and 1 day for meeting (9 AM, March 16th,) in Okeechobee? Conclude this process by July? Meet every 3 weeks.
- Tentative dates for future TAC meetings :April 11th. Orlando, May 3rd. WPB, May 31st.

<u>THINGS TO DO BEFORE THE NEXT MEETING</u>

- Journal articles on invertebrates/fisheries and their relationship to phosphorus
- Journal article on lake levels
- Water quality data from the SFWMD database
- Water budget and phosphorus budget
- Sediment Articles by Remesh Reddy, Canfield and Hoyer and Brezonik
- Manuscript by Curt Pollman

Lake Okeechobee TAC – 3/16/00

- Recap of previous TAC meeting (Jerry Brooks) – discussion of in-lake restoration target

Jerry Brooks – Asked group what other ecosystem measures could be used for the restoration target. If no others are identified, then he proposes that FDEP continue to use 40 ppb total phosphorus for the in-lake restoration goal.
Tony Federico – Are we seeking to protect near-shore waters? How do we extrapolate 40 ppb for near shore to the rest of the lake? Do you intend to used this concentration for the whole lake?
Bill Walker – Algal blooms are seen at total phosphorus concentrations above 30-40 ppb. Correlation of algal blooms and total phosphorus is strongest at near shore, however is still seen in the rest of the lake. Get a 5-10 % bloom frequency at 40 ppb, and 0% at 30ppb
Arnold Silverman – What is the lowest range of total phosphorus when blooms are seen?
Karl Havens – Do we really want to set a criteria for 0 blooms?
Curt Pollman – Suggests using a paleostudy (similar to Mark Brenner) to determine historical trophic state of the lake, as used for Lake Parker. Look at diatoms and extrapolate to historic phosphorus concentrations.
Karl Havens – Has the model they use been calibrated?
Curt Pollman – Calibrated to a training set of lakes in Florida and applied to several lakes, such as Lake Parker. Fundamentals to determine and reconstruct lake acidification (pH in the lake). This would give use more confidence in setting the concentration criteria in the lake.
Bill Walker – We have a set of historical data for the lake to 1973. The historical concentration was around 50 ppb.
Claire Schelske – Problem with this idea-taxonomic naming of diatoms (used two different labs) and takes a long time to count. However, we do have cores from Brezonik that show a 4 to 5 fold increase in phosphorus accumulation. This approach could be used, but not between now and July.
Curt Pollman – Do we want to restore the lake to historic conditions or a condition based on when impairment occurs?
Jerry Brooks – We need to use impairment based on the imbalance of flora and fauna. What is the threshold at which impairment occurs? Karl's work – Where do we see changes?
Karl Havens – Page 81 Havens and James (1995) the correct reference is Walker and Havens (1995) paper shows occurrence of algal blooms. When total phosphorus is less than 30, chlorophyll a of 40 is zero. Between 30 and 60 ppb total phosphorus, steep increase of algal bloom risk. Above 70 ppb total phosphorus, % of samples show risk of bloom. Between 30 to

40 ppb total phosphorus lower risk. Sample using regular sampling schedule, so some blooms are missed. **More info**
Bill Walker – What are average p concentrations at the stations used in this analysis?
Karl Havens – Mid-lake –70 ppb total phosphorus, 30 ppb –south littoral, -north littoral
Bill Walker – so the 40 ppb of lake would be more protective of the littoral zones
Tony Federico – updating Bill Walker data, so hopefully this can be completed by next meeting. There seems to be some data missing from the data set for the littoral zone. Use to see if lake is heterogeneous or not.??
Karl Havens –
Bill Walker – What data used goes back to 1973?
Karl Havens – 8 open lake stations
Tony Federico – the littoral station isn't as long or complete
Bill Walker – complex to correlate the open lake to littoral zone due to lake levels. How much data is there for the littoral zones? What about Karl Haven's paper (1997) "Water Levels and total phosphorus in Lake Okeechobee"?
Karl Havens – 1980s. 10 years of data. How do we want to manage the lake for the TMDL. In years of high lake levels, lake is homogeneous, so total phosphorus concentrations 40 ppb would be seen throughout the lake. In years of lower lake levels, the lake is more heterogeneous, and therefore could see better than 40 total phosphorus seen in the littoral zones.
Jerry Brooks – Need to discuss lake levels later.
Tony Federico – New lake level regulation schedule is so supposed to be implemented
Karl Havens – The new schedule (WSE) is a smart plan that will help lower lake levels, however the levels are not low enough.
Tony Federico – We can use the schedule to predict future lake levels.
Bill Walker – request – get the next 40 years of the regulation schedule.
Karl Havens – there is a web-site (Corps) with the regulation schedule document.
Jerry Brooks- Karl to locate data for everyone. We need to make some decisions because of our timeline for the TAC. Based on this discussion, FDEP will use 40 ppb for the in-lake concentration. If anyone in the audience disagrees, bring data and an argument to the next meeting.
TAC seemed to agree with this.
Bill Walker – clarify – Is the 40 ppb an average for the pelagic zone or average for the entire lake? What stations will be used to see if we are meeting the target?
Jerry Brooks – We probably need to look at different areas of the lake. We don't have a model with predictive capabilities to predict concentrations for each part of the lake. We will use an average of the whole lake.
Bill Walker – If we assume 40 in the pelagic, then we can assume that the littoral zone will be protected. For the long-term, develop a model that can predictive the heterogeneity of the lake.
Karl Havens and Curt Pollman agree. This was a very important decision point by the TAC and needs to be clarified. We agreed that the 40 ppb goal would apply to the average for the eight long-term pelagic stations (stations L001-L008), and that by setting the goal for this lake region, we would be more protective of the near-shore and littoral zones.
Claire Schelske – Are we using an annual median?
Yes
Bill Walker – Is the 40 a yearly average or a long-term average.

Tony Federico – It should be a long-term average. There can be years that 40 ppb doesn‘t trigger blooms.
Remesh Reddy – Blooms depend on how much the 40 ppb is available.
Tony Federico – There won't be compliance of 40 ppb for the TMDL.
Curt Pollman – We will have to have a MOS. So, we need to determine how compliance is going to be determined.
Jerry Brooks – MOS is part of assuming that 40 for the pelagic zone, will result in lower concentrations in the littoral area.
Tony Federico – TAC doesn't need to be concerned with compliance right now – it is a long way down the road. The model work has shown that periods occur where the standard would be met, but then as things like resuspension shift, the average concentration can shift back above 40 ppb for several years.
Bill Walker – MOS can also be applied by adding a treatment area, not necessarily in the concentration or loading, but also the assumption by using 40.
Curt Pollman – Use a running average based on the residence time of the lake – so use a 3 year because the residence time of the lake is 3 years.
Tony Federico – The discussion of the group continues to support the 40
Arnold Silverman – Why is 40 better than 30 or 50?
Jerry Brooks – Jerry Brooks –Open to another number, but this group has to use best professional judgement at some point. Will provide the opportunity at the next meeting to debate this issue. Does the audience wish to speak to this issue now? The department is going to use 40 ppb, so is challenging people to bring an argument against it.
Karl Havens –Does anyone want to share on this topic before we move on?
Paul Gray – statue reads protect flora or fauna. Looking at the Eleochoris on the lake, need to consider the plant communities. Please add a plant person to the TAC. This person can tell how plants will react to the 40 ppb. Will 40 ppb reduce the presence of cattails? Will it protect periphyton communities? With this concentration, will typha continue to spread? EPA's model at 50 ppb, the lake will still be getting 48 additional tons of phosphorus that will be assimilated into the lake. The mud itself is an impairment itself because tricopterates cannot survive. Need to add a macroinvertebrate person to the committee. The mud continues to cause the turbidity. Please look at flora and fauna.
Jerry Brooks – I do not disagree with this. This group represents expertise in this area. Bill Walker has expertise in these ecosystem issues. In response to burying the phosphorus-laden mud with other mud, we will have to deal with this for the TMDL. Looking at feasibility of dredging. We will consider all these issues. Look at sediments in next phase with the alternatives of how to reduce the load to the lake.
Karl Havens – Mud is a major problem. The TMDL is not going to make the mud go away. The mud needs to be removed by removing levee I don't recall saying this (not likely to happen) or dredging.
Tony Federico – Understand what Paul is saying. The lake is a trap, so mud will always be accumulated.
Paul Gray – Doesn't think that adding an additional 50 tons/year is acceptable.
Curt Pollman – The center of the lake will always have mud. It is an ephemeral system and this is how lakes work, building up of organic matter. Lake levels cause problem with this because high water levels wash mud into near-shore areas, which creates unsuitable habitat. This is more of a water management issue.

Karl Havens – Look and Brezonik and Engstrom (1998). There were originally mud areas, however the extent is much larger because has been building up much more rapidly.
Bill Walker – Once we understand the heterogeneity and how to manipulate the water we can revisit the 40 ppb.
Tony Federico – How much of mud is actually from the dredging of Kissimmee and other canals versus the build-up of mud from algal productivity?
Remesh Reddy – Can look the ash analysis, as in Lake Apopka. Much of the sedimentation may be from other sources, not the algae.
Karl Havens – Gleason 's C-14 study, mud is from sources upstream This is incomplete – I indicated that Gleason's study showed that deeper layers of mud may be from upstream sources, while more surficial mud is probably of in-lake origin (algal remains).
Claire Schelske – Brezonik and Engstrom (1998) paper –the pelagic zone wasn't always been mud, however there was lots of organic matter. The inorganic matter is coming from elsewhere.
Bill Walker – Lots of deposition from Kissimmee River, this material differs from center of the lake.
Karl Havens – read from Walker and Havens (1995) paper. The large mud zone is due both to human disturbances and total phosphorus accumulation. The paper I read from was Brezonik and Engstrom (1998)
Carol Head – How is the average going to be determined because the littoral zone will pull the average down?
Jerry Brooks – Group has agreed to use the pelagic, mid-lake stations.
Ken Dodge – Would limits set in TMDL be subject to backsliding.
Jennifer Fitzwater – This is for permitting. There are provisions to allow a higher goal to be set.
Richard Harvey -Have to demonstrate that you could never meet the number. If you can meet 40, but want 50 then that is backsliding because you can meet it. Applies to federal permits.
Jerry Brooks – Antibacksliding is in our standards, so it is in the state as well as the federal.
JF – It is in our regulations for our NPDES permits and other surface water and groundwater permits.
Remesh Reddy – Are we only going to address phosphorus? What about nitrogen?
Jerry Brooks – The lake is listed for nutrients, so if nitrogen is a problem, we will need to address it.
Bill Walker – The lake is p-limited and n-limited in areas. If you decrease phosphorus and force lake to be p-limited, you take care of the nitrogen problem.
Karl Havens – The current total nitrogen levels in the lake water are now at historical levels.
Bill Walker – hold nitrogen constant, algae will use phosphorus. If you address the phosphorus problem, the nitrogen problem goes away.
Jerry Brooks – so to answer your question Remesh, we will focus on phosphorus (DEP/EPA commitment to do a TMDL by 1999 was only to address total phosphorus.
Break
Jerry Brooks – comparison of state and federal requirements for TMDL development. OH – "TMDL requirements – federal vs. state". Identifying impaired waters process. Currently, the Department is undergoing a process (TAC) to determine what the definition and requirements for a water to be deemed impaired.
Tony Federico – Is the entire lake on the 303(d) list?
Greg Knecht, Jan Mandrup-Poulsen, Kim Shugar – The lake is divided into eight segments: 6/8 for nutrients, however the other 2 are listed for other parameters.

Jerry Brooks – our legislation has established that the lake is impaired, which allows us to proceed with the TMDL process. Next phase is to establish a TMDL. The process for developing a TMDL is similar in both the federal and state laws.
Tony Federico – Is the loading supposed to be established first before determining the concentration? Doesn't the law say it's the sum of WLAs and LAs, plus a margin of safety (MOS)?
Jerry Brooks – The State uses the federal definition for a TMDL. We need to determine our restoration goal and then establish a TMDL to reach the goal. Once the TMDL is established under federal and state law, we are then required to allocate the load. The legislation doesn't require us to allocate to individual sources, but rather to groups. However, we would have to specifically allocate to point sources. Right now, there is no way to categorize nonpoint source pollution for allocation. Allocate to the sum of all nonpoint sources. In the future there will be more specific allocation, when we understand feasibilities of various activities. Allocation statute – 403.067(6)(b) OH – outlines allocation considerations. The Department has to consider pollution sources outside the state, activities that have ceased, or alteration to water bodies prior to the date of this act. For Lake Okeechobee, we need to consider the source of phosphorus from the sediments. Should the landowners around the lake be held accountable for past activities? It is probably not reasonable for us to hold landowners accountable for the past activities because of the size of the load from the sediments. This statute allows options for dealing with the Lake Okeechobee problem.
Karl Havens – How should the sediments be calculated into the TMDL? Could we use a simple inflow/outflow model, such as the Vollenveider model, without considering the mud.
Richard Harvey – are we going to absolve everyone from past activities.
Jerry Brooks – Much of the mud in the lake can be linked back to watershed activities. How much is due to canals-public works, Corp and state, and individual landowner practices?
RH – Does this absolve current dischargers? Your activities have caused and contributed to the problem. Use this for cost share.
Jerry Brooks – This hasn't been sorted out yet. In this case, how much of the sediment problem can be allocated to current landowners, and how much can be attributed to the activities of the Corps of Engineers?
Bill Walker – working on the contribution of the sediments, channelization and dredging. Should know accretion rate.
Remesh Reddy – 1/10cm per year
Bill Walker – Could sample sediments and determine the time horizon when the dredging impacts occurred. Doesn't understand the distinction. The dredging was also done for the benefit of the landowners.
Tony Federico – There are still contributions of sediments.
Jerry Brooks – Presented this information to show how policy, science and legislation will be used for TMDLs. I'm presenting how I think we should move forward on this process…. OH – "TMDL Implementation". The Department needs to move on implementation after the TMDL is established. Guidance from USEPA (1991) says that it is up to the State to implement. We'll need partnerships to achieve the TMDL. Some cases will be completely regulatory-point sources, or non-regulatory, incentive-based partnerships for NPS-cost sharing, bmps, public works, land acquisition and other restoration activities. In the case of Lake Okeechobee, lots of discussion as to the activities needed to achieve our restoration goals, such as public works and individual BMPs, etc.

