Appendix D. Minutes from the expert panel

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel
Monday, December 15, 2014, 9:00AM-12:00PM
Tuesday, December 16, 9:00AM-12:00PM
Meeting

Name	Affiliation	Present? Y/N
Chris Brosch	Virginia Tech/VA DCR	Y
Keri Cantrell	NC DENR	Y
John Chastain	Clemson University	Y
Doug Hamilton (Chair)	Oklahoma State University	Y
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Andrea Ludwig	University of Tennessee	Y
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	Y
Jeff Porter	USDA-NRCS, ENTSC	Y
David Wood	Chesapeake Research Consortium/CBP	Y
Non-panelists/Support		
Brian Benham	Virginia Tech (Project Director)	Y
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	Y
Ashley Toy	EPA Region 3 (Regulatory Support), via phone	Y

Welcome and Panel Introductions

- Doug convened the meeting and reviewed the objectives for the two days, including identifying categories and manure types, and dividing into subgroups.
- Each panel member introduced themselves and described their background and relevant experience.
- Manure Expo, July 14-15, 2015 in Pennsylvania

Overview of the Panel Task and timeframe

- Doug summarized the current timeline for the panel and the current approach for deliberations and eventually drafting the report. By end of second day panel will break into subgroups that will begin drafting their sections for reporting back to the panel in the May timeframe. Panel will have a face-to-face to combine everything and work out the final report in the late summer 2015.

Intro to the Chesapeake Bay Program modeling tools

- Jeremy reviewed the Chesapeake Bay Program, the BMP review process and the modeling tools.
- ACTION: Jeremy and David to clarify current values and assumptions in the Phase 5.3.2 Watershed Model from point of manure excretion to the point of application.

Discussion of baseline system(s), definitions and subcategories

- Doug asked for the panelists' thoughts on how to categorize and divide. Need to be careful, could potentially result in too many BMPs or subcategories. He noted the AgWG's ad hoc subgroup has assigned 6 technologies as priorities. Need to stay within those recommendations, but may determine which ones may receive more or less focus. Priority animals? Poultry and dairy. Some beef feedlots.
    - Ashley explained the Delmarva is essentially all poultry (broilers). A couple thousand-head feedlots. Pennsylvania, a lot of layers and significant amount of poultry (predominantly layers), and a lot of dairy, ranging from Amish to large-scale. Most are small, but about 250 large operations. A lot of mixed operations in the Shenandoah Valley, e.g. poultry and dairy. There is some swine, especially in PA. VA has a lot of swine, but most of those operations are outside the watershed. There are racetracks and horses as well, scattered in MD.
- Doug and the panel brainstormed how to categorize and breakout the manure types (* indicates what was agreed to be a major manure category for the panel to consider)
    - *Dairy [on Tuesday there was discussion of possibility to include beef and categorize as bovine rather than dairy]
        - Solid
        - Slurry
        - Liquid
    - *Poultry-broilers and turkey
        - Dry
    - **Poultry-layers
        - Solid. Belted system is increasingly popular in the region. This yields dry, stackable and transportable material. No bedding. Litter much different characteristics from broilers. Some layers have washdown/wet systems, but predominantly dry. Layer will be wetter and heavy than broilers with higher nutrients.
            - Other comments/notes:
                - Egg wash water may end up in the same waste stream as manure. There is also washdown of the buildings, which is more nutrient rich than egg wash water. Most of the water would be spray irrigated in the surrounding area.
                - PA ranks highly (approx. 3rd-5th) in layer production nationwide.
    - Racetracks/horses in MD (pasture); could perhaps lump in sheep/goats that are also pastured or stabled in a similar manner
    - *Swine (mostly in PA)
        - Slurry
        - Liquid-ish
        - Outdoor storage basins, not lagoons. Some indoor/covered systems or pits.
    - Beef feedlot [could perhaps be combined with Dairy, see above]
    - Veal
        - Slurry, in a pit. More like swine.
- For background information or other insights on the range/varieties of livestock manure in the watershed, the panel can pull some background from subgroup report, and ask industry partners.

- Jeff and Ashley noted there are very, very few lagoons in the watershed.
- Mark confirmed that mortality composting or incineration is a separate BMP and not included in the Panel's scope or charge.

Adjourned Day 1 of Panel Session

Welcome and Objectives for the day

- Doug welcomed panelists for the second day of the meeting.

Debriefing and follow-up from the stakeholder session

- Presentations from the Monday afternoon public stakeholder session are available online at: http://www.chesapeakebay.net/calendar/event/22245/
    - It was noted that 4 of the 7 presenters were thermochemical. There has been a lot of discussion of thermal technologies, given the prominence of poultry production in the watershed.
    - Rob explained the manure transport BMP could be documented by the nutrient balance sheet in a nutrient management plan in PA, but this is not consistent across the states.
        - Mark confirmed that manure transport is already a BMP in the modeling tools and the panel doesn't have to deal with that BMP, but can point out where transport can be used or applied to products that result from a treatment process, e.g. biochar, compost, etc.
- Doug: As manure treatment technologies, panel needs to focus on the transformation of the nutrients.
- It was asked if the panel will need to divide out the technologies by whether they are still in R&D, or already being commercialized and implemented.
    - Doug: Depending on available data the panel can do its own prioritization.
    - Mark noted that the panel could suggest "interim BMPs" that are used for planning purposes, not for progress reporting. If there is a BMP that is still in the research and development phase it may be premature to make a recommendation based on extremely limited data. However, an interim BMP could be used for planning purposes by the states, and a future panel could revisit that BMP when more data and research is available.
- There was discussion of BMP data collection and reporting following points raised at the stakeholder forum. Some larger systems like EnergyWorks may have continuous monitoring data with nutrient inflows and outflows, that could be collected and reported by the states, whereas most other treatment systems would be smaller and not have that level of data. David and Doug noted the panel can recommend different tiers or levels of the BMP. If a state requires more detailed data collection, then it can report that data to receive a greater reduction. If a state has less detailed data for that BMP, then they could still report that BMP for credit, but they would receive less nutrient/sediment reduction, which is a "default" rate that is a more conservative, lower reduction rate.
- Doug reiterated that the panel will not make recommendations for specific patented technologies, but on broader categories of technologies. The patented technologies can fall under a category, but the panel cannot recommend or endorse any patented or proprietary technology.

Continued discussion of baseline system(s), definitions, and subcategories

- Doug: First step is to define the baseline. The model builds from as-excreted values, includes inherent nutrient losses from storage and handling.
    - John noted that for these technologies most of the manure data will be described "as removed from the facility."

After discussing the animal and manure types, panel members discussed the technologies and how to subdivide them and cross-reference to the manure divisions, perhaps in a matrix form. Individual categories are in **bold**.

- Microbial digestion
    - **Anaerobic**
    - **Aerobic**
- **Chemical – dry**
    - No further divisions. Some chemicals affect ammonia, some phosphorus and ammonia. No subdivision at this time.
    - Mark noted there is an existing litter amendments as a BMP. JEREMY TO GET MORE INFORMATION ABOUT THE CURRENT LITTER AMENDMENTS BMP FOR THE PANEL.
- **Chemical – wet**
    - No further divisions, but Jactone noted that the practices can be generally be described as either acidic (lowers pH) or basic (raises pH).
- Thermochemical
    - **Combustion**
    - **Gasification**
    - **Pyrolysis**
    - **Torrefaction**
        - Jeff noted that this is not currently being considered or applied for on-farm operations. Jactone noted there could be international studies that investigate on-farm torrefaction systems.
    - Perhaps divide further to wet and dry?
- Separation
    - **Mechanical**
        - There was agreement that a centrifuge fits better here, rather than gravity/settling
    - **Gravity/settling**
    - **Solid screening**
    - **With or without additives or polymers**
        - Very closely related to chemical treatment (wet), but there was agreement that it fits better within the separation category when the additives are used to enhance the settling or separation process.
- **Composting**
    - No further divisions. No mortality composting, which is a separate BMP. Mark and Doug discussed that other feedstocks (food waste, etc.) would not be included in the nutrient balance unless there is data to support it.
- Chris noted that baling, pelletizing, and similar technologies are currently handled as manure transport in the model and could continue to be handled that way in the future.

