U.S. Environmental Protection Agency
Science Advisory Board

Integrated Nitrogen Committee
Public Meeting
June 20-22, 2007
Minutes

Committee: Integrated Nitrogen Committee

Date and Time: June 20-22 from 1:30 p.m. Eastern Time on the 20th to 3:00 p.m. on the 22nd. This is a later start than announced in the Federal Register on March 22, 2007, Volume 72, Number 55, Page 13492

Location: The Science Advisory Board Conference Suite on the 3rd floor of the Woodies Building, 1025 F Street, NW, Washington DC.

Purpose: The intended purpose of the meeting was to allow the Committee to complete information gathering for the first phase of its work, relating to sources, transport, fate, effects, impacts and metrics relating to reactive nitrogen in the environment and make appropriate related writing assignments for its report. The Committee will also begin the second phase of its work addressing the relationship of nitrogen to ecosystem scale through case studies.

Materials Available: Materials made available for the INC's January 30-31 meeting, April 19 teleconference, and June 8 teleconferences are identified in those minutes. Attachment A lists the additional materials made available for this meeting.

Attendees: The sign in sheets can be found in the FACA file for the meeting.

Summary:
In terms of content, the meeting went largely according to the original agenda with minor adjustments until the morning of the 22nd, which the revised agenda addresses. Please refer to the overheads provided by presenters for the details of their talks. The following actions, decisions, and possibilities were articulated at the meeting:

1. Phase I Working Groups will continue their efforts

2. A fourth working group was formed under the leadership of Theis; the other members are Aneja, Boyer, Dickerson, Doering, Herz, Lighty, Mosier, and Stacey. The charge for Group 4 is to evaluate the contribution an integrated nitrogen management strategy could make to environmental protection; identify additional risk management options for EPA's consideration; and recommend to EPA concerning improvements in nitrogen research to support risk reduction.

3. The Committee confirmed its plan to meet October 29-31, 2007

4. The Committee planned its fourth meeting for April 9-11, 2008

5. It may be possible for the Committee to have a workshop on its findings and recommendations.

6. The PWG discussion should capture the notions that emissions vary with application approach, application practices are changing to make more efficient use of nitrogen, and many of the coefficients are based on current general practice.

7. Mosier asked for a list of references which Walbridge said he would supply. (Done)

8. Lighty will ask Department of Energy about its nitrogen related programs, particularly DOE's research investment in NOx which may include gasification and other ways of utilizing fuels. Galloway will gather information on nitrogen related programs at USGS.

9. The SAB's Committee on Valuing the Protection of Ecological Systems and Services (CVPESS) has draft report might be useful to the INC and should be made available. (Done)

10. In the course of developing its report, Committee members may identify critical data gaps (like transfer coefficients) confirming with other experts.

11. The Impacts & Metrics Working Group will gather some information on the effect of reactive nitrogen on public health. Some of this may be found in the criteria documents and staff papers on ozone and fine particulate matter standards. Dr. Lighty offered her assistance with this task.

12. Although it may not be possible to quantify trade-offs, the report will address them clearly.

13. Each section of chapter 3 should have a recommendations section.

14. The Committee will consider doing fact-finding or inviting presentations on:

A. the views of emissions inventory experts on the state-of-the art of N emissions;

B. the development of emissions models (such as SMOKE which feeds CMAQ),;

C. how to get a stream on the impaired for nutrients list – the impairment assessment approach and plans for the future;

D. point source contributions from/to water; and

E. cap-and-trade programs.

Further Information on Matters Discussed:

Wednesday, June 20, 2007

The chair introduced the meeting with a brief review of the history of the Committee (See his slides).

The overarching goals for the Committees are:

1) The committee will learn about EPA's various programs for reactive nitrogen, so as to
2) Develop scientific and technical recommendations regarding the enhancement of integrated research and management strategies for reactive nitrogen, which will
3) Provide EPA the information to better integrate reactive nitrogen research and risk management strategies across environmental media and programs.

The specific objectives are:

1) Identify and analyze, from a scientific perspective, the problems nitrogen presents in the environment and the links among them;
2) Evaluate the contribution an integrated nitrogen management strategy could make to environmental protection;
3) Identify additional risk management options for EPA's consideration; and
4) Recommend to EPA concerning improvements in nitrogen research to support risk reduction.