Tony Federico- What is the boundary for a basin plan?
Jerry Brooks – Up to our discretion as what we think we need to achieve our goals. OH – "Phosphorus Mass Balance" for any waterbody. We have numerous inflows of phosphorus to the lake – structures, overland flow, rainfall, and sediments. Outflow=sedimentation and outflows. Initially, need to understand what levels of phosphorus the lake can receive without exceeding standards (regardless of the sources at this point). How much can the lake receive without causing an imbalance (exceeding the 40 ppb phosphorus)? When determining the load, need to view the load from the sediments, as well as direct inflows. Have to share reductions between the sources. Go into basin and look at sources and look at what techniques and tools are available to reduce and achieve the reductions. Efforts are currently underway to determine feasible BMPs. Have to recognize the best we can do with the technology. Then what can we achieve with the public works with the C&SF Restudy. The next source to deal with is the sediments. This year's legislation has the SFWMD looking at the feasibility of dredging to deal with the sediments.
Karl Havens – The difference from the gross loading of total phosphorus from the lake sediments versus the inflows is the same. This sentence seems confused. What I said was that loading from sediments is a gross input (mud to water), but that the net effect of sediments is to act as a sink, because the flux in the other direction (water to mud) for phosphorus presently is greatest. Sediments are actually a sink.
Claire Schelske – Double counting the phosphorus with inflows and sediment resuspension.
Jerry Brooks- Discuss later. State is going to be responsible party for the phosphorus load from the sediments. After all these sources are dealt with to the best of our knowledge and technology, then we will look at other public projects-STAs, RaSTAs or reservoirs.
Arnold Silverman – BMPs are flexible because they have to do with money and equity.
Tony Federico – Does the order matter? Should look at the public works-RaSTAs first because we are more certain as to the results of the treatment facilities versus BMPs.
Jerry Brooks – We can look at these options in any order. All these things take into account what the legislature has directed- accountability of landowners and the State, recognizing historical practices where landowners will not be held solely responsible for the past.
Bill Walker – I hope you are not looking to us for policy decisions.
Jerry Brooks – No
Bill Walker – Is the committee now being charged with the allocation? By July?
Jerry Brooks - What I want this committee to do is the development of the TMDL. Use their knowledge and experience to determine the Lake's response to inputs. How much can we put into the lake to meet our restoration goal and not causes imbalances?…
Karl Havens-look at phosphorus mass balance. The net loss needs to be decreasing over time. If you want a lower internal concentration. You need to decrease the input, or increase the input or sedimentation.
Paul Gray – will this reverse the benthos trend.
Curt Pollman – The change in the internal concentration will affect the diffusion flux between the sediments and water column. If you lower the input concentration, you will see a new steady state at a lower level. Don't know the time it will take for the changes to occur.
Remesh Reddy – Need to differentiate between bioavailable (soluble reactive phosphorus and total phosphorus). The resuspended sediment is largely composed of soluble phosphorus.
Curt Pollman – What will the internal concentration change to when the external loading is decreased? Dredging will help increase, but will need to do it more than once. Second scenario

– will need to dredge more than once because the new phosphorus-laden mud zone isn't going to go away anytime soon and will continue to be a source to the water column.
Karl Havens – with dredging, there will be a greater net loss.
Bill Walker – The loads to the lake have only decreased a little since the 1070s, however, the water column concentration is increasing, sedimentation has been increasing. Use a 2 box model, with a sediment box and a water column box. Vollenveider is a one box that doesn't work because the net sedimentation and storage rates change over time. The two box can model storage, as well as water column conc. The dredging will remove sediments which changes the steady state concentration. Needs to be continuous. Could change the rate of recovery. The sediments have been contributing more phosphorus to the water column because the mud covers a larger area, so there is a larger surface area to make phosphorus bioavailable.
Claire Schelske – The ortho-phosphorus data should reflect changes as well.
Bill Walker – Removing the sediments should speed recovery, unless the disturbance creates a larger problem.
Jerry Brooks – Is there going to be a significant change in recovery time based on the amount of external reduction?
Curt Pollman – No, the turnover time of the sediments controls the recovery time.
Curt Pollman – The surface layer of the mud (top 5 cm) controls phosphorus resuspension to the water column.
Bill Walker – The average in-lake concentration is increasing however, the mean flow weighted outflow concentrations are not increasing.
Claire Schelske – 2 reasons, particles are more enriched with phosphorus and there is more ortho-phosphorus
Karl Havens – If look at individual outflows, some are increasing
Bill Walker – OH from Tony Federico-average inflow and outflow concentrations over time
Tony Federico – How the lake outflows are managed are changed overtime. OH-graph of moving average total phosphorus assimilation
Karl Havens – The graph is misleading because inflow loads are increasing lately. The assimilation is controlled by the inflow loads. Need to look at percents.
Claire Schelske – 2 OH-equations –sediment loss = particle deposition (burial) + internal loading. If you can't change the internal loading won't be able to achieve the goal, but external loading affects internal loading.

Lunch break

Presentation by Tom James (SFWMD) on Lake Okeechobee models (OHs)

* Vollenweider model – gives total phosphorus concentration based on sedimentation rate, load, depth, and lake flushing (outflow)
* Modified Vollenweider model by Kratzer to fit 29 Florida lakes –the model predicted well up to the mid 80's after that the model underpredicts, this is due to lake levels and sediment-water column interactions. The model is being run using a steady state assumption
    * Tony Federico – The big divergence occurred in 84
    * Karl Havens - Net sedimentation is based on residence time
    * Bill Walker -use settling velocity versus a sedimentation rate
    * Tom James – target load over time based on equation 4. The targets are not met. Only twice did the observed meet the predicted.

- Karl Havens – the model never really worked, it just coincidentally matched from the 70s-80s
- Bill Walker – the model doesn't account for sediment-water interactions.
- Arnold Silverman – The values are similar from 1979-1995. Has the lake reached steady state
- Karl Havens – There is an increasing trend
- Bill Walker – need to use longer than a year because of the 3 year residence time
- Tom James – we have used 5 year average

* Lake Okeechobee WQ Model
  - Tom James - Mass balance model, modified version of EPA's WASP. Listed stuff from overhead. Discussed diagram of model (OH). There is interaction with the sediment for all the cycles (N and P). Calibration time period 1983-1989, validation time period 1990-1996. Resuspension was an external force to match inorganic suspended solids in the water column in the calibration process to force the soluble phosphorus into the water column. OH –data fits the model
  - Karl Havens- Long-term goal
  - Tom James – there is a burial factor based on Brezonik and Engstrom, aerobic layer –1 cm, anaerobic –10 cm, and below that burial, OH – LOWQM Predicted versus observed total phosphorus. The predicted was too high in the 70s and then fit better latter. Possible explanation-change in state of lake
  - Bill Walker – what is meant by 99% CI
  - Tom James +/- 2 standard deviations = the CI

* Stella Model
  - Tom James-the settling and resuspension constants were constant.
  - Tom James – Metta, 97 work showed that only the first 10 cm were disturbed
  - Claire Schelske-What does disturbed mean?
  - Bill Walker-the sediment that is somewhat affected, not necessarily resuspended. Need to look at pore water of sediment
  - Remesh Reddy- only a small fraction is resuspended (1 cm)
  - Curt Pollman – bioturbation can cause disturbance up to 5 cm
  - Tom James - larger mass creates more inertia
  - Remesh Reddy – 1 cm or less is actually lifted into the water column
  - Tom James- this model is yearly (annual)
  - Bill Walker
  - Tom James
  - Bill Walker – your not using the water balance
  - Tom James-yes
  - Karl Havens – If only one cm is resuspended instead of 10 cm, does this mean that the recovery time is faster.
  - Curt Pollman – yes
  - Paul Gray – the affect of hurricane, would it mix deeper and then have to reset the model
  - Tom James –OH – Stella predicted versus observed. It didn't predict the 70s or the late 90s well, but fit the 80s and early 90s.
  - Tony Federico – good to look at earlier years because that is what we want to get back to

* Tom James – good to use a variable model versus steady state. Reason for difference in predicted and observed : vegetation-very little in 1999 @ high lake stage. Quantities of SAV change with lake level. OHs showing changes over different periods.
* Tony Federico – how was SAV determined?
* Karl Havens – picked 14 of 60 sites for SAV equally spaced around the lake Actually we sample at 14 transects, each with 3 sites, for a total of 42 sites.
* Tom James – much more SAV in 1990 at lower stage approximately 11 ft.
* Bill Walker – does this occur in any of the pelagic zone
* Karl Havens – 2 of the 8 stations fall in this area. Lake level is likely to fall to 13 feet by end of summer. I don't recall saying this, but if I did it was in error. Best estimates based on rainfall predictions put the lake at between 13.4 and 14 ft this summer, but this all depends on what actually happens with regional rainfall and any management actions that might occur between now and then.
* Tony Federico – it is mainly on the fringe.
* Richard Harvey – would a restoration strategy be to have an extreme drawdown to let the vegetation reestablish
* Karl Havens – La Nina the lake could go down low this summer naturally
* Bill Walker – the lower observed versus predicted in the Stella was due to the large quantity of vegetation uptaking phosphorus
* Tom James – added a SAV component to the Stella model. Arbitrarily chose 100 units. High resuspension rate was inverse linear relationship to SAV
* Bill Walker- with low lake levels the water may not reach the vegetation and therefore may not even be part of the model.
* Tom James - Calibrated it too fit, so it was tweaked. Wind and other things did not show a relationship
* Bill Walker -SAV is controlling the resuspension of the P
* Claire Schelske – How big is the sink that it is resuspended?
* Tom James – It is being researched in the next 2 years.
* Tony Federico – where the resuspension occurs, there wasn't any vegetation
* Unknown-couple this with phosphorus equilibrium
* Karl Havens – SAV and benthic algal mats at south end of lake can both be in the lake with lower lake levels, it doesn't just doesn't have to be SAV. Lots of biological processes could occur with lower lake levels.
* Karl Havens – Just a one box, this is just a hypothesis (SAV reduces) resuspension affects for the lake
* Curt Pollman – This is just a mathematical term
* Bill Walker – Develop a model with depth affect on resuspension.
* Tom James – Needs to be slower –growth and depth of SAV. Depth doesn't directly affect resuspension. OH – Summary
* Bill Walker – Why is this model, which is used by EPA, not used to forecast?
* Tom James - Can't produce the early years. The lake transforms based on the depth of water.
* Karl Havens - If the restudy components get completed (RaSTA and ASRs), the lake could recover faster.

* Jerry Brooks – If we can prove that lake stage is causing changes in the lake, including phosphorus, then management can look at managing the lake, not just by controlling phosphorus inflows. Tom James – the overprediction in total phosphorus is due to the soluble material. Too much is being generated, not resuspended.
* Karl Havens – Lower water levels would require a lot of other actions, like ASR wells.
* Bill Walker – Do you have a plot of lake stage over years? The model appears to match in the years where lake levels were higher. There is something else.
* Tony Federico – seasonality
* Tom James – Used sediments from 1968 and used Engstrom's ratios
* Tom James – 30, 000 tons of phosphorus in the sediments.
* Bill Walker – If you use a shallower sediment depth, you might see more of a response.
* Tom James – that is if you assume that the lower sediments are contributing that they are being buried.
* Bill Walker – This is such a sensitive component in the model. Develop a model with a depth factor.
* Claire Schelske – Are you assuming that sedimentation is 1 mm per year. Are you burying it at the same rate
* Tom James – yes. This model is very sensitive to burial.
* Karl Havens – Big picture of what has happened over the last 100 years. Phosphorus inputs in the 40s and 50s were lower, more phosphorus assimilation, and more SAV. Now less SAV, higher inputs of phosphorus, and a lake that is not able to assimilate as much of the inputs
* Jerry Brooks – Before the dike, the lake was deeper.
* Karl Havens – Yes, but littoral zone was larger and lake covered a greater extent.
* Jerry Brooks – What is the best hydrologic conditions that can represent the lake now. Relevant question – what is an acceptable loading rate. We need to understand how lake stage affects the phosphorus cycle. Lowering lake stage may be a better option than trying to get more reductions of phosphorus in the watershed. This is a policy decision that a policy maker need to understand the relationship between lake stage and phosphorus. If we can bring this information to policy makers, they can more strongly support changes in the Lake regulation schedule.
* Bill Walker – Relationship between depth of lake and sedimentation? If lake is at one level, set the TMDL to be one thing, at another lake stage, have a different number.
* Reducing external sources is definitely a problem, but the internal sources affect the time to achieve restoration.
* Bill Walker – the TMDL should be same regardless of how internal source is handled.
* Jerry Brooks – policymakers need to understand both external sources and how we manage the lake to meet our goal of restoring the lake to a point of meeting standards.
* Karl Havens – some the management options may not happen – ASR wells, dredging. They are being investigated. This shouldn't affect the TMDL.
* Jerry Brooks – It affects the recovery time
* Curt Pollman – Load reduction as well as the sediment affect the recovery time of the lake. Can overshoot the goal by imposing more reductions and then backing off when the concentration goal is met.

* Richard Harvey – To what degree does the external loads affect the recovery time? How does the surface area of the mud zone affect the recovery time?
* RH – How do each of the options affect the internal phosphorus concentration? What options would be better to pursue?
* Bill Walker –How about in lake Apopka, where water is taken out of the lake and then put it back after sending it through a STA.
* Bill Walker – Dredging isn't really a good option
* Jerry Brooks – How to tie lake stage into a TMDL
* Tony Federico – Location of STAs?
* Karl Havens – How will STA removal affect the TMDL?
* Bill Walker – It is part of the mass balance of the load (TMDL)?
* Jerry Brooks – This is modifying the lake's assimilative capacity
* Tony Federico – The TMDL doesn't have to be a number. It could be an equation.
* Karl Havens – Lowering lake stage has been discussed for years. There are a number of factors that lowering lake stages affects.
* Jerry Brooks – Is there a means that the group can determine the change in sedimentation rate due to lower lake stage.