- Doug worked with panelists to assign panelists to the technology categories described above. He suggested that each panelist put together an annotated list of literature as they gather data and information.
    - John: separation; chemical – dry
    - Keri: Thermochemical, chemical – wet,
    - Jeff: microbial digestion, thermochemical, separation
    - Rob: microbial digestion, composting
    - Andrea: digestion, composting
    - Jactone: chemical – wet; separation (mechanical and settling)
    - Doug: separation, digestion, composting, chemical – dry
- **ACTION**: Doug will provide further instructions and suggestions for the panelists as they begin to gather references for their assigned categories.
- The panel discussed Table 1 in the BMP Protocol and how to evaluate quality and applicability of references.
- **ACTION**: Jeremy to share alternative version of Table 1 with the panel (Completed 12/16)

Wrap up and next steps

- The panel discussed when they could potentially have a regular conference call each month.
    - **DECISION**: 4th Thursday, 10AM EST, 2 hours or less; starting 1/22/15. The first call will include final selection of technologies and combinations with manure.
    - Doug noted that in February-April everyone will analyze data and start formulating ideas and preliminary recommendations. In May the panel will need to have a relatively clear sense of how to organize recommendations and what they will start to look like (tiers, etc.)
- The panel discussed when/where to hold their next face to face. Given timeline and other events, will need to fall around June.
    - **DECISION**: Target week June 22-26, meeting Thu-Fri 6/25-6/26, with travel on 6/24 and 6/26 or 6/27.
- **ACTION**: Jeremy to share links and previous BMP panel reports with the panel (completed 12/16)
- **ACTION**: David and Jeremy to provide the nitrogen and phosphorus species breakdown in the modeling tools

Adjourned

SUMMARY OF ACTIONS AND DECISIONS
Open Session: Manure Treatment Technologies Expert Panel Stakeholder Forum
Monday, December 15, 2014, 1:00PM-5:00PM
http://www.chesapeakebay.net/calendar/event/22245/

Welcome and Introduction

- Jeremy Hanson (Virginia Tech, Chesapeake Bay Program; Panel Coordinator) welcomed participants and reviewed the agenda. He briefly summarized the Chesapeake Bay Program's BMP review process that the Manure Treatment Technologies expert panel will be following.

Stakeholder Presentations

Kristen Hughes-Evans, Sustainable Chesapeake

- View the presentation for more information.
- She reviewed air emissions data available for 5 different projects. She noted that all have NOx data available, but only the bshl project had ammonia data.

Patrick Thomson, EnergyWorks BioPower, LLC

- He reviewed work EnergyWorks has done to generate energy and recover nutrients at CAFO operations. He discussed the measurement points of their process and how they account for "real-time mass and energy balance."
- View the presentation for more information.
- Robb Meinen (Penn State): what size farm?
    - Thomson: The facility we currently have can handle manure from 6.5 million birds. The technology can be scaled down, though there are benefits to scale.
- Doug Hamilton (Oklahoma State): how small can the farm be to support the on-farm heating unit?
    - Thomson: Throughput about 2 tons/day, but the systems we are trying to install in the US are not focused on the heating since the climate is warmer. The houses only need heating a few months a year. We have a 5 ton and 10 ton unit.

Andre Dight, bhsl

- He provided background of bhsl and their technology.
    - View the presentation for more information.
- He discussed results from an environmental study of the technology in the UK, which consider transportation, fertilizer use, and reductions in fossil fuel use, among other things. He also noted that bhsl has been collaborating with Mark Reiter (Virginia Tech) in studying ash applications to tomato field crops.
    - View the study report for additional details information.
- He mentioned in October 2014, bhsl received a State of Maryland grant for $970,000 to build a demo unit in Rhodesdale, MD.

Sonia Nofziger-Dasgupta, Envirokure

- She described EnviroKure's aerobic technology, which produces USDA-certified organic fertilizer from poultry manure.
- View the presentation for more information.
- Jeff Porter (USDA NRCS): Has Envirokure thought about using other manures that are already wet that do not require added water?
    - Nofziger-Dasgupta: We started with chicken manure. Felt that chicken manure offered best source of nutrients for the products we wanted to create. Given the

premium for organic producers, it is still economic to pay for transport of the organic fertilizer over a long distance.

- Porter: How does your aerobic system compare to other systems in terms of energy demand.
  - Nofziger-Dasgupta: We use ambient compressed air to fuel the digestion, not oxygen. Once we activate the bacteria they do a lot of the work.
  - In response to question from Doug Hamilton, Nofziger-Dasgupta noted they use a centrifuge to separate both pre- and post-bioreactor.
    - Nofziger-Dasgupta: It is a closed system, so very little is lost through gas releases. We'll have to be close to producers, but not likely on the farms themselves.
- Porter asked the other presenters that for on-farm thermal systems, are farmers capable to keep the farmers up and running?
  - Dight: our systems are essentially small power systems, so we have a constant operations/maintenance of these systems with bhsl engineers.
- John Chastain (Clemson) asked if any of the systems are paying for manure.
  - Nofziger-Dasgupta: in our business model we currently have a baseline cost of $31/ton for manure, which includes the transport to the EnviroKure facility.
  - Dight: the systems use the producer's own manure.
  - Nofziger-Dasgupta: we've been primarily in an R&D stage, and have been dealing with manure brokers, so they've maintained liability of the manure.
    - Chastain: Asked because some states still place liability on the producer even if the manure is sold and handled by a broker.
  - A participant asked what the water source is for the EnviroKure process.
    - Nofziger-Dasgupta: Recycle the water as much as we can, and we use municipal water. The Philadelphia water authority has tested the water and it is safe to flush down the drains.
      - She also noted that even though EnviroKure processes the manure, it does not have to come from organic chickens to be certified organic. To sell to Canada as organic, though, would need to get manure from organic chickens.
    - Hughes-Evans noted that ash and biochar are not currently allowable as organic amendments or fertilizers, but that may be currently under review.
  - Porter: one of the goals of these systems is to reduce the nitrogen and the phosphorus, but what kind of plans or programs are there to transport these products to areas that are not nutrient hotspots?
    - Hughes-Evans: Ideally you have someone as a broker to help make those connections and transport the products to other areas.
  - Hughes-Evans noted that Delaware does not allow combustion except when it is on the farm. There have been requests to not include pyrolysis under the combustion category in Delaware.
  - James Davis-Martin (VA DEQ): Manure from CAFOs is already required to be applied in accordance with NMP. If current land application is

rerouted for these technologies, it is reasonable to assume that commercial fertilizer products will replace the manure, so the net benefit from the technology would need to account for that.

Chris Haug, Triea Technologies

- He described Triea Technologies, and the quick wash™ process that they have an exclusive sub-license for in North America. Once submitted for formal review, the low-P solids could be categorized at EPA Class A, pathogen free. Could potentially be customizable to a farmer's needs by altering aspects of the process. Phosphorus recovery has ranged from 70% to up to 98% over various types of manure and locations. He reviewed the products (manure solids, calcium phosphate, process liquid) and potential outlets.
- He noted Triea was awarded a $250,000 grant by MD DNR to implement a 3-phase commercialization plan. Hope to have on-farm, mobile, and regional systems. Also considering how the process can work with manure to energy processes such as anaerobic digestion.
- Phosphorus does not have to be in a soluble form, it can be organic or inorganic.
- View the presentation for more information.

Peter Thomas and Mike McGolden, Coaltec Energy USA, Inc.

- Mike McGolden presented Coaltec's gasification systems. He explained gasification is oxygen-starved, pyrolysis is oxygen free. There are large-scale systems currently in operation. Gasification can be applied to a variety of manures, from layers, broilers, horses, swine, or turkey, etc. For wetter manures, requires solids separation before drying and gasification. There is an on-farm system operating in Ohio, with 4,500 cows on site. He mentioned the operation previously paid about $1 million for bedding, but last year they paid closer to $8,000. It is a cattle sexing operation that was ideal for using the biochar as bedding material. Biggest challenge is developing a full scale market for biochar. Most work so far has been at pilot or small scale.
- View the presentation for more information.

Clint Church, USDA-ARS

- Church noted that two USDA-ARS researchers (Vanotti and Szogi) developed the process that was described by Chris Haug. That process depends on pH manipulation. ARS has also developed a similar process that does not depend on pH manipulation. Church described the latter process and the performance they have been measuring, with up to 96-99% phosphorus removal and a 99% solids removal. Removed solids are about 70% moisture so they are stackable and easily used for composting. Currently constructing a full scale mobile system. Also constructing a full scale on-farm system on a site where they currently have two lagoons, the second of which can effectively serve as the chemical treatment tank. Still in early discussions with that producer. Average carbon content is 20-25% from manure, most manure biochar will be in that range.
- View the presentation for more information.
- Jactone Ogejo (Virginia Tech): what are the characteristics of the input?
    - Church: We tested on typical dairies that were about 7% solids, and this newest location has about 1% solids.

- Keri Cantrell (NC DENR): What size facility, especially for gasification and combustion, do we need to be concerned with regarding EPA or other air quality regulations?
    - Hughes-Evans: Most facilities would fall under boiler rules. Maryland also has biomass regulations. VA and WV have different permitting process that have thresholds. If the system does not heat water it is not considered a boiler under federal regulations.
    - Mike McGolden noted that each state has different requirements.
    - Peter Thomas noted that EPA sent a letter to Max West in FL that mentions when boiler regulations would provide. Will provide a copy for the panel.