In the chair's view, the Committee has made a great start on Objective 1, but has far to go regarding Objectives 2 and 3. He then reviewed the agenda. After the three working groups will brief the Committee on their activities on June 20, the chair will distribute a draft outline for part of the report. One June 21, the Committee will hear presentations from USDA and EPA. On June 22, the Committee will begin writing.

The Working Groups then reported on their activities since the June meeting.

Drs. Aneja and Cassman lead the Producers Working Group which also includes Boyer, Doering, Herz, Kohn, Lighty and Shaw

The PWG agreed inputs to agriculture are well understood and the understanding of internal cycling is understood well enough. However, outputs are not well understood. They reported a fact-finding call INC members Boyer, Cassman Dickerson and Galloway held with Robin Dennis in the presence of the DFO on May 8 . The presentations by USDA's Knighton and Wallbridge on June 21 should improve the Committee's understanding of what data is currently available.

The PWG believes more needs to be understood at other scales such as the field and the farm, across sites in the same region in the same year, and differences in the same site over time. Such information would be necessary to develop benchmark data on individual sources. The Europeans are assessing their carbon-based emissions trading system and found one of the greatest inhibitors to implementing the system was the lack of benchmark data on individual sources which became a barrier to assigning credits. In this case, the Europeans were talking utility and other emissions, for nitrogen in the U.S., we would be talking fields and farms.

One of the greatest sources of uncertainty is the amount of nitrogen stored in soil. The PWG is also trying to get a handle on nitrogen cycling in turf systems. Their assumption was that the turf system was very large. They now know it is large, have rough estimates and believe it may be better understood than the main agricultural systems.

Boyer asked for help on fertilizer inputs. Doering said there are three or four ways to do this and will talk with Boyer about which one to pick

The Committee's discussion of the volatilization of animal wastes led into a broader discussion of how various numbers are calculated and the value of improving the numbers. Shaw mentioned that many of the coefficients are based on general practice, but practices are changing to make more efficient use of nitrogen. This should be captured in the discussion because emissions do vary with application approach.

Galloway asked about the creation of reactive nitrogen from energy production. One member noted there has been a decades long substantial effort to quantify nitrogen from energy production because of photochemical smog modeling. Big point sources are well managed. Mobile sources are harder to quantify and have larger error bars, but are known. Two members think these sources are the best known.

Dickerson and Mosier, who lead the Environmental System Working Group, described its activities. (The Environmental System Working Group also includes Boyer, Hey, and Mitsch. Mosier led the presentation. (See overhead for this presentation)

Mosier said the working group is trying to establish inventories in terrestrial systems. While USDA/NRI will have good data in five years, it doesn't have it now. However, Cassman and Mosier had a very productive conference call with Martin Petrovic of Cornell on the subject of nitrogen and turf.

The ESWG prepared short papers (called two-pagers) on cereal crop production, swine and poultry waste, and urban turfgrass. These were distributed at the meeting. Hey and Mitsch are developing a paper on aquatic systems.

Moomaw and Theis lead the Impacts and Metrics Working Group, which also includes Cowling, Doering, Paerl and Stacey. As Moomaw was unable to attend the meeting, Theis did the entire presentation. (See overheads)

Theis spoke first of "classical" impact categories -- such as global warming, eutrophication, ecotoxicity, human health (cancer and non-cancer), acidification, smog formation, ozone depletion -- and units in which they could be expressed. The units for classical impacts typically allow comparisons among alternatives, which is helpful if you want to make choices. One form of analysis associated with the classical impacts is mid-point impact analysis which is based on emissions from the steps up to and including the production of a given product or service. The analyses can then be arrayed to provide a mid-point impact signature for the various alternatives. Total impact (and risk) depends on the subsequent cycling of emissions, and the use and end-of-life disposition of the product; alternative units, such as dollars, can be used here. Although policy analysts see advantages to combining endpoints measured in dollars, this approach has not found significant support in the scientific community.