Public comment:
Reginald Butt –Glades Area Environmental Initiative - How will this affect nutrients in our area (Glades county) of the lake. We meet water quality standards in the lake, but the water quality could be better. How does this tie into the Restudy?
Jerry Brooks – The problems affecting water quality is nutrients
Karl Havens – Taste and odor is due to blue-green algae. The lake used to have diatoms instead. The blue-green algae are the result of nitrogen problems. No, the blue-green algae are a result of the phosphorus problem, which has made the lake nitrogen-limited and favored blue-greens. We do not have a problem with nitrogen pollution in the lake. South end of lake has turbidity due to high water levels and few plants.
Reginald Butt – How does all this tie in to the Restudy. Water is expensive. Will our cost of water increase when construction begins? How do you prove that this won't make our water quality worse.
Jerry Brooks – will evaluate what are the environmental affects of the Restudy. The ASR could bring an alternative way to store water in the basin.
Alan Stewart – aquaculture facility with hyacinths – Okeechobee county – proposal for removing 50 tons of phosphorus from Taylor Ck. And then will export phosphorus as feed.
David Elam – Martin County – When the sediment is stirred up by boats and waves, they cause resuspension of phosphorus in the lake.
Paul Gray – Audubon sanction Kissimmee River down to Harney Pond (29,000 acres). Snail Kites aren't nesting, overrun by cattail. Handout –biological status report – Jim Hulbert knows about invertebrates –speak nest week on how phosphorus affects the invertebrates? Oligochaete (Remesh bioturbation report)
Jerry Brooks – As a lake becomes more eutrophic, it will have an affect on the ecosystem. At what point does phosphorus loading affect the invertebrates or other biological systems? There may be other management activities to deal with these biological systems.
Paul Gray – There are many variables and a range of phosphorus values.

Karl Havens – Invertebrate sampling for lake. Missing a lot of data. We know that between 50 and 100 ppb that the communities changed, but don't know exactly.
Jerry Brooks – contact these biological experts and challenge them to prove that the 40ppb pelagic zone is not adequate to protect these biological factions.
Paul Gray – also, can they discuss how more muck will harm these fauna
Bill Walker – the lake will always trap phosphorus
Paul Gray – no, trapping phosphorus that creates muck that covers more sand area is what we don't want.
Karl Havens – need to remove extra mud.
Paul Gray – don't want to make a TMDL that rebuilds the mud zone
Bill Walker – data request – monthly and an annual mass water balance, need update from 96-2000; need volume, area or in-lake phosphorus concentration
Karl Havens – use a model based on the Stella model with a term (not necessarily SAV)
Bill Walker – working with 2 box model, but need more data
Jerry Brooks – what are the variables that control the net sedimentation rate.
Curt Pollman – wet deposition data from FAMS; not as much data for dry deposition. For Lake Okeechobee, we could look into this.
Jerry Brooks – Pull that deposition data together.
Tom James – changing the deposition is not a very sensitive matter.
Bill Walker – it could be a large part of the TMDL (when there are lower total phosphorus concentrations) and can affect implementation component.
Curt Pollman – Pat Brezonik's data is pretty good. The SFWMD and Tampa NEP had bird contamination.
Bill Walker - 20mg/m2/year
JP - Bill Walker and Tom James work on relationships of stage.
Next meeting in on April 6 in West Palm Beach at the SE FDEP District office.
Jerry Brooks – want to know of the aerial extent of the mud (Remesh will do). What is the active depth of the mud?

Adjourn – 4pm

Lake Okeechobee TMDL TAC Minutes – 4/6/00

Jerry Brooks revisited commitments from the last meeting per Paul Grey's request for added presentations. Gary Warren is a macro-invertebrate specialist, but could not be reached with sufficient time to prepare a presentation for this meeting. Gary Warren had Claire Schelske summarize for him. Claire is not here yet. Basically, Gary Warren concurs with Dr. Canfield's work on the lake.

No one else has expressed an interest to present any information arguing against an in-lake phosphorus target of 40 ppb for the pelagic zone established by the TAC. Need to move forward on how to model the lake. Model should allow enough flexibility to change restoration target, if new information is proposed. Still go with 40 ppb as a pelagic zone target, with assumption that littoral zone concentrations will be lower.

Paul Gray – John Chick wants to offer input on fish communities, but believes the algal link to total phosphorus is tighter. Still wants some comfort that faunal community is protected. A phosphorus concentration of 40 ppb may do this, but would like to hear it from a fish person.

Jerry Brooks – Yes, must not ignore certain components of the ecosystem. The TMDL process requires that we determine what level of a pollutant can be discharged without adversely affecting the designated use. But seeks to avoid some of the problems encountered in the Everglades process. Can still achieve our goal without getting bogged down in many of the details, especially given our time frame. Use the tools we available now.

Claire Schelske and Remesh Reddy arrived.

Jerry Brooks – Claire, can you share Gary Warrens' opinions, or should we ask him join us to share his perspective?

Claire Schelske – Brief discussion only. He is willing to present, given more lead time. But he likely agrees that total phosphorus/chlorophyll relationship is the way to go.

Karl Havens – Also spoke with Gary Warren. Started looking at lake in 1989, no historic data. He is the expert on the invertebrate community in the lake.

Jerry Brooks – Will contact him directly, to update him on our process. Should have been sent all the total phosphorus data by now. See if he is willing to talk to the group.

Claire Schelske – He is willing, if he understands the purpose.

Jerry Brooks – Reviewed the agenda for the day, covering the expected presentations and opportunity for public input. Finally, we will discuss more on the TMDL process we'll pursue.

Curt Pollman – Atmospheric Deposition presentation:

Overhead A1 - Must consider Wet Deposition and Dry deposition:

1) Gaseous absorption
2) Gravitation settling (particles > 1 μm)
3) Impaction (pushed by the wind onto plants)

Overhead A2 - size distribution of atmospheric aerosols. Three general clusters. Believes most phosphorus is associated with the larger particles about 10 μm in size.

Overhead A3 - Cole et al. (Limnology and Oceanography 35: 1230-7, 1990) - Phosphorus Deposition from the atmosphere into Lake Mirror – particles originating in nearshore margins drop out rapidly, within first 10 meters. Due to size of Lake Okeechobee, not a big part here. Bigger inputs are gaseous deposition and fine particle deposition. Believes overall estimated numbers for atmospheric phosphorus deposition into Lake Okeechobee are too high, but interested in the drop off as moving west offshore into the lake. Flux estimates are almost an order magnitude too high. Estimates for the Everglades dry deposition are way too high to apply to Lake Okeechobee.

Bill Walker – How do the local activities like sugar cane burning affect this?

Karl Havens – Can be important. Cane burning can cause an effect like snowing, which at times moves out on the lake.

Curt Pollman – Discussion of how an air deposition collector functions, such as the shifting between the wet and dry collector. Problems include missing the first bit of rain that has highest concentrations of phosphorus, when the hood shifts opening up the wet collector; contamination from bird droppings and bugs; and the foam seal degrades in the sunlight.

Overhead A4 - Florida Atmospheric Mercury Study (FAMS). 9 sites in Florida, do regional assessments to characterize regional rates of mercury deposition around the state. FDEP also analyzed their samples for total phosphorus deposition on a regional basis. 7 of 9 stations were in South Florida (south of the lake). Bulk deposition estimates have problems.

Overhead A5 - FAMS Wet deposition, volume weighted mean total phosphorus concentrations. 3-17 μg/L ranged over the sites (concentration in rainfall). Much lower than the previously accepted values (from USGS study). 17 ug/L was at the station in the Everglades Nutrient Removal (ENR), which could be receiving bird contamination in the dust coming from the Everglades Agricultural Area (EAA).

Overhead A6 - FAMS Annualized wet total phosphorus deposition rates typically ranged from 5-10 mg P/m^2-yr. The Everglades Nutrient Removal site had a total phosphorus deposition rate of 34 mg P/m^2-yr, but may have the dust from the EAA having dust-creating activities. The EGG site under a Brazilian pepper tree to measure through fall flux, found 263 mg P/m2-yr (but not useful for the Lake). An average of about 10 mg P/m^2-yr for all sites.

Overhead A7 - FAMS monthly average of wet deposition – look at all sites and monthly averages. A peak is observed in February and March, which may be due to pollen. Peak again in May and July, which is driven by rainfall amounts, not total phosphorus levels.

How do aerosols affect wet deposition? *Overhead A8* - For mercury, got excellent match in the replicates (no gross contamination). *Overhead A9* - Now for phosphorus, see a lot of variability, even with clean sampling collection techniques. Seeing stochastic aerosol effects and insect contamination. Used paired samplers, on 45-foot high towers, set a couple of millimeters apart. Results were 1 to 2 orders of magnitude different in some cases. Believes FDEP lab took great care in handling and processing the samples. Indicates dry deposition plays a significant role.

Karl Havens – Showing us wet data only?

Curt Pollman – Not confident in showing bulk deposition data.

Overhead A10 - Comparison of wet total phosphorus concentration (mg/L) and % cumulative distribution. FAMS data are a little lower than Brezonik's results, and are higher than the SFWMD data. FAMS uses cleaner methods and towers, compared to Brezonik. SFWMD is looking into their data to clean it up.

Overhead A11 - Wet deposition data for SFWMD plotted total phosphorus (mg/L) against Ca^{2+} (mg/L) relative to ammonia (NH^{4+}) to look for bird dropping impacts. At high total phosphorus concentration in rain (1>mg/L), get a strong correlation to Ca^{2+}, showing likely contamination from bird droppings.
Remesh Reddy – What is the volume weighted concentration of phosphorus in rain?
Curt Pollman – 4.8 – 4.9 mg/L P in rainfall (volume weighted).

Overhead A12-A14 - Table 1 - summary of recent literature on atmospheric phosphorus concentration , which had an average wet deposition of 6-14 mg P/m2/yr and 6 mg P/m2/yr for dry deposition. Range of reported values are consistent with what we're reporting here. Dry deposition data are sparse and agreement is not very reliable.

Overhead A15-A17 - Presented aerosol data (Improved Network) from an Everglades National Park (ENP) site and a site near Tampa, paired by date. Noticeable effect in ENP, must be something going on. What? *Overhead A18* - Plotted Fe concentrations of fine particles at ENP. Every year get iron excursions periodically that may show Saharan dust. Doesn't explain the whole story. *Overhead A19* - Also, did a plot against K, indicates wood burning. May be getting

a signal of cane burning in the EAA. Could be an impact on Lake Okeechobee, as well. Believes these are of local origin, as no Na/Cl in the aerosols, so not a marine signature present.

Paul Gray – Most burning is in the dry season (Jan./Feb..). Could check that.

Arnold Silverman – One of the greatest sources of phosphorus is from the Saharan Desert.

Curt Pollman – Yes. Wet 10 mg P/m2-yr. Dry deposition is much smaller, but 20 mg P/m2-yr is a good high-end estimate.
Dave Correll – Does the concentration in phosphorus change as you move across the lake.

Curt Pollman - Lower deposition rates may occur at the center of the lake.

Paul Gray – Looked at role of dust from agricultural areas blowing across the lake.

Curt Pollman – Hasn't looked at this. It could impact southern part of the lake.

Bill Walker – Offered to present data he has related to this. Could re-enforce Curtis' findings.

Karl Havens – Role of waves forming on the lake?

Curt Pollman – Jack Winchester hypothesized that enriched surface layer could generate droplets with 200 ppb phosphorus when moving aerosols around. They may redeposit or actually could leave the lake.

Bill Walker's presentation:

Measuring atmospheric deposition in refuge 1993-98. Have 4 sites center, southwest (has no tree islands, increased bird contamination), southeast, and south-central. Least bird impacts at central site and get the lowest numbers here. Try to set up alternative bird roosts, but generally didn't work. Get drip and splash contamination as lid moves from one side to the other in the collectors.

Summary of total deposition rates. Tried to screen out contamination. Excluded samples with dropping or animal material, and further for things like samples with spider webs.

Wet deposition 12-39 mg P/m2-yr, and much higher at southwest site. For dry deposition, get 16-100 mg P/m2-yr, w/ 118 mg P/m2-yr at the contaminated site. Best guess is 16-23 mg P/m2-yr, but still have contamination, so still an overestimate.

Plotted rainfall versus wet deposition. Strong inverse relationship. Higher at low rainfall, dropping with extended rain. Station 1-9 is the clean station. Don't see a strong signal tied to the cane-burning period for wet deposition. Get 10-20 mg/m2-yr total deposition at the clean stations. Past studies assumed 35 mg/m2-yr, so its about a factor of 2 higher than what was found here. This would cut the atmospheric load to about 35 tons/yr.

Curt Pollman – Dry deposition flux (draw air across a filter) = Deposition velocity (highly uncertain) function of particle size x phosphorus particles. Need to do sensitivity analyses to account for this. Use a high velocity if phosphorus tied mostly to large particles and a low velocity if you assume phosphorus is tied to small particles.

Jerry Brooks – In summary, suggests that 15 mg P/m2-yr is a reasonable number for the atmospheric deposition of phosphorus on the lake. Dry deposition may be lower due to the size of the lake. Wet deposition seems to be around 10. Are there arguments against this value? Tom, is there a paper that is coming out that refutes this?

Tom James – Paper will include that value in the acceptable range.

Bill Walker – Need sensitivity study to see how much this matters. He has done some work to look at this. Could show now or at the end of the day.

Jerry Brooks – Any other reasons that 15 doesn't work?

Curt Pollman – 15-20 sounds good, but would like to see the sensitivity assessment.