Discussion

- Porter: of these technologies, how many are beyond the R&D and ready for production? What are the timeframes to be in full production?
    - Dight: for combustion we've made lots of iterations and are identifying manufacturers. With combined heat and power we are still commercializing. The technology is moving quite rapidly.
    - Nofziger-Dasgupta: we're looking at 10 months-15 months.
- Dominic Bassani (Bion): One of the things, there's a lot of discussion of phosphorus and ammonia. When you start looking at trading or regulatory side, need to consider what the liability or policy issues might be.
- There was discussion of the possibility of presenters or others sharing confidential or other sensitive data sources with the Panel. Hanson noted that the Panel's deliberations are closed and they have access to password-protected platforms for safely sharing such data if it is provided for the Panel's consideration. The Panel's analysis would place greater weight on peer-reviewed, published data, but any available information could prove beneficial.
    - Cantrell: would prefer they provide whatever they are comfortable providing.
    - Brian Benham (Virginia Tech): Any such data would preferably be shared in a summarized form.
- Hughes-Evans: nitrogen emissions are relatively low, but can't assume ammonia emissions are negligible until there is data to back that up. For smaller scale projects or facilities it may not be practical to have real-time monitoring. Larger scale projects could more reasonably afford extensive or real-time monitoring.
- **Post-meeting note:** Dominic Bassani (Bion) shared slides for the meeting participants.

Wrap up and next steps

- Hanson asked each Panel member to share their biggest take-away messages or lessons learned from the day.
- Hamilton: Presentations reiterated that the Panel has a number of specific technologies to consider. Panel will need to nail down where the specific technologies fit into the categories.
- Porter: There were several presentation of farm-based and community- or regional-based systems. Will need to grapple with that issue and determine how to approach that as we form recommendations.

- Andrea Ludwig (University of Tennessee): This has been very useful information and it is great to see actual removal rates or performance, but it definitely raises practical questions related to implementation, management, etc., which will need to be considered.
- Chastain: Feel encouraged by the participation from entrepreneurs in the room. We're still learning more about our charge and we will see where the Panel goes from here.
    - Hamilton reiterated that the Panel is not recommending specific technologies, but nutrient and sediment reductions. Not a recommendation of one technology versus another, but what the benefits are for each of them as a broader category.
- David Wood (Chesapeake Research Consortium): from the CBP perspective it is good to know the range of technologies and capabilities.
- Ogejo: Great presentations and glad to hear of all the work and research currently being done.
- Cantrell: Excited to see so much progress by these technologies over the past seven years.
- Meinen: Still questions about the transport of the manure or end-product, whether it is out of the watershed or not. Receiving data from stakeholders would help the panel in its recommendations. Think some of these technologies and their odor benefits would be well applied in Pennsylvania. He mentioned the North American Manure Expo is located in the Chesapeake Bay Watershed in 2015.
- Chris Brosch (Virginia Tech, VA DCR): this panel will have a unique job in interpreting these BMPs into something the states can track and report for their annual progress runs.
- Hanson echoed that he was also encouraged by the participation from the private sector, and he was excited to work with the Panel following the productive stakeholder session.
- Patrick Thomson asked for clarification of what the process is once the Panel's report is released to the Agriculture Workgroup (AgWG).
    - Hanson explained the process as it is described in the latest version (July 2014) BMP Review Protocol. The report is released to the AgWG and other relevant CBP groups, including the Watershed Technical Workgroup and Water Quality Goal Implementation Team. Time is allowed for all those entities to review and provide comments and ask questions on the report. The Panel Chair and Coordinator work with the Panel to address comments and make necessary revisions or clarification. Then the report goes through the approval process. Hanson noted the process can take multiple months, depending on the BMP and the report.
- Hanson thanked everyone for their time and participation.

Adjourned

Participants

Name	Affiliation
Panel members and support staff	
Doug Hamilton (Chair)	Oklahoma State
Keri Cantrell	NC Dept. of Environment and Natural Resources

John Chastain	Clemson University
Andrea Ludwig	University of Tennessee
Robert Meinen	Penn State
Jactone Ogejo	Virginia Tech
Jeff Porter	USDA-NRCS, East National Technology Support Center
David Wood (CBPO Modeling Team Rep)	Chesapeake Research Consortium, CBPO
Chris Brosch (WTWG Rep)	Virginia Tech, VA Dept. of Conservation and Recreation
Jeremy Hanson (VT Project and Panel Coordinator)	Virginia Tech, CBPO
Brian Benham (VT Project Lead)	Virginia Tech
Mark Dubin (AgWG Coordinator)	University of Maryland
Ashley Toy (Regulatory Support), via phone	EPA Region 3
Attendees and presenters	
Ann Baldwin	NRCS-DE
Dominic Bassani	Bion Environmental
Clinton Church	USDA- Agricultural Research Service
Andre Dight	bhsl
Chris Haug	Triea Technologies
Devon Hooper	EnviroKure
Kristen Hughes-Evans	Sustainable Chesapeake
Dan Johannes	Chesapeake Bay Foundation
Spiros Mantzavinos	The Mantzavinos Group-Public Affairs
Mike McGolden	Coaltec Energy USA, Inc.
Sonia Nofziger Dasgupta	EnviroKure
Lucinda Power	USEPA
David Size	Poultry Litter Solutions, LLC
Peter Thomas	Coaltec Energy USA, Inc.
Patrick Thompson	EnergyWorks BioPower, LLC
Remote participants	
Mark Zolandz	EPA Region III
Robin Pellicano	MD Dept of Environment
Louise Lawrence	MD Dept of Agriculture
Jarrod Miller	
Mike Phillips	Perdue Agribusiness
Jack Meisinger	USDA Agriculture Research Service
Quirine Ketterings	Cornell University
Louise Lawrence	MD Dept of Agriculture
Mark D Lupke	
Susanne Trevena	EPA Region III
James Davis-Martin	VA Dept. Environmental Quality
Jeff Sweeney	EPA, CBPO
Michael McCaskey	
Kelly O'Neill	
Michael McCaskey	EnergyWorks BioPower, LLC
Steven Maslowski	
Joseph Ziobro	
Joy Gillespie	EPA Region III
Gary Flory	VA Dept. Environmental Quality
Lindsay Dodd	DE-MD Agribusiness Association
Ann-Marie Adams	EnviroKure

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel
Thursday, January 22, 2015, 10:00AM-12:00PM EST
Conference Call

Name	**Affiliation**	**Present? Y/N**
Keri Cantrell	KCB Consulting	Y
John Chastain	Clemson University	Y
Doug Hamilton (Chair)	Oklahoma State University	Y
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Andrea Ludwig	University of Tennessee	Y
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	Y
Jeff Porter	USDA-NRCS, ENTSC	Y
Non-panelists/Support		
Brian Benham	Virginia Tech (Project Director)	Y
Chris Brosch	Virginia Tech/VA DCR (WTWG rep)	Y
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	Y
Ashley Toy	EPA Region 3 (Regulatory Support)	Y
David Wood	CRC/CBP (CBP modeling team rep)	Y

Welcome and Panel Introductions

- Doug convened the call and reviewed the agenda.
- Jeremy asked for any comments or corrections to the December meeting minutes; none were raised. **DECISION**: The December meeting minutes were accepted.

Confirm dates for next face-to-face

- Jeremy asked if Thursday-Friday, June 25-26 still work for the panel's next face-to-face meeting.
- **ACTION**: Jeremy will secure a venue in the Annapolis area for the June 25-26 meeting.

Walkthrough and Discussion: Matrix of Technologies

- Doug introduced the matrix that he distributed prior to the call. He recalled the discussion from the last meeting and explained the matrix would serve as a guide to the technologies and manure types. It would direct the reader to pages with descriptions of the technology and manure types. This first version of the table only included the major manure types. The additional minor types (poultry-layer, horses, etc.). John was okay restricting it to the major types for now. Jeff felt it would be a large enough task to describe the technologies and major manures, but maybe an appendix could be added for the minor types.
- Doug noted some of the categories like mechanical separators could be subdivided into further rows. Andrea suggested using Yes or No in place of shading or coloring.
- Doug asked for questions, thoughts, or glaring issues with the matrix.
    - Keri noted that aerobic could be applied to poultry litter, e.g. EnviroKure.