Another approach is to look at the impacts on ecosystem services. The four types of ecosystem services considered are provisioning – products and services (much like classical impacts); regulating – climate, water, diseases, etc.; cultural –non-material benefits (recreation, aesthetics, knowledge systems, etc.); and supporting – services needed for all other ecosystem products and services (for example, oxygen, soil formation, biomass production). Analysis of ecosystem services may address trade-offs (where human demands exceed what nature can supply); impact (degradation) related to human health; ecojustice (disparity that results from disproportionate claims mode on ecosystems – rural urban, wealthy/poor, developed/undeveloped); and intrinsic value of species.

Because the ecosystem services approach is newer, the metrics are less developed. Several institutions, including EPA, are giving it serious thought and the I&MWG believes it cannot be ignored.

Theis had circulated a draft table (attached) to the Committee in advance of the meeting. Members were asked to complete the table based on their best judgment and sent it to Theis so he could integrate their answers. Theis said the I&MWG has struggled with gaps in information. In such situations, a larger number of contributors helps to reveal where the data gaps are. It is also a way to better understand the implications of trying to use ecosystem services as framework.

Following these presentations, Galloway observed that the current working groups are examining reactive issues by scale and for the future. He proposed that a new working group be formed to evaluate the contribution an integrated nitrogen management strategy could make to environmental protection, identify additional risk management options; and recommend improvements in nitrogen research to support risk reduction. The full Committee would then develop scientific and technical recommendations to enhance integrated research and management strategies for reactive nitrogen and provide EPA the information to better integrate reactive nitrogen research and risk management strategies across environmental media and programs.

Thursday, June 21, 2007

After the DFO reconvened the meeting, the chair reviewed the plan for the day and assignments. The chair will use the discussion of the draft outline for chapters 1-3 and assignments to prepare a revised outline to be distributed later in the day.

Invited Presentations

The first set of presentations focused on issues relating to agriculture. Each of the three speakers had overheads which are attached.

Dr. Raymond Knighton
National Program Leader - Air Quality
Natural Resources and Environment
Cooperative State Research, Education and Extension Service
U.S Department of Agriculture (30 min)

Although he is now working air issues, he has previously worked soil and water issues for USDA and will try to cover all three areas in this presentation. CSREES is a financial assistance partner to the land grant universities. Out of a $25 million annual budget, about $11 million goes to the land grant institutions to use as they see fit. There are three competitive grants programs (air quality -- $3.5M, integrated water quality $4.5 m, and soil processes -- $2.0 m). There is an additional $4 million per year in targeted programs (earmarks). His handout describes the program in greater detail. Because the products of USDA-funded research are not being applied as quickly as would be beneficial, they are putting more effort into policy, economic and cultural barriers to the employment of control technologies and other mitigation practices.

CSREES does not routinely monitor nitrogen, but it does provide funding to the land grant institutions and two networks.

There is probably tremendous uncertainty about how the rate applied in the field is reported to USDA. Many application rates are estimated from fertilizer sales. Both timing and total amount of nitrogen applied influence nitrogen outputs. Use efficiency is another area of uncertainty. Inter-annual variability is high. Spatial variability (soil type and topography) and mineralization add to uncertainty. Some of the "standard methods" used to determine mineralization rates in soils are more like debates. Often they work in the lab, but not in the field. Crop removal often is unaddressed. What happens to the nitrogen left in the corn leaf on the field? Much of it volatilizes. Issues like soil type and topography add to uncertainty on fate and transport.

Understanding the relationship of application rates (plus soil nitrogen) to yields is a key to improving fertilizer recommendations. The current curves are good for educating producers but also encourage them to add more fertilizer in hopes of greater yields. The real science and education needs are to optimize production while minimizing environmental degradation. It might be helpful to re-frame the thinking to

farm income's relationship to potential environmental degradation. In such a framework, social and environmental sciences become important as well as agronomics.

At the end of his presentation, Knighton addressed needs for measurement and modeling and spoke to issues of federal coordination and cooperation. In many states, the recommendations on fertilizers are 20-30 years old and were designed for yield, not the prevention of environmental consequences. There is no constituency for improving research on the environmental dimensions of fertilizer use in agriculture. The issue is not just developing recommendations for the average farm today, but double the yield of land while protecting the environment, something agriculture has never done. There is not a great deal of work going into animal feeding studies, but they do show that less protein to the animals reduces outputs of reactive nitrogen

Dr. Mark Walbridge
National Program Leader - Soil and Water Resource Management
Agricultural Research Service,
U.S Department of Agriculture (30 min)

Walbridge's presentation on ARS nitrogen related research focused on:

1. Managing nitrogen losses in agricultural drainage waters
2. GRACEnet
3. NLEAP Model
4. Nitrogen Balance in Animal Feeding Systems.