Bill Walker – It appears that up to 30, the model isn't very sensitive. He would pick a higher range, having used 20 in his work to be conservative.

Curt Pollman – 15 is close to the low end. Prefers 18ish, but sounds like it may not be a very sensitive factor. People will attack the dry deposition rates. If sensitivity studies show it doesn't matter what we select, then we don't need to collect any better data.

Jerry Brooks – How about 18? The group agrees. Audience input? (None)

Break (12:30 –12:45 PM)

Remesh Reddy Presentation on phosphorus levels in sediments in the lake:
Work was done about 10 years ago. Copies of Overheads were distributed. *Overhead S1* - Showed sampling grid for Lake Okeechobee. Looked at sediment types using cores. *Overhead S* 2 - 1988 figure with sediment distribution compared to 1998 mapping. Did diving to confirm at some sites. Mud zone is moving to the west into the sand zone. Peat and littoral zones appear to be stable.

Overhead S3 - phosphorus retention capacity: mud>littoral>peat>sand sediments. phosphorus solubility in mud and littoral sediments is governed by Fe under oxidized conditions (at sediment/water interface), and Ca under reduced conditions. Phosphorus fractions in surface sediments: mud zone, 13% is in stable form, 75% is in calcium bound form, but may not be stable. 3.7% is linked to Fe.

Overhead S4-S6 - Dissolved fraction gets into the water column. In the water column, algae control the phosphorus solubility. Fe controls soluble reactive phosphorus in oxidized zone of the sediments. FePO4 is stable so long as stays oxidized, but once its buried, exposed to the

reducing conditions, Fe changes form and PO4 becomes available if recycled in to the water column. Ca or Fe controls soluble reactive phosphorus (somewhat uncertain).

Overhead S 7 - Dissolved reactive phosphorus very high at lower redox potential. > redox potential of 300 mV, Fe controls, low dissolved phosphorus available. By comparison, Ca controls the availability of phosphorus in Lake Apopka under all redox values.

Overhead S 8-S9 - At high pH sediment conditions (9.5 SU) and high resuspension, get a lot of dissolved phosphorus available to the water column, see a 10 fold increase. Occurs at times of high photosynthetic activity. Does not appear (do to buffering) that this occurs in the lake.

Overhead S 10-S11 - In the mud zone – bottom vs. resuspended sediments: appears some phosphorus in bottom goes to the solid phase (not all desorbs); but for resuspended matter, it appears that most of the phosphorus desorbs.

May see a seasonal effect in pore water concentrations (lower in winter). May be due to microbial activity. *Overhead S13-S14* - Amount of soluble reactive phosphorus increases over top 5 cm: 1.4 mg P/L versus 0.1 mg P/L.

Bill Walker what is the mixed depth then? 3 cm?

Overhead S15 - Diffusion supplies phosphorus from depth in the sediments up into the mixed layer. Maybe up to 10 cm. Concentration of phosphorus in the sediments appears constant from 10–30 cm. Estimate of the diffusion coefficient is uncertain. Bioturbation could make it much higher.

Overhead S16-S17 - Brought cores from the field into the lab. Able to maintain aerobic conditions in the boundary layer. Checked pore water profiles, found similar to those in nature.

Overhead S 19 - Dissolved reactive phosphorus fluxes between 1989 to 1999 didn't vary much: some increased, some decreased. Soluble phosphorus flux values from sediment are lower than what is seen in other waters. Similar to Indian River lagoon, much less than Lake Apopka or Tampa Bay. 1-5.3 mg/m2-yr Apopka 0.1-2.2 Lake Okeechobee, 0.6-1.7 Indian River Lagoon.

Bill Walker – There is a net accretion in the lake, which is likely to be occurring within the mud layer?

Remesh Reddy – Yes.

Lunch Break

<u>Continued Remesh Reddy Presentation on phosphorus levels in sediments in the lake:</u>
*Overhead S*20-S21 - In lab, purposely depleted oxygen concentration. Mud zone sediments showed a 10-fold increase in available phosphorus.

Overhead S 22 - Pore water iron shows a similar distribution, increasing with depth. *Overhead S* 25 - Did a number of lab studies to show role of oxidized sediments and phosphorus availability.

If add low phosphorus water, see an increase of phosphorus from the sediments. Did it as the control. Then repeated with flows having progressively higher phosphorus loads. Water is a sink up to a point, then becomes a source (e.g., when they added 1000 ug/L total phosphorus to the overlying water).

Overhead S23 - Load of total phosphorus to water from mud = 266, sand = 61, peat = 110 metric tons/yr.

Overhead S26-S27 - If assume all sediment phosphorus is available (in the top 10 cm) it would take 500-600 years to get rid of it all if you had clean water coming in.

Curt Pollman – With a 5-cm exchange depth, gets about 15 or 20 years for a removal period to reach equilibrium. 28 million Kg are available.

Bill Walker – He gets about 30 years to enter into a new equilibrium for any change in the loading.

Remesh Reddy – Could see a reduction in the available phosphorus over time as the planktonic carbon:phosphorus ratio increases. Shortens the time needed to reach lower phosphorus in lake. Just a hypothesis.

Bill Walker presentation: "WQ data analysis and phosphorus mass balance modeling." (*Overhead W1)*

Looked at long term phosphorus trends based on the 8 pelagic stations (*Overhead W2)*, spatial variations, and bloom frequency versus Chlorophyll a.

Annual median phosphorus trend, using the seasonal Kendall slope (*Overhead W3*), shows 2%/yr for 8 open lake stations for total phosphorus (*Overhead W5*). Chlorophyll a trend is less certain (1.5%/yr) and turbidity was also about 2%/yr (*Overhead W3*). Methods have changed over the years for most measures or turbidity.

Appears trends were more pronounced earlier on. L005 has the strongest trends (*Overhead W4-W6*).

Karl Havens – Makes sense that the western and southern stations are the only ones trending up significantly in recent years.

Bill Walker – See Highest chlorophyll a at a midlake station even with lowest phosphorus levels, due to lower light limitation (lower turbidity) (*Overhead W6*). Bloom frequency increasing with time, particularly after 1988 (*Overhead W7*).

In the open lake, blooms are not very frequent below 50ppb annual median total phosphorus (*Overhead W7-W8)*.

*Overhead W*9 - Lake Model – Mass balance for phosphorus 1973-1998. The numbers represent fluxes, not concentrations. Assumed the 20 mg/m2/yr value to set 35 metric tons/yr atmospheric deposition.

See a stable or reducing load trend, but must be something else going on to explain the increasing total phosphorus concentration trend. Mean depth over time is rising. *Overhead W11* - Water residence time is variable (ranges from 1-10 years), averages about 3 years. Can't use a 1or 2 year time frame to model unless you use a truly dynamic model. *Overhead W10* - Used 4 year rolling average because it worked. 3 years may work also. *Overhead W1* - Phosphorus residence time in the water column is also about 2 years. Saw a decreasing trend in the net settling rate since the 70s.

TF – Believes the outflow total phosphorus levels are relatively flat.

Bill Walker – If the places where the outflows from the lake are changing (from high concentration areas to low concentration areas) could explain why total phosphorus in-lake is increasing.

Overhead W13 - Proposed TMDL = Qnet + Knet Area Ctarget = Linflow + Latmos – Lremoved, so Linflow = TMDL – Latmos + Lremoved.

Overhead W14-W15,W18 - Need to figure out what causes an exponential decline in Knet, about 6.5%/yr. Declining settling rates lead to less ability for the sediments to retain total phosphorus. As sediments build up, more is recycled, lowering settling rate. What was the area of the lake before the levee? If area decreases, less retention capacity.

Curt Pollman – Lower calcium could affect total phosphorus concentrations.

Overhead W18 - Bill Walker – Possible factors: Gradual accumulation and recycling of phosphorus, decrease in lake area (by creating the dike), recycling aggravated by increased water depth (due to wave action, resuspension, intermittent stratification and O_2 loss, loss of rooted vegetation, increased horizontal transport, and included light limitation of algal growth).

Is it reversible? Decrease external load, decrease water depth, remove sediment, re-establish vegetation.

Don't know if we can tell if the settling rate can be returned to higher levels, so assumed use of the 1994-1998 rate.

Overhead W19-W20 - Lake O TMDL Calculation summary:

Used a variety of Knet (settling rates). 1984-1996 rate used to match up with the WASP model period.

Provides ranges of inflow load reductions for each period. Ranged from 30% to 75%.

Overhead W22-25 - Gave an example of how the TMDL could be allocated. Base case, then adds Stormwater Treatment Areas (STAs) before the lake, then applied a lake water recycle STA (performance is enhanced over STA that does not operate continually). If Knet goes up, then can remove more. Can play with the size of the STAs. The performance of the STAs (based on the Everglades Nutrient Removal Project) will be more predictable than that of BMPs.

Jerry Brooks - If went to the Reservoir stormwater Treatment Area (RaSTA) approach could have efficiency higher than that of the standard STA.

Bill Walker – Based the effectiveness of the lake recycle STA on an Everglades test case.

Phil Mancusso – From Clean Water Act perspective, need to make sure actions will result in improvement. Need to include things that will get you to the goal. Can't include things that may happen in the future. And needs a Margin of Safety (MOS).

Bill Walker – MOS could be done by sizing the STAs.

Phil Mancusso – Need to use conservative estimates for values. What you do for implementation is different.

Curt Pollman – If you mess with using conservative values, you lose your best fit. Better to just add more tons of removal needed at the back end, use that as MOS. (Explicit vs. implicit approach)

Bill Walker – Need to improve lake residence time estimate, using the new regulation schedule.

Jerry Brooks – We may be overestimating outflow now.

Karl Havens – We can look at the historic changes in outflows/locations. Calculate loads.

TJ – Will get that and other data through 1999 to Bill Walker.

LM – You can get water budget info from the Restudy web site.
Jerry Brooks – Wrap up. WMD to provide data on outflows to help estimate settling rates. Need input on effects of stage on retention, then we could use this as a factor for management. What variables are affected? Understands can't take credit for it in the TMDL necessarily.

What was the concern TF had on Bill Walker's work?

Tony Federico – Had to do with estimates of the outflow, needs to look more closely at what Bill did. No predictability as to which outflows will be used and to what degree.

Jerry Brooks – In the Neuse River in NC, EPA approved a phased TMDL. If we regulate the lake and use reductions for now and evaluate options as time goes on. Would that be consistent with the NC case?.

Tim Wool – Neuse applied a 35% N reduction based on Tar-Pamlico. By July, 2000 they have shown that it is going to work. Can't apply these things to the TMDL calculation, but can do so in the allocation.

Karl Havens – OK to take water out of the lake, put it back in, and take credit for it?

Tim Wool– Yes.

Phil Maniscusso – A lot of uncertainties to be discussed. For example, is an Aquifer Storage and Retrieval (ASR) a recycled load or a new load?

Jerry Brooks – By the next meeting, want everyone to think about Bill's work. Will get agenda out earlier next time.

Wrap up:

- The SFWMD (Tom James) will work with Bill Walker on getting more data.
- Effects of stage on total phosphorus concentrations in the lake (Bill Walker) – managers will need this for decision making
- Address questions on Bill's model (especially outflows)
  - Use of a phased TMDL
- Build upon what Bill has presented
- Gary Warren presentation or other presentations?

Public comment?

Paul Gray – What will the TMDL do to solve the faunal impacts? The TMDL will solve the algae problem, but if you don't do something about the mud bottom. Mud is not the same as sand. Critters that live in sand can't live in mud, so you have an impact on fauna. Mud also affects turbidity. Supplied copies of Audubon's comments on EPA's TMDL.

Jerry Brooks – Anything else? (no) Dates for next meeting. May 3 (Wed) and May 31 (Wed). Propose to hold them in WPB. Will set the sites. Can change the 31st meeting if that's a problem.

Adjourned.

Lake O TAC Meeting of 5/3/00
West Palm Beach, FL

All TAC members in attendance. 12 audience members.

Overview of April 6 meeting by Jerry Brooks.

Agenda revision. Will add time for CP to present his recent work w/in Item III.

Follow up from last time. Paul Gray sent a note that we need to consider other ecosystem components. Gary Warren (Fish and Wildlife) is one such expert we should hear from (macro invertebrates). Gary says relationship is not as direct. Willing to give a presentation in the future to show link between TP and macros. He does believe that the TAC is on the right track using algae.

KH – Provided updated data on bloom frequency handout to the TAC.

JB – Any comments? No contradiction from what we previously thought.

BW – Aren't we beyond a discussion of the 40 ppb issue?

JB – He thinks so, but anyone else?

BW – If that is a pelagic target, we assumed that the nearshore zones will be better protected. Maybe we should look at how much better? Has anyone looked at that? Karl?

KH – Tom James has.

BW – Should do it for the record. Probably varies with the water depth. Could provide an incentive to lower the lake level, as the gradient would be steeper as water depth gets shallower.

CS –

JB – Two issues for lake management. If lake is high, maybe the lake is very homogeneous, and may be 40 ppb does not protect the near shore zone. Maybe we need to set a target to protect the littoral zone instead. Use that to drive water levels in the lake.

KH – Look at the 30+ years of data for open water areas vs. near shore, under differing stage levels. Difference is less under high stage.

CS – At some water level you still have a TP sink, above which you may lose the sink or get an added source. Affects your Knet.

BW – Do the littoral zones act as an STA under certain flow levels?

KH – Could be near the Kissimmee, but most of the SAV recovery will be in the southern part of the lake (where there are no inputs).

AS – Is the question whether 40 ppb is a reasonable target? And allow to temporary excursions? How much uncertainty should there be around that target?

JB – Had concluded that at higher lake levels more TP migrates to the littoral zone. At lower lake levels inputs like rain and inflows determine the TP levels in the littoral zone. Its not the assimilative capacity of the littoral zone that is changing.

CS – At high levels, the littoral the zone size changes. We need to discuss this when we discuss Knet. Agrees with Jerry's general assessment, but need some recovery time for the littoral zone after the water level drops. Littoral zone might be a significant sink.

