Introduction (Ullman):

1. Center for the Inland Bays
    a. Develop management policies to control “nutrient leakage” from land to the Inland Bays
    b. Challenge is to maintain or improve surface water quality and ecology of the Inland Bays despite population increases in the watershed and intensifying agriculture.
2. What can be feasibly accomplished in water and nutrient management to meet Center goals?
3. Can nutrient leakage be controlled by collaboration across the agricultural, water supply, wastewater, and environmental sectors?
4. Given what is possible and practical, how can we get better nutrient and water management practices?

Question 1: How can the State of Delaware best use its water and nutrient resources (and maintain/improve its environmental quality)?

1. Nutrients are a **resource** and should not always be treated as a waste material
    a. Recycle, reuse, repurpose
    b. How does local demand for nutrient resources compare with nutrient availability?
    c. What are the actual nutrient flows into and out of wastewater systems, agricultural fields, aquifers, streams, estuaries.
        i. Data needed to determine feasibility of alternative nutrient management strategies
        ii. May serve as a basis for assessing environmental costs and benefits
2. ***Seasonality*** of wastewater flow, nutrient removal effectiveness, nutrient concentrations, and agricultural needs need to be incorporated into wastewater treatment and disposal technology and regulation.
    a. Storage, including possible recharge and recovery may be a useful approach to deal with seasonality.
    b. Wastewater providers need flexibility in handling their wastewater and associated nutrient loads.
        i. Seasonal flexibility
        ii. Emergency management
    c. Agricultural irrigation should target areas and plumes of high nutrient water and nutrient in irrigation water should be included in agricultural nutrient management plans.
    d. Possible alternative uses for storage lagoons (floating solar panels)?
    e. Can wastewater processing be adjusted throughout the year to better remove nutrients or to make a product of more interest to agricultural users?
3. Wastewater providers should get ***credit*** for nutrients recycled to agricultural spray on demand systems.
    a. This would require that agricultural nutrient management include nutrients in irrigation water as part of their management accounting.
    b. If nutrients in irrigation groundwater are used as part of management plan, this use should be documented in management plans and nutrient accounting.
    c. Wastewater and agricultural providers should get credit for reductions in nutrient import into Delaware.

   d. Nutrient trading between sectors should be allowed/encouraged to minimize loads to the environment.
4. Rapid infiltration beds (**RIBs**) and/or surface water discharge will always be needed during periods when agricultural irrigation in not needed or in emergencies.
   a. Are RIBS really a good alternative to seasonal surface water discharge?
   b. Should surface water discharge be permitted at some level during winter months?
5. State revolving funds should be used for **pilot studies** and implementation planning of alternative reuse of wastewater and associated nutrients.
6. As long as **population continues to increase**, even with better wastewater management, wastewater flow and nutrient loads will increase. The lack of an effective growth plan will limit effectiveness of the best wastewater management.
   a. The State needs to have input on county land use planning in order to effectively manage wastewater disposal and surface water quality.
   b. The agency controlling land use should have to cover infrastructure costs, including water, wastewater, nutrients, schools, roads, etc…
   c. Long range goal should be to preserve the character of the local environment
      i. The character is what brought people to Delaware
      ii. Destruction of the character may cause people to leave
   d. When large and effective wastewater treatment is available in a region, all domestic effluent streams should be required to "hook up."
      i. Benefits to the environment
      ii. Benefits to the wastewater provider (either governmental or provider)
      iii. Subsidies may be useful to encourage hookup.
7. Would separate **gray-water disposal** systems reduce volume of wastewater needing treatment and the ultimate nutrient loads to the environment?
   a. How much difference would this make to actual nutrient loads to the environment?
8. Management is by **watershed**; Existing nutrient loads should be managed by watershed.
   a. For all watershed segments, mass balances of nutrients and water should be established and used in management.
   b. Nutrient loads should be expressed in common units
   c. Nutrient loads from agriculture and wastewater sources should be expressed as a fraction of the TMDL for a particular segment of the water and not just as a direct load.

        i. From each watershed, actual loads from individual domestic systems, community systems, regional systems, agriculture, non-agricultural gardening practices and rainfall should be documented or estimated so that relative impact is known.