1. Managing nitrogen losses in agriculture drainage waters is a major cross-agency effort. Because USDA spends about $4B a year on conservation research practices to benefit the environment, Congress wants to know if it doing any good. This led to the Conservation Effects Assessment Project (CEAP) watershed studies. CEAP is now expanding to look at grazing lands, wetlands, forests, and other land uses in the mid-Atlantic states.

2. Nitrous oxides are a greenhouse gas of concern and are increasing. GRACEnet is the Greenhouse gas Reduction through Agricultural Carbon (C) Enhancement network.

3. NLEAP is Nitrate Leaching & Economic Analysis Package that estimates N losses from agricultural fields. The goal is to develop improved soil & nutrient management systems for sustained productivity and environmental quality. Because it is hard to measure nitrogen losses from farm fields, modeling is more practical. It can be used with GIS systems. NRCS is adopting this as their nitrogen trading tool.

4. USDA's analysis of Nitrogen Balance in Animal Production Systems reveals that ammonia emissions are particularly high in the summer. A significant amount of the nitrogen fed to the animals comes out – overall about 68% of fed nitrogen is lost as ammonia in the summer and about 36% in the winter.

One member asked if the data were prorated by the number of animals fed. Walbridge said he could find out and offered to make a paper available to the Committee. He knows most of the data are reported per head.

Mosier asked for a list of references which Walbridge said he would supply.

Ms. Roberta Parry, Water Policy Staff,
Office of Water, U.S. EPA (30 min)

Her presentation focused on policy and where science can be used in policy -- or not. She began by speaking to standards, point sources and non-point sources under the Clean Water Act.

1. Point sources -- CAFOs are defined as point sources in the CWA; therefore EPA has no latitude in regulating them. Ditches, pipes and things that carry runoff from the field to the surface water are not exempted, but agriculture storm water discharge and irrigation return flows are not covered.

CAFOs were first regulated in the 1970s, but the regulations were ignored for a long time. AFOs are a nonpoint source. CAFOS are defined by their size (large, medium, and small). It is very rare that a state will designate a CAFO as small. 23 states do not allow stricter than federal regulations, in the others federal regulations are the floor and the state regs can be stiffer.

In 1994, lagoons burst at several locations and got people's attention. Also, CAFOs were getting larger and larger. EPA estimates there were about 19, 000 CAFOS in the US at this time – about 5% of all AFOs. In 2003, EPA finalized a rule that all CAFOs that discharge or have the potential to discharge need a NPDES permit. Environmentalists and agriculture sued EPA and EPA is re-writing to cover discharges and proposed discharges (pipe, inappropriate operation).

If manure, applied according to a nutrient management plan, runs off, it is not a discharge, it is exempt agricultural storm water.

The basic rule looks at the production area (for which zero run-off is appropriate) and land application. There must be a publicly available nutrient management plan for land application that minimizes runoff of N and P in manure, but most existing plans are built on N

2. Non-point sources -- Many projects target agriculture, especially nutrient reduction. The success of coordination with USDA Farm Bill conservation programs varies by state.

She spoke of USDA Conservation Programs from the EPA perspective.

USDA's conservation programs are voluntary. USDA provides financial and technical assistance totaling about $4 billion per year in conservation. The program is divided into working lands and land retirement. The Environmental Quality Incentives Program (EQIP) is the biggest program. It provides cost sharing of up to 75% for conservation practices under 1-10 year contracts. The Conservation Security Program (CSP) is supposed to "reward the best to encourage the rest". The Conservation Reserve Program (CRP) takes about 40 million acres of land out of production for 10-15 year contracts. There are both general signup and continuous signup programs. There is also a Wetlands Reserve program.

Every year EPA reports to Congress on the state of the nations waters. EPA expects to develop a statistically valid report on a different kind of water body every year, repeating on some cycle to allow trends analysis. In 2006 they reported on wadeable streams. (http://www.epa.gov/owow/streamsurvey/)

She spoke of the Clean Air Act. Congress may take away EPA's ability to regulate air emissions from animal operations. It could be that there will be reporting requirements for facilities emitting over so many pounds of ammonia. But how would they know that they were? EPA is doing an AFO Air Emissions Monitoring Study to assure compliance so that AFOs will know whether they are, or are not, in compliance.