RR – Just a temporary sink over time.

KH – I think of littoral zone as being those areas that no longer have bulrush, for example. If we could get those to recover, then could get an added sink.

CS – How big is the littoral zone? (He thought 400 km2.)

KH – About 20-25% of the lake. Once you get behind the cattail wall, you are fairly isolated.

BW – Either way its not a huge sink.

CS – Not huge, but even 20% is worth discussing.

JB – This is all part of the Knet discussion. We can't deal with all the details. We need to move forward. Focus on the pelagic zone and indirectly protect littoral zone. If lake stage is high, that latter protection may not be there. Thus, maybe we need to shift focus to littoral zones being protected. If we have to protect the pelagic portion of the lake by going to 10-20 ppb, we'll never get there.

KH – Need to say lake levels are part of the solution.

BW – Can that be part of the TMDL? Vary the TMDL by lake level? Or could do it for a high lake level, and that covers lower levels.

JB – De-couple as much as possible. Adds complications.

KH – Restudy kicking in may lower lake levels beyond what we assumed. Effect might be to shorten the time period for recovery to occur.

PMU – Should focus on best estimate of the existing conditions. Recognize that things vary due to man's actions and to nature. Can go back and revise the TMDL once the Corps schedule changes.

BW – Will give you a chance to see what happens to Knet, can't predict what it will be.

KH – Knet has been steadily declining, has not leveled off yet.

BW – Increased a bit last year, but only one year of data.

JB – Recognizing this potential flaw, still recommend looking at the pelagic zone and setting its level. Public comments?

(None)

JB – OK, look at the assumptions for setting the Knet value presented last time. Karl?

KH – Water to S-308 to St Lucie and L-8 to the Caloosahatchee. Outflow has not changed significantly over time.

JB – Tony, can you explain your concern over Knet values?

TF – One, need best TMDL in time allowed. Separate the MOS out. If you use a steady state model, it doesn't deal with transition time.

Model issues – measure outflow from the lake using in-lake conc or the actual outflow data? To develop an isolated mass balance for the pelagic zone, causes problems. Don't know the relationship between it and the one for the littoral zone. Can you do that if have a one-box model for the whole lake.

BW – With a one box model, better to use the pelagic zone rather than outflow data. Not much difference in the last few years.

TF – Don't really have a mass balance for the pelagic zone, but do for the lake.

KH – Rim canal is deep and acts as a settling zone.

TF – Views the rim canal as part of the lake. Taylor Creek enters via a rim canal.

BW – If you calibrate to the outflow conc, and then translate to the pelagic zone (for your target)? Don't you get back to the same place?

TF – We're setting 40 ppb as the lake wide average based on stations that aren't open water.

BW – Station 5 might be an outlier.

KH – And Station 7.

TF – That's 25% of the stations.

BW – Not much difference in recent years data.

BW Powerpoint presentation.

Flow weighted mean for the L-8 conc before 1987 is only 2 data points, also true for INDS before 1982. And the data at 900 ppb values are suspect. Limited data for S2 and S308 drives flat lines and odd spikes.

TF – Are these data really missing? Doesn't recall there being these data gaps.

TJ – Some data may have been removed through a QA process to remove outliers.

BW – Program to fill data gaps may be inappropriate. Need to use something else and not use a single data point to interpolate.

BW – Noted that some structures were ignored after 1992, but they're less than 1% of the total flow.

TF – Sampling is done every two weeks at each structure. Couldn't have these data gaps unless severe editing was done.

BW – That is the way the data are in the data base he was given.

TF – This needs to be checked.

KH – Can't do it now.

BW – Fortunately, don't need the early data to calculate Knet. But should decide if we want to follow up on it.

JB – More fundamental question from TF is whether we look at actual outflow data vs. discharge flow data and in-lake pelagic data? At first thought TF was right. But the problem may be using the restoration target for the pelagic zone of the lake, then need to use that number.

TF – Would agree if the mass balance could be constructed for the pelagic zone. But we can't because significant loads don't go directly to the pelagic zone.

BW – Would need more than a one-box model. But thinks he make this problem go away.

Slide on Yearly Settling Rate:

Not much difference between rates after 1987 whether you use inlake or outflow concentrations. And thinks we have better data since then.

Cumulative Settling Rate Slide:

Appears that since 1992, the settling rate has remained about the same. Get a rate of about 1.4 m/yr, and slightly lower if you use the outflow data for 1996. As they are about the same, then which you prefer doesn't matter much.

TF – He understood that we assume the lake is in equilibrium (lake, vegetation, etc). So what is the Knet for the period when the TMDL levels are met (=40ppb).

BW – Hard to do, Knet is independent of lake TP concentration. Earlier on, the lake was not in equilibrium.

JB – Don't fully know what drives Knet.

KH – Don't know what Knet will be at 40 ppb.

TF – Knet would be higher.

KH – Not sure about that, can only guess that Knet would be some positive number.

BW – Equation assumes Knet is independent of concentration. Other empirical lake models assume Knet would be lower at lower concentrations. But not calibrated to this lake. Does not advocate using a different model. We have enough data to calibrate his proposed model.

CS – What changes the Knet then?

BW – Only works in steady state world.

CP – My work will show that the Knet will change due to feedback from the sediments. May be the same if the gradient remains the same between the interstitial water and the lake concentrations, then Knet could stay the same.

RR – Partitioning coefficient may change due to the shift in the make up of the sediments coming in.

CP – Had to assume burial rates and TP concentration. Drives what your calibration looks like. Had more buried than what is delivered, then reduced it by 30%. Point is, the sediment reservoir increases then feedback increases. Got a pretty good match for the last 4-5 years. Allows for a dynamic Knet. These last few years were not part of the calibration period.

BW – If use CP's model, still have to figure out the Knet.

CP – My model doesn't use Knet.

BW – Yes, but still must use the CP model to match the data. Model allows us to look at results from changes in Knet. How do you start?

CP – Looked at data for sediments. Used 1990 value of 1.4 mg/kg, then backed it off to 1.2 mg/kg for the earlier period. Need to look at this assumption more. Believes the steady state concentration is 1.6 mg/kg. Could do sensitivity analysis to see how much this matters.

BW – What is your time step? A year?

CP – No, using a short time step, with monthly data. With either model, thinks we'll get to the same loading rates. However, his model allows prediction of how long to reach the new steady state. Saw an article saying the EPA estimate is 200 years to recover. He believes a mesotrophic lake will react faster than would a oligotrophic lake. Rapid drop in first 3-4 years and 98% drop within 40 years.

PMU – Will get copies to any TAC members wanting a copy of EPA's TMDL, but theirs also shows most of the recovery occurs in the first 30 years in all cases examined. Added a MOS to the original TMDL.

JB – We decide early not to have this group evaluate or criticize EPA's TMDL. Start with a clean slate. May be ready to look at it soon and compare approaches used. Do want to be able to address recovery time. EPA model was criticized by some as not being able to do this. CP, are you ready to present your work today?

CP – Can show basic elements. Extends Bill's mass balance model. Added some dynamic features.

KH – At some point the TAC will likely have to endorse a model. Have three choices so far.

TF – Can we get the models, allowing each of us to reproduce their results?

CP - Sure, once we're more comfortable with the product.

BW – Mine is ready, as its just an equation.

JB – Also be prepared to consider other approaches. But need to understand the weaknesses of each. Decide which is better overall. Also look at the EPA model and weigh it against what we have.

PMU – Just to clarify, EPA's model is not EPA's model; it was taken from the WMD. There were some modifications that EPA applied.

Lunch

BW – Revisit TMDL from last month's meeting. Went over changes he made due to extended data including 1999. Changed rainfall P to 18 mg/m2-yr, settling rate to 1.4 m/yr. Found higher net inflows. Largely due to higher Knet, TMDL is now 175 mtons/yr (vs 154 mtons/yr) and watershed inflow concentration increased to 57 ppb from 47 ppb.

BW – May need to revisit due to north storage areas and ASR projects. More goes out than what comes back.

Discussion of Mean (31 year) Annual Lake Okeechobee Inflows/Outflows in 1000 ac/ft.

KH – Can you assume the Restudy will be implemented, when calculating the TMDL?

PMU – No, you can't include things until they are built. If you have started a STA, you can count it. Also, can revise once you build other things.

JB – Need to think about the impact the TMDL will have on the Restudy and what the Restudy will have on the TMDL.

BW – Used the Net Inflow value assuming the Restudy for his latest model.

JB – Limit inflows and outflows data to match the period in which you have the higher quality record (used to calculate Knet).

BW – Could do that, but you're looking at a wetter period.

KH – Have been thinking about whether you can mix and match periods for each of these different factors.

TF – Can we revisit the declining Knet graph? If you go back farther, does it make sense that Knet could be 1.4 m/yr in the original state? Doesn't look that way.

CP – Could have happened, because when you introduced a perturbation, the rate could have jumped up.

TF – Doesn't think the Knet would be 1.4m/yr at 40 ppb TP.

BW – The errors from the model are independent of the lake concentrations and of the inflow volumes. Using the Restudy flows may not change things much. Decide on a time period, 92-99? Or the whole record? Shouldn't bias it to a wet period.

Options: Average inflows 92-99 2382 million m3/yr vs. 1973-1999 1753 million m3/yr.

KH – If you use the recent Qnet, it increases the TMDL by 25-30 mtons.

JB – Is Knet independent of flow?

KH – If "Yes," then need to use the longest period of record.

BW – Agreed.

JB – Is Knet also independent of stage?

BW – May be independent of this, as well.

CS – Not sure of this.

CP – It has to be independent of the volume. It's a function of the surface area and the settling rate. Whatever the conc is in the water column, it will stay the same. We're talking about what happens at steady state.

CS – Its not a steady state.

CP – Will reach a steady state for the water column TP concentration. Fluxes have to match, can't change with volume. Long-term record does not show clustering of residuals (from statistical analysis) around a particular water stage.

TF – Did the WMD do an assessment of the wind/wave relationship?

KH – Not that has been written up.

BW – The critical factors compete. Shallow waters allow sediments to be stirred up more easily, but deeper water allows bigger waves and more circulation.

CS – Isn't more likely you under estimated the loads at the inflows/outflows due to frequency of sampling. 26 grab samples/yr isn't enough.

KH – 60% of the water leaves through evaporation, but phosphorus remains.

TF – But you have rainfall.

KH – Assumes not big ground water loss.

TF – Isn't there? What about the seepage water the farms pump?

JB – Can't really say we have consensus.

KH – Is everyone OK to use flow data all the way back?

TF – Needs to think about this.

BW – Leads to a TMDL of 167. However, the inflow concentration is insensitive, which is really what you'll measure to check progress.

AS – What is the ake stage when area is 1739?

TJ – About 14.5 ft is in the literature.

JB – If the area of the lake affects the Knet due to changes in the littoral zone, then maybe you need to look at the concentrations at the structures.

BW – Are you saying only looking at the area of the pelagic zone?

JB – Thinks so.

BW – Will get you a higher Knet, but you get the same TMDL.

JB – In looking at the outflows, need to look at the whole system (per TF suggestion). Captures all the activities in the lake. BW looking at flows at the structures and the concentrations in the center of the lake. That gets you higher outflow loads and ignores the removal in the littoral zone. Gives you a different answer?

KH – Doesn't think the answer changes. Recall from Bill's earlier graph, the lake and outflow concentrations are about the same since 1985.

JB – That addresses his question.

KH – Only matters if you decided to back in time, then the two values will differ. But we're not going there, are we?

TF – Not sure I'm there yet.

KH – Well, what would be the mechanism that will get you to a higher Knet?

(No answer)

Greg Graves – How can the lake discharge concentrations be higher than the lake concentrations?

BW – Some peaks are bogus data.

KH – Some data reflect values from a station where the water experienced higher resuspension than across the 8 stations used to average for the lake value.

CP's Presentation

3-Box model approach extending Bill's work. Has the water column, plus surficial sediments and interstitial waters (at 200 ug/L). Includes atmospheric values (but used old numbers for deposition). Will update by next time. Assumes the concentration in the mud zone (fluid phase) dominates the conc in the water column. Used burial rate from Brezonik + Engstrom using mud cores and lead dating. Surficial sediments (solid phase) assumed to have 1.2 g/kg.

BW – What happens to P deposited outside the mud zone?

CP – Assumes it is all eventually carried to the mud zone.

RR – Mud zone covers 40% of the lake.

KH – Assumes no return from sand?

CP – Could modify, but thinks this is small.

Slide comparing model results for water column. Shows poor agreement until about 1983, then good except for one separation (which was also seen in other models). Pore water results show a drop after 1988, due to lower P loads coming in.

Slide showing water column variations:

CP – His model is not set up to reflect short-term shifts, say on a daily basis. So, the model does not do a good job of showing variation, but does show trends. Can't use to show short-term dynamics.

KH – Doesn't necessarily see even the trends. Would smoothing help?

CP – Could do that. Hard to see in this plot.

RR – Thinks the buffering capacity of the sediments is reducing over time. Therefore, the trend may be upward. Did the partitioning coefficient change?

CP – No, left them the same. Could alter them if you thought they changed over time.

RR – Could you use the first half of the data set to set the partitioning coefficient and calibrate the model. Then check against the second half of the data set?

CP – Doesn't see why. There is no fixed relationship between the TP concentration in the lake in the pore water.

Greg Graves – Doesn't see that the model reflect the increasing trend seen in the actual data. Looks like it over estimates early on and under estimates later data.

CP – True for the early part, but thinks it fits well at the end. May help to look at the annual data.

KH – Having looked at all these models, need to have some factor that varies like SAV in TJ's model.

BW – To start the model, you need some TP storage for 1973.

GG – Assumed mud area stayed the same since 1973?

CP – So far, yes. Didn't know how it changed as a function of time.

GG – That would bring the predicted line down.

KH – We have that information.