9. **Irrigation/Fertigation/Sludge Disposal** has agricultural benefits and wastewater benefits, but is it good for the environment?
    a. Under what conditions are nutrients in irrigation water useful?
    b. What crops are best suited for spray irrigation/spray on demand fertigation?
        i. Can nutrient release to the environment be regulated by farm practices?
    c. Can biosolids from wastewater be combined with other local waste nutrient materials (chicken litter, septic biosolids) to make a more balanced fertilizer (i.e. nutrient ratios similar to plant uptake ratios)?
        i. Can management and processing of waste biosolids and chicken litter be improved to benefit agricultural uses.
    d. Preference should be given to agriculture preservation lands in the use of waste nutrients for fertilization and fertigation.
10. **Siting** of wastewater plants should be consistent with long-term land-use planning
    a. Development zones should have designated areas for wastewater processing and disposal
    b. Development outside of designated development zones should require a higher level of scrutiny
        i. Developers held to a higher standard
        ii. Developers cover costs of infrastructure (“adequate public facilities”)

Question 2: What are the opportunities?

1. **Agricultural management** to take advantage of wastewater nutrient availability
    a. Best Crops
    b. Best Fertilization Practices
    c. Better timing of irrigation/fertilization/fertigation.
    d. Treatment of wastewater for irrigation rather than for release to the environment
        i. Need to process to provide a product with balanced amounts of water, nitrogen, and phosphorus
        ii. Possibility of mixing waters from sources with different compositions to get a "more balanced" product
        iii. May not be possible to get a perfectly balanced wastewater product to meet all agricultural needs
2. **Monitoring** of the success of agricultural nutrient management
    a. Actual practices may vary and the most successful practices should be replicated, where possible
    b. Best practice scenarios
        i. Combining environmental, agricultural, and financial goals
3. **Storage**
    a. Standards for storage ponds
    b. Standards for artificial recharge and storage of wastewater effluents in aquifers and agricultural reuse.
4. Use Total Maximum Daily Load requirements to **reduce development** and retain the agricultural character of the rural regions of Delaware.
5. Put **costs** into the planning process
6. Identify regions or high nutrients in groundwater and target these areas for **groundwater mining** for spray irrigation and fertigation.
7. Incorporate **energy cost** scenarios into wastewater disposal planning.
    a. Need to do this now for the future.
8. **Regional planning** of wastewater disposal and water/nutrient reuse.
    a. Local knowledge
    b. Local geology/hydrology
9. **Demonstration projects** for nutrient reuse
    a. Wastewater
    b. Biosolids processing and reuse

Question 3: What next? What can we do with what we know?

1. Alternative nutrient controls
    a. Reduce nutrients at source
    b. Separate gray water from wastewater
2. Pilot and demonstration projects for spray-on-demand irrigation
    a. Funding by Clean Water Council
    b. Demonstrate flexible used of disposal alternatives
    c. Establish criteria for effective use of spray-on-demand technology
    d. Determine the real costs of spray-on-demand and cost sharing strategies consistent with benefits
3. Set up spray irrigation districts with multiple farms and a variety of crop and crop rotation strategies to maximize nutrient reutilization at minimum infrastructural costs.
4. Impact fees needed to support environmental quality
    a. Fees should encourage development in existing development corridors
    b. Outside of development corridors, fees should be higher as costs are higher
5. Cradle to grave nutrient accounting
    a. To reduce nutrient release to environment
    b. To test effectiveness of processing and regulation
    c. Include groundwater sources and sinks in nutrient accounting
    d. Compare effectiveness of all wastewater disposal techniques on the same basis
6. Form a new Grand Old Pee and Poo Party (GOPPP) to insist that wastewater and environmental planning become a fundamental part of development and land-use planning.

Question 4: How should performance standards be changed, derived, or developed to best utilize water nutrient resources? ~~(Original Question: How can environmental goals be achieved when large wastewater treatment facilities are consistently unable to meet performance standards?)~~

1. **Seasonality**:
    a. Use flow-weighted average annual concentrations to determine performance standards based on loads to adjust for seasonal variation
        i. Base compliance on a different period of time (two year average or exclude critical periods)
    b. Account for seasonal variations in treatment efficiency (cool weather, less treatment; warm weather, more treatment)
    c. Account for natural bioremediation in the environment in performance standards
        i. Stream discharge =0; RIB = some; dedicated irrigation = some more; irrigation on demand =most
    d. Use wastewater storage as a means to provide greater nutrient use by crops, thereby requiring less nutrient removal by treatment
2. **Trading/Offsets**: e.g.
    a. Holistic approach needed: performance standards should be developed with consideration of other programs (e.g. stormwater, agriculture, etc.)
    b. Goals should be to minimize nutrient imports to watershed and leakage to the environment: Allow experimentation to meet these goals
    c. Set both goals (more stringent) and limits (less stringent)
        i. Reward achievement of goals
    d. Direct credit for real reduction of other (non-wastewater) or other types of wastewater loads
    e. Pollution Control Standards are irrelevant: Let farmers use all the nutrients and basic filtration and disinfection.
3. **Flexibility**:
    a. Allow lower level of treatment during periods when wastewater can be used for agricultural application
    b. Develop regulation language that would allow loads to the environment that are equivalent to 3 mg/L TN and 0.2 mg/L TP (or some other standards) discharged directly to surface waters, based on reasonable assumptions or actual determination of nutrient removal by plants, soils, and aquifers
    c. Interconnect wastewater systems with alternative processing and disposal means.