- Mark pointed out if the panel feels there is not enough information to make a recommendation for a technology or technology-manure combination, then the panel can recommend that a future panel evaluate that technology when more information or research is available.
- John: A producer can change or alter the specific combination or doses of chemicals to get higher performance, so there may need to be more site-specific options for some technologies, if possible.
- Jactone: We could also use the table to summarize efficiency values or range of values that applies to a technology-manure combination.
- Doug recalled that the intent is to use the table as both a guide, and as a summary of N or P reduction values.
- It was suggested that some of these processes or values may be dependent on season. It was noted the CBP modeling tools would not need that kind of complexity so the panel should keep it simpler.
- John: Might be really difficult to put too much information into the table at once, but we can use it as a guide to help direct readers.
- Ashley: we characterize by technology or BMP.
- Mark noted the Bay Program has been developing a BMP verification framework and the panel will be asked to provide its thoughts and some guidance to the states about options on how to verify that these systems are installed and functioning.
- Keri: Might be better to have thermochemical technologies listed after the separation technologies, since the former relies on the latter for the wetter manures. Combustion, gasification, pyrolysis and torrefaction will be sub-categories of thermochemical. Not sure if each will have its own chapter or one combined chapter.
- John: We'll figure out a lot of the details as we go along. Some products like biochar could be composted.
- It was noted that once a slurry is separated then it could be treated as a solid in the table, which we could note in the definitions.
- Doug mentioned the panel will need to consider the audience for the report.
    - Ashley explained that state programs are a big part of the audience, which may have some science or engineering background. They will rely on the report for guidance on definitions and verification. Very programmatic audience.
    - Mark agreed with Ashley. He added there will be multiple audiences, particularly the CBP modeling team, plus the state regulatory and inspecting agencies. There are additional audiences or communities that look at these reports as well, like the National Academies.
- It was suggested to use the term Aerobic Treatment instead of Aerobic Digestion. There was discussion about whether or not aerobic technologies are expected to be implemented in the Chesapeake Bay region, given the operational and start-up costs some were skeptical. Doug noted the panel does not want to remove a category prematurely, so we'll keep the categories as they are for now and then re-evaluate them after we have spent more time searching and assessing the literature. If there's a lack of information then we can consider which technologies may need to wait for a future panel.

Discussion: Progress on literature search/assessment

- Doug asked the panelists how their efforts are progressing with literature. Overall there was some progress, but most panelists are still ramping up their effort following the holidays and university breaks. John noted he has a good amount of literature on separation that he is sorting through. Culling through his reference list.
    - There was discussion of peer-reviewed versus non-refereed sources (e.g. project reports or other gray literature). It was noted that non-peer-reviewed sources can still be used, but they may be given a lower weight or less confidence. It is up to the panel to sort through those kind of issues using their expertise.
    - Robb asked if anyone had developed a spreadsheet to track what resources they've looked at, what they concluded, etc. Columns for TP, TKN, TN, etc. **ACTION**: Robb will share a template from a previous project with the group.
    - Doug asked that if any subgroup or panel member develops a spreadsheet of their own, please share it with Doug or the whole panel.
    - Jeff noted he has seen a number of relevant ASABE presentations (like the conference in Broomfield).
    - **ACTION**: Jeremy will create a folder for each category on the Scholar site. Jeremy will provide additional instructions to panelists for organizing the literature on the Scholar site.
    - **ACTION**: Panel members will continue their respective literature searches and increase effort over the next month. By next call the goal is to have the subgroups functioning and communicating on a regular basis. Try to get as many relevant articles as possible on Scholar before the next call.
    - Doug noted the next call is scheduled for Thursday, February 26th at the same time.
    - John felt it would be important to only collect and share resources that we think contain information we can use. There's a lot of literature and we do not have time to spend on studies that are not relevant.
    - There was discussion about the specific types of information or data the panelists should be looking for. Mark explained that nutrients are definitely the focus, specifically total nutrient reductions, the overall mass balance, nutrient transformations, nitrogen volatilization, mineralization rates, and so on. All of those pieces of information can be used to inform the panel's recommendations or the modeling tools.

Wrap-up and next steps

- Doug and Jeremy reviewed the action items for the call. There were no other actions items or issues raised. Doug thanked everyone for their time and discussion.

Adjourned

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel

Thursday, February 26, 2015, 10:00AM-11:30AM EST
Conference Call

Name	Affiliation	Present? Y/N
Keri Cantrell	KCB Consulting	N
John Chastain	Clemson University	N
Doug Hamilton (Chair)	Oklahoma State University	Y
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Andrea Ludwig	University of Tennessee	Y
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	Y
Jeff Porter	USDA-NRCS, ENTSC	Y
Non-panelists/Support		
Brian Benham	Virginia Tech (Project Director)	N
Chris Brosch	Virginia Tech/VA DCR (WTWG rep)	N
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	N
Ashley Toy	EPA Region 3 (Regulatory Support)	Y
David Wood	CRC/CBP (CBP modeling team rep)	Y

Welcome and Introduction

- Doug convened the call and reviewed the agenda.

Update on June face-to-face meeting

- Jeremy noted that he reserved space in the Annapolis area for the panel's June meeting. Additional specifics will follow via email.

Data and input from stakeholders

- Doug recalled the email he sent to the panelists and confirmed everyone received it. He noted that Jeremy will serve as the point of contact between the panel and stakeholders that could provide data for the panel's consideration. Jeff noted he is working on a separate project for a conference and is working with some companies to compile some data. Jeff will share the paper or presentation from that effort with the panel when it's available.

Discussion: Progress on data and literature search/assessment

- Jeff noted for thermochemical technologies there is very little data or research at the farm scale. We do have a fairly limited pool of information since these technologies are relatively new in terms of livestock manure management.
- Doug noted that John drafted a summary that summarized literature sources on separation technologies.
    - Jeff noted that John has been working with NRCS on a document that includes this information, and that document is not released yet. Unsure when it will be published.
- Doug noted he and John needed to gather more information on dry chemical treatments.

- There was discussion about how the panel should address non-manure feedstocks in composting or digestion systems.
    - Jeremy noted that these outside feedstocks are not explicitly simulated in the modeling tools as a nutrient input, like manure or inorganic fertilizers. So if a system incorporates an outside feedstock that would increase the nutrient output, the panel would need to consider that.
    - Ashley: from a regulatory standpoint, anything that comes into contact with manure is then considered manure, e.g. bedding materials. Not sure how it works within the modeling tools, but Gary Shenk (EPA, CBPO) recently gave a presentation to Region 3 folks about stormwater and a similar presentation would be useful for this panel.
        - **ACTION**: Jeremy will coordinate with Gary Shenk to include him in the panel's next conference call.
    - Arogo noted that composting often requires other feedstocks or inputs to balance the carbon or other components.
    - Doug: if they are only adding carbon, then that would be a moot point from a nitrogen and phosphorus perspective.
    - Jeff: For digesters, food wastes are added to increase the energy production, so they would be adding nutrients.
- There was discussion that states may have different requirements regarding food waste and manure composting. Doug noted that Oklahoma does not allow any food waste in manure composting.
- Doug noted that some poultry producers use a sort of in house composting and wondered how this might be addressed as a storage or treatment practice.
- Ashley: in-house windrowing is very common on the eastern shore. In terms of in-house composting, that is a process for mass mortality, but otherwise not common.
- Jeff and Robb will raise windrowing to the group that is developing the charge for a forthcoming animal waste storage panel.
    - Post-meeting note: After discussion with this other group, they determined that it will not be addressed by the storage panel at this time (nor will it be addressed by the treatment panel). There were a number of issues raised, particular data availability and tracking/reporting concerns that make it more worthwhile to wait before these in-house practices are considered as a BMP.
- Doug: For addition of additional feedstocks, there are some inputs that would add carbon without increasing the nutrient output. Those outside inputs could reasonably be included with manure composting. For manure composting you are most likely adding something with higher carbon than food waste.
- Ashley: in terms of the mass balance, ultimately we are looking at the quality of the manure going in and the compost going out. The nutrients could go up or down. We could put an upper bound on how much feedstock is added to the manure. After a certain point it wouldn't be considered a manure treatment technology because it treats too large a portion of food waste or other feedstock.
- Jeff: to be considered an agricultural manure digester, many states have established limits to the amount of food wastes that can be added to the system.

Discussion of path forward on literature assessment

- Doug noted that in the panel's SOW, we are into the data analysis stage. He had taken the table that Robb provided and adjusted it for a few studies he provided. Doug had uploaded it to the Scholar site, so it can be downloaded, updated, renamed with a date/initials and then re-uploaded to Scholar. He asked others to do this as well for their studies. Presenting it a spreadsheet helps to start identifying possible trends or patterns.

Wrap-up and next steps

- **ACTION**: Jeremy will invite Gary Shenk to present to the panel on its next call.
- Doug: It will help if we can come to some conclusions about how to handle outside materials or other aspects of the mass balance when we meet with Gary.
- Doug and Jeremy reviewed the action items for the call. There were no other actions items or issues raised. Doug thanked everyone for their time and discussion.

Adjourned

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel
Thursday, March 26, 2015, 10:00AM-11:30AM EST
Conference Call

Name	**Affiliation**	**Present? Y/N**
Keri Cantrell	KCB Consulting	Y
John Chastain	Clemson University	Y
Doug Hamilton (Chair)	Oklahoma State University	Y
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Andrea Ludwig	University of Tennessee	N
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	N
Jeff Porter	USDA-NRCS, ENTSC	Y
Non-panelists/Support		
Brian Benham	Virginia Tech (Project Director)	Y
Chris Brosch	Virginia Tech/VA DCR (WTWG rep)	Y
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	N
Ashley Toy	EPA Region 3 (Regulatory Support)	Y
David Wood	CRC/CBP (CBP modeling team rep)	Y
Invited guests: Gary Shenk (EPA, CBPO) and Matt Johnston (UMD, CBPO)		

Welcome and Introduction

- Doug convened the call and reviewed the agenda.