CP – Will look into that. Reason for model is to look at role of feed back from sediments. If you drop the inflow load by 70% and hold Atm load constant. Get immediate drop in the water column levels. Then the role of the sediments takes over. Shape of the curve and time to accomplish initial drop determined by the depth of the reactive sediment layer (thinks 3-5 cm).

GG – If the recovery period is 30 years, that seems to indicate you don't need to remove the mud?

CP – Will still affect time to reach leveling off of water column P. Model is very sensitive to what depth you use for the mixed active layer of the sediments. Actual resuspended depth is just a couple of millimeters. Advantage is you don't need to calculate a Knet.

KH – You still get a Knet.

CP – Yes, could do that and compare, but it's a product of the model, not an input value.

BW – Response times of both models are about the same.

JB – Given the early stage of development, does CP's work represent the next step?

TF – Can't really say at this time.

BW – Not really all that different approaches.

KH – Will you end up with the same sort of a family of curves as in the EPA TMDL?

CP – Yes.

KH – Can you do some sensitivity analyses?

CP – Yes.

KH – If you have several options that will get you there, then it is no longer a technical consideration. Its policy that sets the time to meet the goal.

BW – Solve it for a steady state of 40 ppb leaves you with only one answer. Other answers can take you below 40 ppb in the water column. There is no response time set to that. However, it takes an infinite amount of time to actually get to 40.

JB – But all values above that never get you there?

BW – Right. If you need to add a time element, then you could use CP's approach.

CP – Could make your life simple to take the steady state approach and say the 3 residence times of the sediment gets you to 95% of the answer. Not have to worry about using a dynamic approach.

JB – Would the two models get you about the same results?

CP – Should because you rely on the same basic principles.

PMU – Time is not a factor you consider. Just set an external load. Time to get there was not required, but was included to because it was available.

JB – There was some concern over running the model out that far, particularly by running it using the same input data again and again. Why are BW's and EPA's models so different?

BW – Each used a different Knet.

PMU – What was the EPA's model active sediment depth?

TJ – 11 cm.

KH – Short recovery time surprises him. Lakes around the world show a longer recovery time.

TF – Lake Toho recovered quickly, right? Based on a 6-month turnover time.

TJ – Turnover time for Lake O is 3-3.5 years, so the recovery time would be 18-20 years, given the 3 year recovery time for Lake Toho. Amount of sediment TP plays a role.

TF – Let's focus on the steady state, then can worry about the recovery time. May take 50 years to get the inflow concentrations down to where you want them.

JB – If the two models get you there, let's use the more simple of the two. Does everyone agree that we ought to keep it simple?

BW – Knet may go up or down, so may there is value to look at the dynamic model to decide if Knet may continue to go down. Can't tell right now if Knet hasn't just been stepping down over the last few years.

JB – Can we say there will be an increase in Knet? If not, then we can't propose to use a higher value.

BW – Better to see what the future Knet values are then, tweak the TMDL accordingly.

JB – TF is saying we should apply a Knet that matches 40 ppb. If you choose to use a 3+ Knet, then apply to model. Get a higher load (324 tons/yr). How are we confident that we can get to the target given what we're seeing today?

TF – Bill's model gives the load allowable once the lake is at 40 ppb. Right?

BW – Yes.

KH – Only CP has offered an explanation of why the Knet was higher historically. Anyone else?

CS – Doesn't think Knet could be lower than what we're discussing.

PMU – Repeated thought that the TMDL should be iterative as the things that are known. The EPA TMDL is legally accurate, legally defensible.

RR – Thinks the Knet will not change once the lake is at 40 ppb and inflow is at 57 ppb.

CS – Thinks you will see a change if the biological component controls the TP concentrations rather than the sediments.

KH – Lake in the Netherlands is much like Lake O. Shallow, wind driven. TP levels are about 200 ppb. It is not responding to load reductions. They are looking at dredging.

BW – If you tie it up biologically, what happens?

CS – It will drive the Knet up. Nothing left to settle.

KH – How much could Knet go up then, 10-20%?

RR – Go with what you have now.

CP – I've run the model and found that the Knet will go negative for a while, then climbs again until you reach steady state.

KH – Shouldn't revisit the Knet in 5 years. When you drop the loads, the system isn't in steady state.

TF – Won't see dramatic load reductions in the watershed. How about developing the TMDL as an equation?

CP – To follow up on Karl's earlier question. At 324 mtons/yr, leads you to 61 ppb inflow.

TF – Still wants to have the raw data checked.

KH – Will do so.

JB – Need to think about whether the Knet should be higher or lower.

TF – Could set the TMDL as an equation. It would vary year to year.

JB – My concern is that an implementation plan must be linked to this TMDL.

TF – No practical link between the two. It's a function of money.

PMU – The CWA says it's to be a load, not an equation.

JB – The number we generate is going to be based on an equation. This might reduce our workload in the future.

PMU – When you go back and recalculate, why isn't that a new TMDL?

KH – What happens if its an equation and the Knet is zero in 5 years? Then the TMDL really drops. What do the have to do then?

JB – At current TMDL of 160 mton/yr, set up the design to get there. Say we revisit it 5 years from now, the TMDL is lower. But we're doing all we can do as a practical matter. May have data to show we need to have to do more.

PMU – Need to go back to rulemaking for the new TMDL.

JB – If we can agree on the equation, then doesn't want to go to rulemaking every time. That only opens the door to more challenges.

PMU – Gut reaction is you can not have an equation. Will look into that. Will the state's bill force you to have to revise your allocation each time?

RR – Knet could only go negative if the inflow concentrations are less than the lake concentration.

KH – What are the consequences of finding a lower Knet?

Larry – Based on Curt's range of values, and the equation, you may swing from needing distilled water to having to do nothing. This doesn't make sense. Particular problem if you are not confident about the data.

BW – Doesn't like the idea of an equation. May be many things to revisit in 5 years, not just the settling rate.

TF – A number is the extreme hard wire.

BW – That's the honest approach. It represents the best knowledge we have now.

PMU – Doesn't think the answer will come back that an equation will be OK.

TF – Equations are used everywhere! Won't be able to get to what Knet is at now. We probably won't ever decide or get consensus on what Knet is. The equation gives you flexibility.

RR – The target is fixed, right?

TF – Yes, the target is fixed.

RR - The Knet can only reasonably go down in this case.

CP – A dynamic model may show you what the Knet could be.

CS – Really discussing how often we will revisit it.

JB – Favors an equation because we figure out what the Knet is. Maybe CP's approach will help limit the range of Knet values we might see.

CP – Proposed starting with a long-term Knet predicted value as a starting point.

BW – We still would need to understand where each of the 6 parameter variables CP used. Have to understand the model better.

KH – Let's say in 2 years, it is decided that sediment removal is the way to go. Does the TMDL automatically go up?

JB – Yes, if you have some assurance that the action will occur.

CP – May be able to provide later in the meeting.

BW – Tom James paper "Historical trends…" indicates that calcium levels in the lake are lower, which may affect the Knet. Is there a calcium budget?

TJ – No. Calcium is sampled quarterly.

CS – Is there a Chloride budget?

TJ – Yes, in it is in the budget paper.

CP – Calcium fluctuates between under saturated to supersaturated.

CP reported his long-term model results. Starts at 1.45 m/yr and trends to 2.17 m/yr.

BW – This higher value gets you a TMDL of 254 mtons/yr using his model.

PMU – Margin of safety covers the uncertainty of the model, which is why EPA chose a number lower than the calculated TMDL.

BW – Why does Knet go up?

CP – Have to look at the input parameters. Knet drops initially due to perturbation, and then it rises. Will explore further by the next meeting.

JB – Will you have something for the next meeting?

CP – When is that?

Kim – May 31.

KH – What will it take to settle this?

JB – The DEP will absorb all input and reach a decision.

RR – Please send us the equations and inputs.

CP – Will do.

KH – How do we deal with the active layer issue. Does it affect more than the time to recovery?

BW – Yes, it impacts CP's model.

KH – Will pursue possible missing data.

CP – Started with 2 different load reduction (70% reduction and 324 mton/yr) and both gets you to the same eventual Knet, which was expected.

CP – Will also look at historic coverage of the mud zone.

JB – Believes we can exchange e-mails with data, copying Kim, before the next meeting.

PMU – Will there be a TMDL document summarizing what is going on that the state will maintain?

JB – Will have to do that for the administrative hearing we believe will come.

Greg Knecht – Next meeting is here (DEP WPB office) at 9 AM.

Adjourned!

Lake Okeechobee TMDL TAC Meeting 8/1/00 – 8/2/00

Jerry Brooks – opening (Ramesh and Arnold are not present)
Hopes that this will be the last meeting. The group has received an award from the Department for their efforts with Lake Okeechobee. The certificates will be sent by mail. FDEP will propose a TMDL by the end of the month and then will go into rulemaking. Last meeting looked at models from Curt Pollman and Bill Walker. We need to identify differences in the two models that would create the different outcomes. Also, since the last meeting looked at literature to find examples on phosphorus enriched lakes for insight on Knet and phosphorus dynamics in these kinds of lakes. Also, to see how Knet is affected by decreases in phosphorus loading. In some cases, the lakes improved and in others they did not. Did anyone have anything they found in the literature?
Karl Havens found four other journal articles. Provided a handout that summarized the articles.

1. The sediments are a source until the lake comes into equilibrium.
2. Phosphorus reduced, sediments became a source, lake came into equilibrium and there was no net exchange
3. Phosphorus reduced but internal loading continued for a long time.
4. Found that the active layer of the sediment is much deeper than originally thought because phosphorus is still being transported to the water column after 15 years of external phosphorus reduction

Bill Walker – need a method of burial.
Claire Schelske – Great Lakes are an example of change in Knet.
Curt Pollman – Burial rate – affects long term projections. This rate will affect TMDL whether it is constant or variable
Bill Walker – another lake in Oregon – Gene Welsh has a study coming out with an example of an European lake with information on recovery.
Karl Havens– we are looking at time periods way into the future.
Jerry Brooks - Bill Walker send article
Curt Pollman – Presentation on geochemical equilibrium – Homeostasis
Lake is supersaturated with Calcium phosphate – hydroxyapatite

OH3 – there has been a decline in Ca2+ over 20 years – a change by 15 mg/L
OH4 – stoichiometry of calcium
OH5 – discusses the degree of saturation based on IAP/Ksp
OH6 – If the water column is in equilibrium with the hydroxyapatite phase, dissolve inorganic phosphorus will increase with a decrease in Ca2+.
Claire Schelske – Is calcium stable at 30 mg/L
OH7 – H+ dynamics. There hasn't been much of an overall change in the H ion activity.
OH8 – trend plot with calcium and inorganic phosphorus. Used data 1980 to 2000 because he feels that there are problems with data prior to 1980. Should do an ion balance to determine the validity of the data.
OH9 – trend plot with calcium and Total Phosphorus loading.
Bill Walker – 1980 to 1988 calcium comes from backpumping from the EAA (14%)
Tony – There is calcium in animal feed.
Curt Pollman – the calcium follows chloride, which comes from the EAA
OH10 – similar pattern for inputs of calcium and chloride
Bill Walker – could be due to evaporation
Curt Pollman – I looked at that but didn't account for the trend
OH11 – the same source for magnesium is the same for chloride
OH12 – pattern is less distinct for calcium and chloride. There should be more scatter because calcium is biologically active.
OH13 – Ion product calculations
OH14 – Lake is supersaturated with hydroxyapatite. Means that hydroxyapatite protection is a phosphorus sink for the lake. Ratios greater than 1 means that it is supersaturate. All but 2 points are above 1.
OH15 – No overall increase between 1980 to 2000. This may suggest that homeostasis has occurred. The decline in calcium triggers the release of phosphorus to the water column or SRP released to the lake is balanced with calcium so there doesn't appear to be a change.
OH16 -
OH17 – Observed Log SRP plotted against Predicated Log phosphorus. If the data fell on the 1:1 line there would be homeostasis, but the data is above the line but below the 100:1 line.
OH18 – The dashed line is the limiting data (1:100)
OH19
OH20 – As calcite becomes supersaturated, then a whitening affect occurs, which a large release of phosphorus.
OH21 – the data is relatively stable
OH22 – DIP that is available for algae, then to zooplankton then to fish, which all account for SRP. Hydroxyapatite thus has a large affect on DIP. This needs to be studied more in the laboratory.
Jerry Brooks – significance of this to calculating the TMDL? Is this one of the explanations for the difference in the model predictions.
Bill Walker – the mechanism to trap phosphorus is decreasing, resulting in a high water column phosphorus conc. Two explanations: whitening affect and just a decline in calcium
Curt Pollman – Vnet is high when phosphorus is binding to calcium. Vnet decreases as the lake comes into equilibrium. Also a long-term decline in Vnet is where the water column is supersaturated with hydroxyapatite and calcite, so water starts to dissolve them releasing phosphorus into water column.