   d. Facilitate reuse and recycling nutrients as opposed to disposal (RIBs)
   e. Allow wastewater processor determine how to achieve standards based on a variety of disposal methods
4. **Economics**:
   a. Cost/benefit analysis should be considered during Performance Standard development
   b. Statewide standard vs basin/watershed standard?
      i. Which is best?
      ii. Which can be better managed?
   c. Evaluate all nutrient contributors to the environment equitably
      i. Costs of TMDLs should not fall exclusively on wastewater processors
      ii. Costs for agriculture and domestic septic users, based on their contribution of nutrients to the environment should be used to offset centralized wastewater infrastructure and disposal costs
   d. Performance standards should take into account all sources of nutrients loss from each utility.
   e. Nutrients be taxed on a cost per pound of N and P to subsidize environmental remediation
   f. Cost benefit analysis of moving from 10→ 5→ 3 mg/L standard
   g. Ag nutrient management plans + reports should be public
   h. Energy costs should be a component of wastewater planning

5. **Loads**: e.g.
   a. Evaluate nutrient loading primarily on a mass balance basis instead of a concentration basis
      i. Exception for drinking water standards, where they exist.
      ii. Concentration standards should be met at point of discharge or pumping (well)
      iii. Can be directly compared to TMDLs
   b. Require that performance standards be developed based on the current and possible projected loads to receiving water bodies.
   c. Integrate wastewater treatment loads with agricultural loads for assessment
6. Performance Standards **Balance/Impacts** of Performance Standards
   a. Performance standards should be attainable
   b. Performance standards should be based on best available technology and local environmental conditions
   c. Standards should not push back large systems to small.
   d. Water/nutrient mass balance and discharge sceanarios must be developed during permit application
      i. Sets goals
      ii. Sets standards to which performance can be assessed
7. **Site Specific**:
   a. Systematic assessment of status and trends w/ independent review

   b. Impact of performance standards on ecosystem
   c. Demonstration that changes in loads leads to environmental change
   d. Better water use records, especially irrigation
   e. Allow for consideration for site specific conditions in setting performance standards and assessing performance
   f. Watershed based
   g. Performance standard expressed as percentage of TMDL
   h. Define “equivalent” performance standards for Spray/RIB/Surface Discharge loads
   i. Analysis of treatment technology to meet/define performance standards

8. **Land Use**:
   a. Brief/Educate elected officials regularly
   b. Regional planning/account in County Land Use Process
9. **Storage** should be encouraged to achieve performance standards and to allow for timely reuse and recycling.

General Themes from Question 4:

- Spray irrigation capacity is being added to existing facilities. New facilities are proposing RIBS. Funding or other assistance might promote spray irrigation over RIBS
- Irrigation on Demand allows for some reuse and recycling; net effect may be difficult to ascertain as additional nutrients will be added above wastewater to meet crop demand
- Mining groundwater nitrate study (for spray irrigation and to eliminate high nutrient plumes)
- Land use policy debate should drive nutrient policy
- Storage of wastewater is a cost of development and effective agricultural irrigation and costs of storage should be spread across all sectors
    - Possible storage pond benefits
        - Aesthetics
        - Golf courses
        - Not a wetland
- Private utilities use impact fees when serving growth, why not government?
- Storage to allow choices of disposal.
- Are “emerging contaminants” really a concern?
- Easier to site drinking water intakes after considering wastewater ouflows that siting wastewater facilities in response to existing drinking water intakes
- What are the energy costs of alternative wastewater treatment and disposal methodologies now and in the future?
- What is the scientific basis for the current performance standards?
    - Can one standard be developed for all disposal methods?
    - How can the performance standards be related to environmental goals?
    - Should performance standards be related to population being served?
        - Load per equivalent dwelling unit
        - Allows for adjustment as service area/population changes