Manure loads and processes in the Watershed Model and Scenario Builder

- Gary Shenk and Matt Johnston provided details about how manure and the associated nutrients are simulated in the Watershed Model and Scenario Builder, which combines data (BMPs, land uses, etc.) into a scenario for the Watershed Model. Gary described some basics about the Watershed Model.
- Matt went into more detail on Scenario Builder, where most the manure processes occur. The manure nutrients start with as-excreted manure, based on animal populations and values from Ag Census and ASABE or other reliable sources. As-excreted manure is then divided between direct deposit (pasture) and barnyard manure. Volatilization and storage/handling losses are applied to the barnyard manure, but these losses can be reduced through certain BMPs to retain more manure nutrients for transport or land application in the model. The next step is taking the remaining manure from the barnyard to "stored" manure, which can then be land applied to crops or transported out of the county (via the manure transport BMP). See the slides for more information and visual illustration of this process.
- Jeff: anaerobic digesters may add food products or other sources of nutrients into the process, so how could the panel consider these inputs?
    - Matt noted that those nutrients types of nutrients are not currently accounted for in the model, but could be added based on data or recommendations from the panel. There hasn't been a request or need to explicitly account for them before.
    - John: Those additional inputs like food waste can be a significant source of additional nutrients in some cases, but some systems are only manure.
- Doug: for a normal scenario, let's say digestion doesn't change the total N but transforms the form of the N. It seems that the model could account for those transformations.
    - Matt: There is speciation of N and P in the model, so if there are transformations recommended by the panel that can be built into the model. We can handle absolute reductions in the model if there is a tier based on absolute or measured reductions. It's important to remember that BMPs are also used for planning scenarios so there needs to be a default, or base, rate/tier that the states can use for planning purposes when specific data is not available.
- John: A base tier or rate that is an average for technologies, especially for separation technologies, will be our biggest contribution. Doing our best to derive that base tier seems to be most important. Think we need to focus on that basic tier first.
- Doug: There is a lot of interest in having more detailed tiers based on monitoring data when that specific data is available, but agree that the base tier is very important.
- John asked for clarification about ammonia, ammonium and volatilization in the model. He was concerned that a lot of it may actually be ammonium, not ammonia.
    - Matt clarified that the model does not treat ammonia as ammonium.
- Doug: our task is to determine what those transformations may be, but we don't need to worry about the land application or other pieces of the larger model.
- Gary: Scenario Builder is pretty simple in terms of how it handles these nutrient species and transformations. If there are different ways to represent these species or transformations, then those can be built in if there is data to support those changes.
- Doug: does the panel need to know what the speciation is in Scenario Builder?
    - Matt: Typically, the panel will work and go the direction they feel is best, based on the literature. Then towards the end as the panel is writing its recommendations a smaller group of panelists and the modeling team can work

out the specific details like speciation or transformations in the context of the model and Scenario Builder.

- Jeff mentioned that alum application does not reduce phosphorus but converts it to a less plant available form, reducing the risk of P runoff.
    - Matt: We have alum in the model right now, but it does not impact P availability.
    - Jeremy: We can consider alum as part of the chemical treatments category if there is some data for the subgroup to consider.
- John: based on the graphic seems that BMPs could be placed elsewhere too, not just the three spots where the graphic has them.
    - Matt: That's correct. Conceptually we can put BMPs at other places in the process, and that can be part of the discussion down the road. If speciation or transformation information is in the literature, suggest including it, but otherwise focus on the overall N and P.
- Doug: there may be different "piles" or boxes of stored manure following the various treatment practices, e.g. solid or liquid. Seems like that can be incorporated into the model. By separating manure into a solid form it is more likely to be transported for land application in another area that needs the nutrients.
    - Matt: some BMPs may not impact the nutrients other than the separation into solid and liquid, but that could lead to more nutrient transport of the solid manure. Transport is already a BMP in the model.
    - Jeff noted that the land application and later volatilization will vary for solids that are land applied versus liquid manure that is injected.
    - Matt noted there are other practices and panels that address those issues, so this panel won't need to consider those land application or incorporation aspects.

Continued discussion of data gathering and assessment

- Doug noted that he will continue to follow up with panelists individually about their progress.
- John explained he wants to start developing a first cut of base or default rates based on the studies he's collected.
- Doug agreed with John's approach and noted that is what he would also suggest. Develop that first tier and share those tables and justification with the rest of the subgroup. John is at that point, but others need to continue adding to their spreadsheets of literature among the subgroups. When we have a fairly complete list of sources we want judge the literature as instructed in the BMP Protocol. There may be some older studies or some sources in the spreadsheet that we don't incorporate in the final report, but useful to note them for our internal purposes.
    - For April call, each subgroup would ideally have references into the spreadsheets with basic breakdowns of the data. By May, would like to see some rough drafts from subgroups based on what they found from the literature.
- For June face-to-face we want to have a rough draft of the recommendations chapter for each category/technology subgroup. So everyone needs to have their respective spreadsheets developed and vetted by April and vetted by May with preliminary drafts and summary tables.

Travel plans and update for June meeting

- Doug noted he is still negotiating with the Ok State admin folks about designating a hotel for the meeting. Should have that done by the next meeting so we can confirm travel plans and reservations at that time. Stay tuned for an email from Doug. The hotel will have a shuttle available for carpooling to/from the airport and meeting.

Wrap-up and next steps

- Doug recapped. He felt it was much clearer where and how the treatment technologies will fit in terms of the model.
- **ACTION**: By the next call (4/23/15) Doug asked everyone to get the literature settled the best they can and have full spreadsheets ready, including the basic summary of data in the spreadsheets.
- After the April call we will work through the BMP Protocol and work to draft preliminary recommendations and summary tables for May, and full draft chapters from each subgroup detailing their thoughts and recommendations for the June meeting.
- Jeremy noted the next call is scheduled for Thursday, April 23, 10:00AM-12:00PM EST.
- Doug thanked everyone for their time and the productive call.

Adjourned

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel
Thursday, April 23, 2015, 10:00AM-11:30AM EST
Conference Call

Name	**Affiliation**	**Present? Y/N**
Keri Cantrell	KCB Consulting	N
John Chastain	Clemson University	Y
Doug Hamilton (Chair)	Oklahoma State University	Y
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Andrea Ludwig	University of Tennessee	Y
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	N
Jeff Porter	USDA-NRCS, ENTSC	Y
Non-panelists/Support		
Brian Benham	Virginia Tech (Project Director)	N
Chris Brosch	Virginia Tech/VA DCR (WTWG rep)	Y
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	N
Ashley Toy	EPA Region 3 (Regulatory Support)	Y
David Wood	CRC/CBP (CBP modeling team rep)	Y

Welcome and Introduction

- Doug convened the call and reviewed the agenda.
- **DECISION**: The March call minutes were approved.

Continued discussion of literature assessments and progress

- Doug: For opening discussion, the definition of removal will essentially be the mass into the system minus the mass leaving the system, divided by the mass into the system. We need to key on the mass, since that is what matters most for the Model. A lot of literature uses concentration. By that basic definition some of these technologies do not have a net reduction, because they only change the form not the total mass.
    - Jeff had the same thought as Doug about the basic reduction definition. Also, it will be important to define where the different forms of N and P end up, whether in a solid product or released through an emissions stack, etc.
    - There was some discussion of the accounting and tracking of nutrients post-treatment. The panel will include recommendations about tracking of the end use or application of the nutrients, but calculations and processes about the fate of those nutrients are outside the scope of the panel, which is focused on the mass into and out of the treatment systems. Field application or other post-treatment issues are in the scope of other groups or panels.
- Anaerobic digestion
    - Doug: For digestion, we would only consider covered lagoons under anaerobic digestion. There are at least some covered lagoons in the watershed. In that situation we will need to discuss what happens to the sludge, when it eventually gets cleaned out.
    - Jeff was aware of some studies that assess differences for surface application of digested versus undigested manure.
        - It was noted that field application is outside the scope of the panel, but should at least mention these differences in the report and ensure that other relevant panels or groups are aware of the studies, e.g. the nutrient management panel
        - Jeff: there is a movement pushing for solid state anaerobic digestion, but there isn't much out there right now. Would support removing it from consideration right now by this panel. We can make a statement to acknowledge the technology and that it is not addressed now, but perhaps down the road.
- Aerobic digestion.
    - Doug noted that in the literature there are at least 5 systems that are well documented, so we'll stick with aerobic digestion and not throw it out. Not as far along as anaerobic, but we can still make a recommendation.
        - Robb noted that some operations use aeration. Primarily using aeration to deodorize, but in some cases they are also using it for the flush water system to recirculate it and clean the floor ways.
        - John and Doug discussed that we may want to distinguish between aeration for odor control and aerobic treatment for nutrient reduction. The reuse of the water for floor cleaning may have different results and ammonia benefits.
        - There was discussion of processes that should be considered, such as nitrification-denitrification and biological phosphorus removal. Annamox is primarily done for municipal treatment, but some are beginning to look at it for use in livestock operations with perhaps some modifications.