Management options – add calcium to lake to bring down phosphorus conc. Need to due calcium budget on lake.
Jerry Brooks – what dynamics could occur in the lake to decrease calcium concentrations?
Curt Pollman – Whatever is changing the chloride budget is changing the calcium budget. EAA – active process of pulling water from deeper aquifers which has higher concentrations of chloride and magnesium, so you see higher concentrations of chloride in the canals.
Bill Walker – This is a large amount of calcium, so lime on pastures probably isn't contributing, but backpumping could.
Claire Schelske – to take calcium out of the water column would require lots of phosphorus (calcium is found at 35 ppb, while 100 ppb in the water column)
Curt Pollman – The loss of calcium overtime is due to external contributions. More phosphorus is being dissolved than before because less calcium for it to bind to.
Richard Harvey – Do the EAA farms add CaSO4 to balance the soil pH?
Curt Pollman – It takes 4 residence times to get to equilibrium (residence time is 4 years).
*Calcium Budget needs to be done
*Calcium concentrations in the other basins in the watershed.
Break
Bill Walker – Presentation
Presented calcium plot, similar to Curt Pollman
Presented chloride data and a linear regression – fairly steep decreasing trend for chloride
OH2 – Empirical models – predictions of 4 other water bodies. Provides predictions for outflow loads and then came up with Knet. Vollenveider predicts a Knet for the lake of 1.6 using a 1st order equation. Settling rate declines and loads to lakes decrease. This is seen in all the studies presented by Bill Walker. To get to steady state need monitor 30 – 50 years. None of these models show that the settling velocity will actually increase even with decreases of loading. A low Knet between 95-99 is also result of high water levels in the lake.
Curt Pollman – The Knets for the other lakes don't necessary represent steady state systems.
Bill Walker – The higher Knet for the lake in earlier years is probably due to the sediments not having yet reacted to the phosphorus loading.
Bill Walker – OH not in presentation – talked about predicted settling rate based on midwestern states.
OH3 – observed and predicted yearly mean total phosphorus concentration. The lines don't match. The model needs to be recalibrated. It was underpredicting and needs to add data beyond 1996. Doesn't explain intra-year variability.
OH4 – Adjusted model to go beyond a 1-box model to incorporate sediments. Can still calibrate to water column studies, but may want to go back to calibrate to the processes dealing with the sediments. The 2-box model allows us to predict the sediments reaction to phosphorus load reduction.
OH5 - Calibration plots of inlake total phosphorus concentration and Knet. When lake levels are lower there is less feedback of phosphorus from the sediment to the water column. Lake levels affect feedback.
Karl Havens– When lake stage is high, there is less removal because of different mechanisms (ex. Less uptake by vegetation, erosion of shoreline, light limitation).
Jerry Brooks – Are you still using the 8 stations representative of the pelagic zone?
Bill Walker – Yes.

Karl Havens– 3 of the 8 stations had submerged aquatic vegetation in the 80s when the lake levels were lower.
Phil Mancusungaro – Bill Walker's model shows variance the same years that the Lake Okeechobee Water Quality Model. How is Bill Walker's calibration better?
Bill Walker – Showed calibration model and the positive deviation for the Lake Okeechobee Water Quality Model
Karl Havens– When lake levels are high, the concentrations are high throughout the lake (lake is homogenized); and when lake stages are low, phosphorus concentrations are different throughout the lake.
Jerry Brooks – Bill Walker did you look at the relationship between lake stage and water column total phosphorus?
Bill Walker – If you look at a long-term trend there is a relationship.
OH6 – shows you can forecast using the model. Model solves for steady state with the sediment to solve for Knet. There is somewhat of an immediate effect from phosphorus load reductions, but then the recovery is slow. It takes 80 years to reach 40 ppb in the lake.
Tony – Did you assume a depth of 2.7?
Bill Walker – I used the depths for the last 20 years and repeated them. Those depths have a mean of 2.7.
OH7 – Modified time series using different water management scenarios, constraining the maximum monthly depths. Different TMDLs are generated for different max depths. Should rerun using monthly time steps with monthly depths to see how the model responds. This shows that there is some sensitivity to depth.
Curt Pollman Pollman's Presentation
OH1 – Major Model Revisions. The burial rate over the mud zone is 0.00235 m/yr. Bill Walker used 1 m/yr but this was for the whole lake, not just the mud zone. Used the average SRP/IP ratio.
OH2 – Model calibration. Same problems of the other models – it over predicts in the early years
Karl Havens– Plot of observed vs predicted. The LOWQM didn't predict the earlier years.
OH3 – Predicted sediment total phosphorus concentrations for the top 5 cm.
OH4 – lake water phosphorus calibration using a constant burial rate and then another line when the burial rate changes with sedimentation rate. A difference isn't seen
OH5 – Same as above but with the Porewater phosphorus, instead of lake water.
OH6 – Lake Okeechobee Internal phosphorus Loading Model –
Variable mud zone, but doesn't affect sedimentation rate
OH7 – Adsorption Isotherm Data. Curt Pollman used data from Station O10. He has concern with Reddy's isotherms because he used high equilibrium phosphorus concentration.
OH8 – Kinetic approach works well to predict equilibrium aqueous phosphorus concentration
OH9 – Net sediment burial rate in Lake Okeechobee mud sediments. Curt Pollman's modeled Vburial is 2.5 which matches closely to Brezonik and Engstrom's work
OH10 - Median value – 2.4 mm/yr, which is close to the 2.35 that Brezonik and Engstrom came up with.
In the early 70s, when the system was out of equilibrium, the system was retaining more phosphorus, and began retaining less later as the system started equilibrating to the phosphorus loads to the system.

OH11 – TMDL model runs. Used averages of loads and other data for the time period of 1973 to 1999.
Karl Havens– if you were to put in 135 metric tons/yr, the graph will fit into yours.
OH12 – Comparison of predicted steady state lake water phosphorus based on comparing Vburial held constant versus using a variable Vburial. ???
OH13 – You will see a fast response initially and then a slower recovery rate. This is twice as rapid as Bill Walker's model.
OH14 – Vnet analysis
OH15 –17 – conclusions – burial rate has important consequences for long-term predictions; faster burial results in less recycling of phosphorus within the surficial layer due to long-term decomposition; TMDL is 118 tonnes/year with variable Vburial and 171 tonnes/yr with a constant Vburial; Lake Okeechobee would have an initial rapid decline and would have a longer period of decline
Bill Walker – I used a linear adsorption isotherm and a constant burial rate. The results are similar. What was the active depth in the sediments?
Curt Pollman – 5 cm.
Bill Walker – I used the same.
Curt Pollman – Two different methods of modeling have come up with similar results.
Good agreement between Bill Walker and Curt Pollman models.
Karl Havens–
Curt Pollman – Haven't looked at LOWQM.
Bill Walker – Running that model out to steady state is a result is based on a different adsorption and the burial rate.
Phil – it would be interesting to rerun the LOWQM using the same assumptions as Bill Walker and Curt Pollman.
Karl Havens– it would still need to be recalibrated.
Jerry Brooks – think about these models and tomorrow discuss what model should be used for the TMDL. The TMDL could probably best be defended using Curt Pollman's model. I would like to here the group's comments on this.
Tony – would like time to spend more time looking more closely at both models. There isn't time to do this by tomorrow.
Bill Walker –
Jerry Brooks – not looking to use EPA's model at this time. The ranges provided by Bill Walker and Curt Pollman aren't that large.
Curt Pollman – the model that uses a variable Vburial is the most appropriate, which would yield a TMDL of 118 tonnes/yr.
Bill Walker – 129 presented in the last time with the 1 box model. With the 2-box model, the TMDL is 135 tonnes/year. All are similar.
Jerry Brooks – Tony would you feel more comfortable looking at the different input variables.
Tony – Could I look at the two models and submit comments on them.
Phil – We would happy with a number that moves towards restoring the lake.
Jerry Brooks – tomorrow we could discuss how FDEP is thinking of structuring the TMDL with implementation.
Tony – look at how implementation will be tracked. We established a goal in 1980, which was higher, and still not met.

Karl Havens– We could also discuss the difference between constant and variable burial rates.
Curt Pollman thinks that there is a bias using the constant burial rate.
Bill Walker – this would be good to do for defensibility of the models. Another question I have concerns with a data file that I have.
Tony – Did Curt Pollman and Bill Walker use the same datasets?
Yes.
Bill Walker – Need to discuss the margin of safety for the TMDL equation.
Adjourn.

Meeting Continued on August 2
Jerry – Need to look at differences in the two models.
Karl – LOWQM isn't on the table here. There are many changes that the TAC has come up with, but to use the model would require allocation. The model would probably give the similar results. Phosphorus in rainfall is 31 metric tons/yr. Differences in the models are adsorption isotherm, rainfall contributions, burial rate, and active sediment layer.
Tony – How long would it take to fix the LOWQM?
Karl – Over a month, doing nothing else. The model can be used for other things.
Tony – Would like to look at it because not comfortable assuming that the LOWQM will give the same results once calibrated.
Karl – Curt did the aerial extent of the mud zone change in your model.
Curt – Yes it grew from 1979 to 1985. Or you can keep the aerial extent the same and change the burial rate.
Jerry – Does the LOWQM needs to be looked at?
Bill – If it is recalibrated it will converge, but we don't know how close they will converge.
Curt - Need to look at burial and adsorption processes. Internal fluxes will drive the model. Need to look at these processes first (internal resupply).
Tom James – It uses a mass balance. Uses a linear adsorption.
Curt – Only a small fraction of the phosphorus settling out is being adsorbed.
Tom James – The LOWQM does this in 2 phases.
Curt – What pore water concentrations are you using?
Phil – With the proper work and proper calibration all of these models could be used, taking into account the MOS. The best science we can do is good enough. Use Bill and Curt's model. Look at the LOWQM. This TMDL will probably be recalculated every ten years or so. Need to move forward.
Jerry – Need to understand the differences between the models.
Phil – Used a margin of safety to choose a different TMDL number from the model predictions because of unknowns and assumptions. Maybe produce a spreadsheet with the differences in the models.
Karl – the thing to do would be to talk about the technical merits of Curt and Bill's model.
Tony - hard to do.
Karl
Curt – the aerial extent of the mud zone for the models was 740 km2.
Karl – issue of a constant or variable burial rate.
Curt – it varies. Supported by limnological studies. Increased by a factor of 2 in later years. Comfortable with having a variable burial rate.
Jerry – Does EPA have time to update the LOWQM?

Phil - No.
Jerry – Other thing to discuss is the MOS. One thing was establishing the in-lake target of 40 ppb. Is that still conservative?
Bill – there isn't a MOS in the model runs itself. If water levels are lower then that could be MOS. Assumed water depth from past water regimes.
Karl – 40 is definitely conservative. That is to prevent blooms in the near-shore areas, so made pelagic to make equal or less for near-shore.
Bill – do we need to quantify the MOS as a load?
Phil – MOS can be expressed in different ways.
Tony – Is having 2 variables for the margin of safety sufficient? Restoration target of 40 ppb and water levels used in the model because future levels will be lower.
Phil – 40 is but water levels isn't. If water levels change then the TMDL should be recalculated.
Jerry – we used the higher depths which would be worse case, but lake levels will be lower.
Tony – we aren't going to recalculate, just use as MOS.
Larry – Lake Levels may not be lower.
Karl – due to restudy
Jerry – Is the restoration target of 40 sufficient enough, so we don't have to enter into something controversial with lake levels?
Phil – EPA took a different approach. Other assumptions and factors could also be MOS.
Paul Gray – I'm not sure that 40 is a MOS. In the everglades, cattail are overtaking sawgrass at levels as low as 20 ppb.
Karl – it is a MOS because of the relationship determined between total phosphorus and chlorophyll a (algal blooms). With 40 in the pelagic zone, the average in the littoral zone will be less than 40.
Bill – we should quantify MOS otherwise it doesn't mean anything.
Bill – OH that showed total phosphorus in the littoral zone and pelagic zone at different lake stages. It could be 30 %.
Paul – 40 is appropriate but isn't a MOS.
David - Could you use precision of parameters as a MOS?
Jerry – language out of CWA. MOS takes into account any lack of knowledge. Another way to state MOS would be say that we don't have uncertainty and confidence.
Bill – the fact that the 2 models converge is an argument for the support of a low MOS.
Karl – use Bill's graph to provide number for MOS for littoral zone.
Bill – can use update algal bloom relationship to substantiate the number used for the pelagic zone.
David Elam – think about downstream receiving waters.
Jerry – give thought of how TMDL is expressed.
Bill – long term average. Are you looking for a compliance test?
Tony – Won't be able to meet one.
Bill – You can put confidence limits around the load for each year. OH shows methodology to track because it takes into hydrologic variability.
Tony – tracking would be good.
Bill – statistically treat concentration…..Use annual average to track.
Karl – could average over 20 years, longer time frame.
Greg – how to express. Long term average
Bill –

Tony – futile effort to do a compliance test. Should show a way to track.
Restroom….beginning of new tape.
Jerry – Bill's forecasting work shows variation around the target.
Bill – create a statistical description around target. Need a basin plan

Jerry – Components of TMDL

* Restoration target of 40
* Loading limit
* equation
* allocation – broad category of NPSs
* implementation plan – phased
* goal of 120 for lake
    1. next five year – reductions to meet 298 tons/yr based on Technical Pub 81-2 and planning of works to reach 120 (BMPs and CERP components)
    2. 2005-2010 – load 140 that will take into account Knet (improved or expanded BMPs)
    3. 2010 – reevaluate TMDL and change as necessary as knowledge increases (know more about recovery of lake) evaluate management activities - additional treatment works.

Jerry – planning will take time. Five years may not be reasonable for construction. Need interim for time for planning for phase 2. By the time that you reach phase 3 you will have time to evaluate management activities.
Karl – know performance of RaSTAs and additional BMPs and have time to observe recovery of lake recovery and adjust TMDL.
Jerry – what is appropriate for phase 2.
Curt – shouldn't include Knet because it hasn't reached equilibrium.
Jerry – BMPs won't produce the biggest changes but there needs to be accountability.
Tony – construction of RaSTAs is going to be more difficult (purchasing land/pristine wetlands in the right place). Should use off-line facilities because greater flexibility. The CERP RaSTAs are not enough. Need approximately 40,000 acres of treatment wetlands.
Larry – would dredging change the TMDL or recovery time
Bill – recovery time
Curt – TMDL would also change because the aerial extent of the mud zone would change.
Karl –
Phil – we have external load, atmospheric load and internal loads. Loads have changed so would speed recovery, but you could change TMDL.
Frank – if the lake meets water quality standards then we can delist, don't have to recalculate the TMDL.
Karl – Don't think that it is going to be feasible to remove all the mud.
Claire – results from a model and reality aren't the same. Dredging isn't economically feasible.
Larry – if you don't fix the problem, you will have to keep re-dredging and keep repeating this process
Karl – question about off-line treatment
Tony – Should implement off-line methods faster because the logistics are easier. Source control would be more difficult and time consuming. Shouldn't do it in lieu of source control.
Karl – what is the difference removing 50 tons before it reaches the lake or let it enter the lake and then take it out. What happens to the lake?