        - Doug: We do need to define the capabilities of some of these secondary treatments to say what their potential is.
        - Robb noted there is probably no data on the aeration systems he mentioned. He suggested the panel exclude it for now. He will get a better feel about the use or demographics of the systems. If it is widespread we can consider including it again.
        - John: aeration usually done in a second or third pond, not the primary pond. Could see aeration in a second or third pond/lagoon being a small part of the larger aerobic treatment piece.
- Arogo and Keri were not on the line to discuss wet chemical treatment. Doug mentioned three types of chemical treatments that the subgroup may want to consider:
    - Struvite precipitation
    - Calcium carbonate precipitation
    - Ammonium sulfate ammonia removal
    - Jeff noted that Quick Wash is a phosphorus precipitation process.
    - There was discussion of the panel's tiered approach and proprietary technologies. Jeremy explained that the panel can not make explicit recommendations for a specific patented technology or technique such as "quick wash," but they could recommend a reduction for a more general category such as "phosphorus precipitation," or something similar so that the panel is not giving an advantage to one particular company or patent. For some systems, like some of the larger ones in Pennsylvania, the panel is considering a separate tier where monitoring and measured loads could be used in place of an efficiency. This would depend on these systems and their reporting of data to states, similar to the reporting by wastewater treatment plants. That tier of measured loads from monitored systems could be applied to any system or combination of technologies regardless of whether it is proprietary. They just need to report the data for accountability purposes.
        - It was suggested that the report may need a chapter or section about combinations of technologies that do not fit under the measured/monitored tier.
- Dry chemical
    - John: do not have a paragraph or written description to share, but have most of needed literature and spreadsheet up on Scholar. Have reviewed most of it and identified some nice reviews from 2008 and more recently. Think there is enough information to write the section. For alum, the original rates were developed using smaller birds, but birds are bigger now and the effect is likely reduced.
    - Used on solid manure, primarily poultry. Alum, sodium bisulfate (tradename PLT), and a third chemical (tradename PoultryGuard). There was a fourth one in the literature that was less effective. Ferric sulfate and phosphoric acid have also been tested.
    - John's suggested definition:
        - A chemical amendment that lowers the pH (acidification) past a threshold to reduce the release of ammonia.
        - He also noted that the amount of amendment applied has to be adjusted to the amount of litter, weight of birds, etc.

- Thermochemical
    - Doug asked if Jeff had an idea about eliminating any of the 4 processes. Jeff noted he and Keri have not made that decision yet. There are some technologies such as liquefaction that is in the research stage, but not being implemented anywhere yet. Aside from liquefaction, not sure if we should exclude anything right now. Hoping to get some more data by the end of May.
    - Doug asked Jeff and Keri to continue to work on definitions for each category.
- Separation technologies
    - Doug: A lot of progress made by John so far. Any things to exclude or modify?
    - Jeff noted he added some information about FPCC projects to Scholar.
- Composting
    - Doug suggested it could be maybe be more similar to the anaerobic digestion or Jeff's spreadsheets. Helps to be a little more explicit about the reason why the reference is high/med/low quality, e.g. outside the watershed, etc.
    - Andrea discussed her write-up for composting, which is posted to Scholar. Need a discussion among the subgroup about the role and effect of bulking agents. Any sort of reporting for
        - John: Penn State is one of multiple labs that can do analysis to determine if the compost is mature and stable. C:N ratio alone tells you nothing about the stability of the manure.
    - John: For solid-screening, aware of only one or three papers. Doug noted another author or two.

Travel plans and update for June meeting

- Doug confirmed that everyone received his email about the designated hotel for the June meeting. He will send an email with additional instructions for those who will be reimbursed through Ok State.

Wrap-up and next steps

- Doug and asked panelists to stay on current track and continue to develop the word documents and spreadsheets to piece together their recommendations. In June, we want to have drafts of the technology chapters to work through.
- **ACTION**: Literature subgroups to continue their review and summary of the literature, which includes the summary spreadsheet and a word document that defines the technology and describes the summary conclusions. This will be the basis for the draft chapters that the panel will discuss at its June meeting.
- **ACTION**: Panelists to inform Jeremy about any dietary restrictions for the June meeting.
- Jeremy noted the next call is scheduled for Thursday, May 28, 10:00AM-12:00PM EST.

Adjourned

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel
Thursday, May 28, 2015, 10:00AM-11:30AM EST
Conference Call

Name	Affiliation	Present? Y/N
Keri Cantrell	KCB Consulting	N
John Chastain	Clemson University	Y
Doug Hamilton (Chair)	Oklahoma State University	Y
Andrea Ludwig	University of Tennessee	Y
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	Y
Jeff Porter	USDA-NRCS, ENTSC	Y
Non-panelists/Support		
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Brian Benham	Virginia Tech (Project Director)	N
Chris Brosch	Virginia Tech/VA DCR (WTWG rep)	Y
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	Y
Ashley Toy	EPA Region 3 (Regulatory Support)	Y
David Wood	CRC/CBP (CBP modeling team rep)	Y

Welcome and Introduction

- Doug convened the call and reviewed the agenda.
- **DECISION**: The April call minutes were approved.

Progress report on literature assessments

- Participants discussed the status of their respective literature assessments.
- Anaerobic digestion
    - Doug: almost done with looking at literature, up to around 18 sources of both lab and case studies. Had wanted to have a draft ready for review by now, but did not get it done in time.
- Aerobic digestion
    - Doug noted there were about 3-4 studies on Scholar. Jeff noted he has been focused on thermochemical and there are not a lot of sources out there for aerobic.
- Wet chemical treatment
    - Arogo mentioned he has some literature ready he just needs to upload it and work on start writing.
- Dry chemical treatments and Separation Technologies
    - John noted he still had to start writing but would have a draft ready for the June meeting. Plenty of studies gathered and uploaded for both categories.
- Thermochemical
    - Jeff: Biggest issue has been that most bench scale. Still digging for other articles. Working with a couple farm scale CIG projects focusing on thermochemical projects in the CBW, but have some preliminary numbers as they continue to gather data. Might not be published but it is very current and located in the CBW.
    - Doug felt it helps if those unpublished case studies confirm what other bench or lab studies are finding
        - Arogo agreed we can work with percentages and results from unpublished sources to compare to bench studies.

- Jeff: There are very few if any technical references. Could be 6 months to 1 year until farm scale results are published. Hopefully we will see correlation between the bench scale and farm scale results.
- Arogo: we want to acknowledge all results whether good or bad.
- Jeff noted there are some bad or ugly results and all the project data are from third parties (e.g. universities) so we should see unbiased results.
- Doug: we can use best professional judgment on what to include, exclude, or weight and explain why.
- John: we could cite some of this information as personal communication as a simple and honest way to present the information, noting the caveats with the information.
    - Doug: Would prefer avoiding relying on references to personal communication for this panel's report.
    - Mark noted there are two projects with public funding and there could be publically available data from NRCS or PA DEP and we could cite those public sources rather than personal communication.
    - Doug: I think we could use that data the same way as the Beegle report. Prefer that they would have a report of some kind that we could cite.
    - John did not have an issue citing the reported information since it's publically available and their methods are documented in publically available documents. As long as the documents are complete and we can review their methods and their data, and it's the best information we have, then no issue with citing that information.
- Mark: the conservation tillage panel looked at some project reports and conducted some RUSLE-2 model runs to help re-confirm some of the project data. In the end they did not rely or cite the model runs, but the information helped to confirm what other sources were finding. There could be a similar approach here where even lower priority sources can help confirm other sources.
- Jeremy suggested that Jeff and Keri compile their draft chapter using whatever information they have available, project data or otherwise. When the panel sees the information in writing and the sources side-by-side they can make a more informed judgment about including, excluding or weighting certain sources.
    - Doug agreed. He added that panelists should use their best judgment when communicating and possibly using data from sources before the results are published by the colleague.
- Jeff: have to confirm with Keri, but thinking that the various technologies should be combined into one chapter. There are a lot of similarities. Doug and John agreed.
- Mark: there may be some material or presentations from public meetings on relevant projects and perhaps those could serve as a reference.

        - John expressed concern that presentations like that would not have sufficient documentation or explanation of methods behind the data.
- Composting
    - Andrea: At about 15 citations and working to put them into the spreadsheet. Updating the description from last month and will continue to build on that.

Prep for writing report drafts

- Doug described some basic elements that he felt each draft chapter should include:
    - Define the practice, the technology category and related sub-technologies
    - First level/tier removal efficiency
        - Influent-effluent mass divided by influent mass.
    - Explanation of different factors (retention time, etc.) that impact the effectiveness of the practice.
        - Doug noted this could be lengthy and take a bit of editing, but will be important.
    - Assessment based on those factors
    - Protocol for individual systems
        - Doug mentioned there is a protocol for digesters that is pretty widely accepted. If there are published protocols for various technologies we should reference and build on those.
    - Ancillary effects
        - Doug explained this could include the good, the bad, and the ugly results or potential effects related to the practice or technology category, e.g. methane production, nutrient transformations, etc.
        - John: there are instances where we know or think certain things are happening but we don't have published data to quantify the effect. For example, effluent from a digester there is a concern about ammonia loss.
            - Doug: In that situation if we know of a transformation, we may not fully know the extent but we can acknowledge that concern.
            - Mark noted there are other BMPs that can sometimes be used to address some ancillary effects, such as lagoon covers.
            - Jeremy noted that expert panels typically include a list of future research needs. He encouraged the panelists to keep a running list of things they feel are important topics for future research projects.
- Doug will provide more detailed instructions to the panel via email.

Travel plans and update for June meeting

- Doug discussed the tentative agenda for the June meeting. Will try to get an early start on Thursday morning. Will have presentations and discussions for each chapter and go in-depth. He suggested 6-10 slides to cover the definitions and things discussed above.
- **ACTION:** Panelists to have draft chapters ready for June meeting (posted to Scholar or emailed to the full group), following more detailed directions from Doug.
- Doug confirmed that everyone on the line had their travel plans ready and were planning to be there in person.

- Doug confirmed that everyone received his email about the designated hotel for the June meeting. He will send an email with additional instructions for those who will be reimbursed through Ok State.
- Doug noted we'll wrap up 1:30 on Friday at the earliest, so plan plenty of time for the airport

Wrap-up and next steps

- **ACTION**: Doug will share instructions for presentations and chapters for the June meeting.

Adjourned

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel
Thursday, June 25 and Friday June 26, 2015, 10:00AM-11:30AM EST
CBF Phillip Merrill Center, Annapolis, MD
Meeting

Name	**Affiliation**	**Present? Y/N**
Keri Cantrell	KCB Consulting	Y
John Chastain	Clemson University	Y
Doug Hamilton (Chair)	Oklahoma State University	Y
Andrea Ludwig	University of Tennessee	Y
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	Y
Jeff Porter	USDA-NRCS, ENTSC	Y
Non-panelists/Support		
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Brian Benham	Virginia Tech (Project Director)	Y
Chris Brosch	Virginia Tech/VA DCR (WTWG rep)	Y
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	Y
Ashley Toy	EPA Region 3 (Regulatory Support)	Y
David Wood	CRC/CBP (CBP modeling team rep)	Y

Welcome and Introduction

- Doug convened the meeting and reviewed the agenda.
- **DECISION**: The May call minutes were approved.

Subgroup presentations and discussion

- Thermochemical conversions (TCC)
    - Difference between liquefaction and hydrothermal carbonization is the pressure. HC is autogenic (20 atm) and liquefaction is 90 atm.
    - Currently systems are for broilers or layers, combustion or gasification.
    - Issues are bench level tests, limited farm-scale project data, incomplete datasets and limited journal article data.
    - According to IBI, true char is at least 10% carbon.

    - Jeff reviewed some summary d
    - Data from CIG project reports of thermochemical projects in the Chesapeake Bay. Char appears to have higher N concentration and lower P2O5 concentrations relative to ash.
    - Very low NOx even with combustion systems. Might not be the case with dairy, but that's that case with poultry.
    - EnergyWorks is under state permits and that information could be used as public information. Need to check on the status of the CIG reports and if that data can be presented or aggregated for inclusion in the report, or if the data is protected.
        - Ashley can check on the permit status for the other PA facilities besides EnergyWorks. Just need the names and can quickly check.
        - Based on CIG reports
        - Mark noted that NFWF has their own online reports available that may be worth checking.
    - We need to get to the mass removal. May be primarily interested in the ash/char content as the primary piece of the nutrient fate/removal.
    - **DECISION:** The panel will use English units in the next iteration of the drafts (lbs, acres, feet), with the exception of cases where metric units are the widely accepted or common standard (e.g. screen size still presented in mm, not inches).
    - Nitrogen is different by the technologies while P is mostly consistent aside from a couple categories.
- Aerobic treatment
    - For liquid and slurry. Aerobic systems typically applied to swine slurry, separated swine liquid and separated dairy liquid.
    - Sub categories: aerobic lagoon, aerobic digester, wetlands, nitrification-denitrification, biological phosphorus removal. Will not look at wetlands for the purposes of this panel.
    - Jeff noted there are some CIG projects looking at lower energy aeration options (~2 horsepower).
    - Nitrification-Denitrification. Will typically have an initial treatment step. Anaerobic digestion, centrifugation, the little data available indicates ~60% TN removal efficiency (as N2 gas). Stable byproduct and reduced odor. Cost is big barrier and issue. Other possible hazard is incomplete conversion to N2 which could produce N2O instead of N2, which would be significant from GHG standpoint.
    - Focus in on nitrification-denitrification following initial treatment similar to municipal treatment.
    - Still have to look at literature for Biological Phosphorus Removal.
- Solid-Liquid Separation
    - John reviewed his definition for S-L separation. John noted that for the S-L section he is only providing numbers for the separation machine, excluding polymers or any additional measures.
    - For our purposes it was suggested to clarify that the recommendations do not include sand separators. Only manure S-L separators. Suggest we mention sand separation systems and that they provide little to no N or P since that is not the

goal of the sand systems. Sand in overall context is very negligible. John intends to explain this in one paragraph.
    - For screen separators the literature is vastly based on % of concentration reduction, not mass removal. Concentration reduction tends to be a more conservative number while mass removal efficiency numbers tend to be higher.
    - The panel agreed that John should continue including VS in the tables. Need some measure of organic load if we'll be looking at treatment trains of practices.
    - Brian noted that others may have different interpretations of what "conservative" would mean, so the panel should be careful about how to present the data. There was discussion about the need and depth/detail necessary in the report for explaining or justifying the recommended numbers/values.
    - There was some discussion about the need for tier 2 or tier 3 for some technologies that would require detailed data about a practice. Reserved for additional discussion later in the meeting.
        - David noted that the states enjoy having an option for reporting a BMP for additional reductions if they have the more detailed information. However they may not expend the effort, depending on the effort to collect or report that additional information for more than the basic tier 1 reduction.
    - Doug noted the panel will later discuss the need to clarify how we distinguish tier 1, whether we have different rates by screen type, etc. Reserved for additional discussion later in the meeting. My thought: the rates vary by screen type or press type, so would need a default (unknown type) to be equal to the lowest of the individual screen or press types.
    - John noted he is still working to add text for the final few categories (gravity centrifuges, etc.), but he reviewed the tables he had for each category. Polymer or metal salt enhanced separation will have its own section. Some of the chemical assisted separation studies are more lab scale, but there is evidence of a correlation when those chemicals are applied to farm scale machines, so the studies can still be useful.
    - There was additional discussion about the detail and categories for tier 1.
    - Robb: but
- Wet chemical treatment
    - There are hundreds/thousands of variations of chemicals that can be used for wet chemical treatment. They can be polymers, metal salts, cationic, branched or other structure, etc. The chemicals are dosed according to the desired P removal. Given the complexities there may not be a Tier 1 for this practice.
    - Move/combine John's chemical enhanced table and info into Arogo's section
    - Doug suggested three, possibly 4 sections (clarified/resolved later in Day 1):
        - Solid separation of manure
        - Settling or screening w/ and w/out chemicals
        - Struvite by itself
- Anaerobic digestion
    - Will not make recommendations on solid state anaerobic digestion, but will acknowledge that it exists and may warrant another panel in the future.
    - AD is mainly used for wet manures or separated liquids, but there is at least one instance where water is added to poultry litter for digestion.

- No overall TN or TP removal for anaerobic digestion. Tier 1 ranges from 30-60% but Doug suggested 40% as a reasonable single number for Tier 1. John suggested including VS data where possible. Doug noted that most of the TS removal is for VS.
- Doug discussed the transformations that occur in the anaerobic digestion process.
- When separating digested manure you will have smaller particles and thus need to approach the separation with that in mind, e.g. use smaller screen openings.
- Second tier would distinguish between thermophilic, mesophilic, ambient (will probably opt to exclude cryophilic as it is very rare).
- Jeff suggested using ASABE numbers for the organic loading rate as NRCS still has to update its standard.
- Doug reiterated that anaerobic digestion is primarily done for other ancillary benefits rather than nutrient removal/transformation, such as energy production, odor control, waste stabilization and GHG reductions.
- Can chart OLR and VS removal on a linear chart, and relate it to another chart for VS and % N transformation.