Jerry – this is a discussion that we will have later. We will have to discuss and evaluate all our management options for phosphorus reduction. Does everyone agree that we should use a phased approach?
Bill – at some time in the future changes in lake management would change the model.
Claire – dredging isn't going to change the TMDL. Inputs shouldn't be changed.
Jerry – you don't think a smaller mud zone would allow the lake to receive more phosphorus.
Claire – making changes in one part of the lake, doesn't reflect water quality throughout the lake, especially when dealing with phytoplankton.
Larry – Have more financial incentives in the first phase. Should have more BMPs done in the first phase.
Jerry – They are included.
Tony – Don't believe BMPs are going to make much of a difference. Regional works are your best bet.
Larry – you mean importing phosphorus into the basin doesn't have an effect.
Bill – water management is the driving force.
Tony – to achieve your TMDL you need large-scale treatment systems because they are reliable. Don't know that BMPs are reliable. BMPs are good because they can be implemented quickly and produce a MOS in the implementation plan. BMPs over the last years has had an effect in Taylor Creek/Nubbin Slough, but the gap to our TMDL (600 ppb to 40 ppb) you will need STAs.
David Elam – need to consider fertilizers. Don't need ones with phosphorus. Erosion is another consideration.
Jerry – Is a phased approach appropriate for the implementation of the TMDL?
Tony – BMPs will not get us to the 397 tonnes/yr according to Tech Pub 81-2.
James Erskine – even if phosphorus is no longer imported, would there still be residuals of phosphorus in the soil?
Tony – Yes
Paul Gray - 7500 tonnes/yr of phosphorus have been brought into the basin. As long as we keep importing and not equally exporting we are adding phosphorus to the basin.
Dave Correll - Chesapeake Bay is an example of supersaturating with phosphorus. This can happen here.
Jerry – Goal and direction of BMPs and nutrient management is that there is not net increase of phosphorus in the basin. Phase 1 needs to pick up additional management activities if the BMPs will not get us there.
Tony – need to immediately build a 40,000 acre RaSTA, because without this we will not make a dent in the reduction. Also, many BMPs are already being used.
Lots of discussion about implementation options.
Jerry – implementation portion of TMDL will be phased to follow legislation.
Paul Gray - Over next year's clean muck will bury the older phosphorus laden sediment, so we really won't need to dredge the lake. Hurricanes will stir up all the sediments.
Karl – Total phosphorus and suspended solids concentration increased after Hurricane Irene. Total phosphorus went from 20 to 224 ppb.
Bill – Modeled a scenario using a TMDL of 135 tonnes/yr showing phased reductions.
Karl – Need time after implementation for evaluation because it will take time for lake to respond. There will be a lag response.
Karl – What does the phosphorus budget for the BMP program include?

Dave Correll – So much phosphorus has been brought in the past that you can't export to meet the import.
Karl – What are we going to do with the models? We have two models to work with that give similar results. What are we going to do about documentation, for example rainfall?
Jerry – Need to have a TMDL by the end of the August, including most of documentation. Circulate the document throughout October for public comment. A public workshop for rulemaking, including TAC and rule language during the first week of October in Okeechobee and go to rulemaking by the end of October. Are there any other comments or observations?

Lake Okeechobee Rule Workshop and TAC meeting – 10/16/00

- We may need an additional workshop
- TAC – take materials we have and rationalize the TMDL
- KH – Bill's model doesn't take into account the wind – attributes changes in phosphorus seasonality to Ca, instead of wind
- AS – he is actually referring to climatic patterns; Ca needs to be taken into account; regarless of whether we use calcium or not, the range is still the same; the 135 is appropriate
- CP – have some concerns – computations for the hydroxyapatite cycle are not correct. My numbers show that calcite isn't an important source based on solubility. The absorption of calcite may be hindered by magnesium concentrations. Mg concentrations are high in lake. There seem to be some problems with the Ca and pH data. There is a relationship between hydroyapatite concentrations and SRP.
- JERRY BROOKS – Do you think it is important that Ca needs to be captured in this process?
- CP – Bill isn't using Ca to fully explain changes. I think it does merit further consideration. The TMDL may only change by 10%.
- JERRY BROOKS – We need to move forward with the best data we have. Just need to know whether we need to spend time on it before we move on.
- CP – Unlikely scenario of having a huge solubility of Ca. The historical concentrations of Ca may have been lower. Always have had saturation of calcite because of the limestone underlaying the lake.
- KH – The result of Bill's simplistic model gives a number similar to Curt's. His new documentation seems to cause a problem. Should use previous stuff
- TF – Want to review Bill's model. Need to consider EPA's model. Should have a specific methodology for choosing a number. I need more time to look at Bill's to develop questions. There is no allocation to point sources. What if one of the non-point source because a point source and there is no allocation.
- JERRY BROOKS – Have to look at the point source and circumstances surrounding it.
- TF – Why not allocate to all sources?
- Wayne Nelson – Asked when he could ask questions.

- KH – Why don't you say all sources, instead of nonpoint sources?
- JERRY BROOKS – residents of the watershed may be concerned with the fact that there is no loading left for point sources.
- Jennifer – Federal legislation requires allocation. State allows us to allocate to broad groups.
- Maybe should state that nonpoint = 135 and point = 0.
- JB – Does anyone have any questions on allocation?
- Carroll Head – Aren't you proposing a number? Shouldn't quiver over 5%?
- Art Darling – Dairy farms are CAFOs that are point sources.
- Jennifer Fitzwater – This TMDL is for the lake and direct discharges to the lake. Dairy farms do not discharge directly to the lake.
- Paul Gray – What are the 3 discharges?
- Greg – 3 discharges in the watershed, not directly to the lake.
- Jerry Brooks – Intend to include all sources within the watershed.
- Jennifer – With the 303(d) process, you will have allocations to other tributaries in the watershed.
- Larry Harris – How about the farms to the south of the lake that discharge directly into the lake.
- Jennifer – Still considered a nonpoint source according to federal legislation, even though it is subject to the Lake Okeechobee legislation.
- KH – Need to watch wording so not to leave out some sources
- Wayne Nelson – Filed a lawsuit 1:1 years ago – decision is still pending concerning definition of point waters. 3 agricultural exemptions: runoff, flood water, irrigation waters. Considerable phosphorus source. If structures are required to get permits, including the District structures. What permitting is going to be required for these structures (S-2, S-3, S-4) through this process?
- Jerry Brooks - They are getting a permit under the Okeechobee legislation. The SFWMD has submitted an application for the structures on Sept. 1. It is being reviewed in house. Go back
- David Elam – all sources should be considered
- Bill Reck - When and how will the allocation occur.
- Jerry Brooks – By 2004, we are required to work with other parties to design a restoration plan. We should have enough of an understanding of loadings from different land uses.
- Ken Dodge – my understanding is that a point source is one requiring a NPDES permits. Need to be careful about what you say.
- Carroll Head – Just define what a point source in the rule.
- Gary Roderick – What about the allocation TAC?
- Jerry Brooks – TAC to report to legislature on how allocation will be addressed statewide. We are ahead of this process and can't wait.
- Bill Walker arrived…
- BW – I don't know if it is worth reviewing.
- Jerry Brooks – Discuss which number
- TF – suggesting that you look at all the numbers and pick the one that has maximum overlap. Need the WASP model. If the Department is going to pick a single number, need to have a methodology. Or you express it as an equation or range.
- Jerry Brooks – Agree. Does this group agree that on how you pick the number.
- TF – Shouldn't pick a specific model because they all have strengths and weaknesses.

- Jerry Brooks – Just want concurrence to the approach. Need to have a single number.
- KH – Should shot for the middle of the range. If you pick the lowest, double count MOS. If you pick the highest, you ignore MOS.
- BW – There are 3 different estimates. The 3 models take different approaches.
- Jerry Brooks – We have different ranges for the model. So, will look at results of all models and take the median.
- David Elam – Matter of significant digits.
- KH – Should any of the models be waited differently.
- BW – The first model is a little too low –115-because it ignores calcium. 152 for model of water column. 139 is modeling water column and sediments.
- Jerry Brooks – Are there any other questions?
- TF – the TMDL document says that it is an annual maximum (page 30)
- GK – it is a long-term average. Then what is the period that will be averaged
- KH – we discussed 10 years for the lake
- TF –
- KH – we need to look at the hydrologic
- BW – long term annual average. Should use the 27 period of record.
- Tim Smith – if you make it more complicated, you are inviting litigation. If you choose something that looks too stringent, then people will contest
- TF – I'm not trying to be difficult. Question about phased TMDL.
- Jerry Brooks – Should be phased approach
- CP – need to have a caveat about the hydrology in expression in the rule
- BW – the set of number that I came up has been adjusted for the EAA backpumping
- Jerry Brooks – Recognize that we will need another meeting to discuss Bill's model and the recalibration of the WASP model.
- KH – Maybe we should discuss technical issues. You can't have the last meeting having new information being introduced.
- Jerry Brooks – We can have interaction through e-mail.
- CP – Bill's hydroxyapatite values are on an order of magnitude higher. Agree with fundamental that calcium has a role in phosphorus dynamics, however it is a minor role.
- BW – it helps explain historical trends, but doesn't really affect TMDL I agree that the equations and numbers could be modified.
- CP – Lake Bartow – Ca mass balance. Get net Ca losses. There is a new sink of Ca in Lake Okeechobee.
- BW – if there is merit to Ca affecting the model, then what about the results from the WASP model.
- KH – the wind is the driving force not seasonal.
- Jerry Brooks –
- TF – the calcium many not be relevant in generating the TMDL
- Jerry Brooks – is it something that we need to pursue
- CP – the calcium will affect total phosphorus by a few ppb, but we should go back and look at it.
- Break for lunch.
- Jerry Brooks – Invite public comment on rule

- Bill Reck – Are we going to reserve some of the loading for point sources?
- Jerry Brooks –allocate to all sources that actually enter Lake Okeechobee. Incorporate into the rule the definition of point or nonpoint sources. We will need to determine if those pollution sources are point and nonpoint sources and then modify allocation as necessary.
- Larry Harris - Would like to thank the TAC and DEP staff on their work. Question on implementation. RASTAs and wetland restoration projects are being planned, along with other CERP components. Can we speed this up?
- Jerry Brooks – Haven't been part of the planning. Secretary and Governor are strongly supporting. They are pushing for this. There are lots of issues that have to be dealt with to move this along.
- Larry Harris – Federally, CERP is being sold as environment project. Is it in conflict with water supply.
- Bill Reck – Add DACS comment…….
- Jerry Brooks – It will be added.
- Ken Dodge – question on phased implementation. What is included in each phase.
- Jerry Brooks – spelled out in Lake Okeechobee Legislation
- Carol Head – item #4 – time line for rule development and implementation
- Greg – covered in this morning's presentation. Implementation following Lake Okeechobee legislation and TMDL legislation
- Jerry Brooks – the Lake O legislation does have time frames for implementation components. At end of meeting, will discuss whether we will have additional workshops.
- Larry Harris - implementation section in the supporting documentation. 2015 state water quality will be met, but isn't line when many of the CERP components will not have been built
- Jerry Brooks – this is in reference to the structures permit for the SFWMD.
- Larry Harris – would like to see it sooner
- Carroll Head – thought we would get an idea of when things are going to happen.
- Jerry Brooks – we can walk through the legislation if we have time. Want to emphasize the TMDL number itself.
- Wes Williamson – We can debate small differences in numbers, but in reality the best we have ever achieved has been around 300 tonnes/yr. Most of us are exporting more phosphorus off property compared to what they are importing. Public works and STAs are the only way to get there. Need to push these projects up. Need to get them going sooner.
- Jerry Brooks – we all agree that all landowners need to do best that they can do. We recognize that we need regional treatment works for restoration. Your interests are shared by the Governor and Secretary, as well as the interested parties in the watershed.
- Wes williamson – We are willing to do what we can as long as we can make a living. Willing to look at new BMPs, etc.
- Larry Harris – If you look at Istokpoga – that is half of the water in the basin – the concentrations have increased over the years. 165 tonnes/yr out of S-65.
- Jerry Brooks – phosphorus loading from that part of the watershed is recognized as a problem in the legislation. SFWMD has the responsibility for the study. However, it will not be funded this year.
- Larry Harris – the water quality hasn't been monitored from Istokpoga. It should be since this is half the water.

- Paul Gray – are we going to be discussing the TMDL number more this afternoon. For timeliness, take a best guess for a model and get a ball park number. Have a long way to go to reach lower loadings.
- Jerry Brooks – From a scientific value, should go back and look at Ca, but will not change the TMDL much. Recommendation, look at ranges from the models and get results from the WASP model. Take a central point of overlap of the ranges. I don't think we need another workshop if the number is close to the 135.
- KH – the supporting documentation needs to be technically sound. Need to reflect that it would be 135 every year because of hydrologic conditions.
- AS – use a long-term average
- Jerry Brooks – use a long-term average on a yearly basis to reflect those changes. Need to give additional thought to language.
- BW – can provide the range of values around the 135 based on hydrologic conditions in the 27-year period. Documents are still labeled "draft" and would like input.
- Jerry Brooks – Can do this outside these meetings by e-mail. Need to set time frames. What time do you think is reasonable.
- BW – end of year
- Jerry Brooks – this would only be a adding a month to our schedule
- AS – can we have a short additional meeting for closure.
- Jerry Brooks – we can leave it open based on public comments and feedback from committee. The public comment period will be extended to the end of December – Dec. 24. At that time, we will make a decision on whether we will have another meeting.
- Tim – How will the lake be in compliance when there is a range of numbers based on hydrology? How will compliance be measured.
- Jerry Brooks – we will have to figure out how will measure our progress
- BW – put figure of relationship of p in the pelagic and in littoral to help support why 40 ppb is a MOS.
- Jerry Brooks – Legislation – reviewed components of legislation – use phases for implementation to achieve water quality. – projects with dates