- Composting
  - Haven't gotten into Tier 2 rates or efficiencies.
  - Processes
    - Turned or unturned windrow
    - Static pile
    - In-vessel
      - Arogo noted that there are various types of vessels such as rotary drums. Most or all types do not produce a final compost product and would require a finishing step such as a static pile.
    - Forced ventilation
  - Bulking agents (wheat straw, cornstalk, wood chips/shavings, other)
  - Various maturity and stability indices are available, e.g. CA Compost Quality Council. CA distinguishes between immature, mature, very mature
  - Still some literature remaining for review.
- Dry chemical treatments
  - Litter pH of 7.0 or less controls ammonia. Below 6.5, no ammonia.
  - Aluminum sulfate, sodium bisulfate, sulfuric acid. All greatly reduce ammonia for first 21-28 days.
  - Birds in WV are closer to 3-4 lbs while Eastern Shore are larger, 9 lbs.
  - There was discussion about the benefits, effects, and issues associated with alum and other amendments. There was general agreement that the practice provides little if any water quality benefit.
  - For the air quality side of things, the CBP will be looking at possibly integrating localized air emissions modeling (CMAC) for the Phase 6 Model. Jurisdictions do not currently report the existing practice anyway, because they do not get credit for the air quality benefit and there is more TN retained for field application. The AgWG also has other efforts to look at litter more comprehensively in terms of feed practices, etc., which may also account for amendments like alum.
  - It was suggest that panel should recommend the partnership consider an alternate approach for incorporating this into the model.

Open discussion of themes, gaps, and other issues following first draft of chapters

- We will have a definitions section or glossary towards the front of the report

1. Thermochemical conversion (TCC)
2. Aerobic Treatment (liquids)
3. Mechanical separation (without chemicals)
4. Gravity settling (without chemicals)
5. Chemically enhanced S-L separation
6. Chemical precipitation (including Struvite)
7. Anaerobic Digestion
8. Composting

Mention Solid-solid separation (screening litter) for further research

The group outlined the technologies and how to break out the tiers and sub categories.

1) Aerobic Treatment
    a) Tier 1
        i) Nit-Denit
        ii) BPR
2) Anaerobic Digestion
    a) Tier 1
        i) Covered lagoon
        ii) Plug flow
        iii) Mixed
3) Mechanically Separated
    a) Tier 1
        i) Stationary Screen
        ii) Rotating Screen
        iii) Belt Press
        iv) Screw Press
        v) Roller Press
        vi) Centrifuge
4) Settling
    a) Tier 1
        i) Settling
5) Chemical enhanced separation
    a) Tier 1
        i) N/A (Tier 2 only?)
6) Precipitation
    a) Tier 1
        i) N/A (Tier 2 only?)
7) TCC
    a) Tier 1
        i) Combustion
        ii) Gasification

iii) Pyrolysis
iv) Wet

8) Compost
   a) Tier 1
      i) Turned windrow
      ii) Static pile
      iii) In-vessel
      iv) Forced aeration

Tiers
1 based on type (whole number significant digits)
2 based on factors or more detailed info
3 monitored or measured inputs/outputs

Adjourned Day One

DAY TWO – Friday June 26

Call to order and introduction

- Doug convened the meeting and recapped the outlined technology chapters.
  - Tier 1 is the basic (conservative) reduction for a practice without additional information
  - Tier 2 is based upon factors or information that is additional or beyond the first tier of practices.
  - Tier 3 would be based on monitoring protocols
- Suggest that Tier 2 is limited to 1 or 2 factors (max 3-4). Tier 3 would take more factors that would be monitored/reported according to state requirements or the suggested
  - Still need a number for the Tier 2. Don't want a range. Have an average or the lowest number (that is higher than Tier 1).

Discuss or revisit lingering issues from Day One

- The group discussed the order/outline for the chapters

Outline for technology chapter (final draft from each group due August 14th)

1) Definitions
   a) One sentence or brief general summary of the technology
   b) Type
   c) What is not covered (e.g. sand separator discussion from day one)
   d) Types of applicable manure
2) Tier 1 removals
3) Process factors (review of available science/literature)
   a) Process factors
   b) Nutrient transformations (and major pathways)
   c) End products
   d) Effect on downstream processes
   e) Key verification items or metrics

4) Tier 2 removals based on factors
5) Ancillary Effects
   a) Benefits
   b) Concerns
6) Tier 3
   a) Listing of verification items or metrics
7) Future research needs and limitations of data
8) References

There was discussion of BMP verification. Additional background information about BMP Verification is available on the CBP website:
http://www.chesapeakebay.net/about/programs/bmpverification

Discussion of chapter leads

- Anaerobic: Doug
- Aerobic: Doug
- Mechanical settling: John
- Precipitation: Arogo
- Composting: Andrea

Timeline and next steps for completing report

- **DECISION:** Next call scheduled for Thursday, September 10th 10:00AM-12:00PM EST
- **DECISION:** Deadline for final draft of respective chapters is Friday August 14th
  - Encouraged to ask for feedback if able to share draft in advance of the 14th
- **ACTION**: Jeremy to share definitions of related BMPs with panel
  - Animal waste management systems (AWMS)
  - Manure Transport
  - Litter amendments
  - Lagoon covers

Recap of Day Two, summary of actions and next steps from both days

- Doug thanked everyone for their time and discussion over both days and wished everyone a safe trip home.

Adjourned

SUMMARY OF ACTIONS AND DECISIONS
Manure Treatment Technologies Expert Panel
Wednesday, March 9, 2016, 3:00PM-4:30PM EST
Conference Call

Name	Affiliation	Present? Y/N
Keri Cantrell	KCB Consulting	Y
John Chastain	Clemson University	N
Doug Hamilton (Chair)	Oklahoma State University	Y

Andrea Ludwig	University of Tennessee	N
Robert Meinen	Penn State University	Y
Jactone Ogejo	Virginia Tech	Y
Jeff Porter	USDA-NRCS, ENTSC	Y
Non-panelists/Support		
Jeremy Hanson (Coord.)	Virginia Tech/CBP	Y
Brian Benham	Virginia Tech (Project Director)	Y
Chris Brosch	DDA (WTWG rep)	N
Mark Dubin	University of Maryland/CBP (AgWG Coord.)	N
Ashley Toy	EPA Region 3 (Regulatory Support)	Y
David Wood	CRC/CBP (CBP modeling team rep)	Y

Welcome and Introduction

- Doug convened the call and reviewed the agenda.

Overview of draft panel report

- Doug explained some of the changes made while developing the draft report. He explained how the recommendations evolved to boil down to a focus on changes to N based on volatilization, which only occurs in the thermochemical and composting technologies.
- Keri asked how the phosphorus benefits might be captured from the treatment practices.
    - Jeremy explained that the CBP partnership is discussing the addition of moisture content as a variable when they report manure transportation. So if they transport a treated manure product that is dry, and they report the low moisture content, then the mass of P they are transporting is increased.
- Arogo asked for clarification on how the removal for atmospheric losses and volatilization are considered removal. The nitrogen will come down eventually.
    - David noted that the technical appendix is added to the report to help clarify issues like this that can be confusing between the panel's understanding and the modeling tools. There is a separate airshed model that simulates atmospheric deposition, so in the watershed model the gaseous losses of N are considered removal. Overall the panel's recommendations will be fully accounted for, just not in a straightforward way.
    - Doug summarized that in terms of nutrient and water quality benefits for manure treatment, it boils down to atmospheric losses through volatilization and concentrating the nutrients for easier transport. Could satisfy the modeling needs and clarify the panel's recommendations by making the edits he described.
    - There was discussion about the black box diagram and how the treatment BMP and atmospheric losses relate to field application.
    - Doug asked the panel members if they preferred to keep the report as is, or if they wanted to add the clarifying tables, information and modify the black box diagrams.
        - Arogo felt it would be best to make the suggested changes. Should stick with what we know and where the streams all go, which will make more sense beyond the modeling sense.

        - Jeff asked if it would be helpful to have the additional information down the road. Perhaps in the long run it would be easier to provide the information now.
            - David: Think it's important for the report to show all the changes and streams. That helps the readers and modelers better understand the science and the rationale.
        - Ashley also supported adding the detail and clarifications. Robb agreed too.
    - Doug got clarification from Jeff and Keri on a couple points in the TCC chapter. Temperature is key factor to give the higher reduction for a combustion system.
    - Keri noted that one of the later chapters about separation needs to more explicitly reference the TCC chapter and how the separation treatment is crucial before applying a TCC process.
    - Jeremy asked panelists to confirm that they agree with releasing the report for CBP review and comment, once Doug incorporates the edits discussed during the call.
    - Keri, Jeff, Robb, and Arogo agreed this would be okay. Arogo felt John would also agree. Andrea had said via email she supported the recommendations.
    - There was discussion about what term best describes the concentrating or separation into the solid portion; the term partitioning was suggested and seemed to be best term.
    - Doug asked panel members for final comments by COB on Friday 3/11. He will share revised version by sometime the following week.
- **ACTION**: Doug will share revised draft report the week of 3/14. Panel members will have one week to provide any final input, or raise objections to the release of the report. If nothing is raised it will be taken as consensus in support of releasing the report for AgWG and CBP review.

Overview of what happens next

- Jeremy described the next steps in the process. Once the report is released, Doug and Jeremy will host an open webinar to walkthrough the panel's recommendations. The webinar will be the start of a 30-day comments period. After comments are addressed the AgWG will be asked to approve the panel's report, followed by the Watershed Technical Workgroup and finally the Water Quality Goal Implementation Team. The process will likely take approximately four months, potentially more.

Wrap-up

- Doug and Jeremy thanked everyone for their time and contributions throughout the panel's work.

Adjourned