EPA scientists with expertise in the air programs gave the second set of invited presentations. The order of presentations was changed from the agenda so that Dr. Haeuber spoke last.

Mr. Gary Lear, Clean Air Markets Division,
Office of Atmospheric Programs,
Office of Air and Radiation (20 min)

Lear addressed the current status of nitrogen deposition monitoring programs (CASTNET, NADP/NTN, and NADP/AIRMoN), the need to maintain and improve monitoring equipment , some issues in data interpretation, and future directions.

A member commented that EPA was heading right down the path of the questions that the INC had identified as critical to understanding the earth system science of nitrogen using simple, economical methods that need to be evaluated. The biggest problem appears to be budget and manpower.

Dr. Rohit Mathur, AMD, National Exposure Research Laboratory,
Office of Research and Development

Dr. Mathur spoke about the CMAQ model (see his slides). He observed that the coupling of oxidized and reduced nitrogen creates some challenges in modeling. Although dry deposition of reactive nitrogen is important, EPA estimates about a third of dry deposition is not being measured because there are no good methods to do so.

EPA applied SO_2 models to the ammonia data to estimate what the range of influence might be for ammonia – the range of influence the distance by which half of the emissions attributable to that source deposit. They are looking also at night-time conditions and whether existing chemical mechanisms perform

He summarized his response to the Committee's questions as follows:

- *Can the modeling framework provide nitrogen emissions and deposition estimates?*
    - *Yes, detailed emission inventories are key inputs and deposition outputs are the primary modeled sink-terms in the mass-conservation equations of the model*
- *Is there a link between EPA atmospheric modeling (N-deposition) and deposition networks (CASTNET, NADP)?*
    - *Model verification and evaluation*
    - *CASTNET: Dry-deposition estimation algorithms*
        - *Using CASTNET process-level Vd algorithm to scale to CMAQ grid-scale*
- *What is needed to improve those networks and data provided to EPA by these networks?*
    - *Need NHx measurements to verify model budgets*
    - *More frequent measurements (e.g., bi-directional NH3)*
    - *Dry deposition measurements for other oxidized-N species*
    - *Greater spatial coverage*

Dr. Richard Haueber, Clean Air Markets Division,
Office of Atmospheric Programs, Office of Air and Radiation (20 min)

Haeuber spoke without slides. His office routinely tries to link measured and modeled data to other data so that they can link the programs to the environmental results. Randy Waite in OAQPS does the same sort of thing for NAAQS pollutants.

These are the gaps he hears:

1. ammonia and ammonia species.

As EPA successfully reduces NOx, ammonia will become more important. Knighton and the NADP data show ammonia has been going up over time. Mathur's slides also show ammonia as becoming a larger part of the nitrogen pie.

2. sustainability of existing monitoring networks

Instead of increasing EPA's monitoring, budgetary considerations are forcing cutbacks in monitoring. This is a Congressional cut, but EPA has some role in deciding what is cut. Even if the budget were cut, there would be issues about the maintenance and upgrading of monitoring sites. EPA's monitors are thirty years old, the designer is

now 90 years old, and maintenance is a problem. There's also the question of how well the monitoring networks represent conditions.

3. monitoring of ecological effects

ORD runs some surface water monitoring networks designed to look at ecological response to emissions reductions resulting from the implementation of the acid deposition program. It is a fairly small set of streams and lakes in the East. The budget for this has also been cut. As a result, in the future EPA will have less deposition data and no new data on ecological effects to compare it to.

4. Modeling is improving, but we cannot model everything we would like to know about. We know forest ecosystems and aquatic ecosystems are impacted by nitrogen, but we cannot model them well.

A member asked, if you go to the middle of Iowa where you have a largely agricultural environment, can you distinguish reactive nitrogen from utilities from that from agriculture? Haeuber responded that EPA is trying to approach this type of problem through radio-isotope work. EPA doesn't have a strong charge to regulate ammonia species, even though it is a growing problem. If EPA doesn't have the regulatory ability to deal with it, then he would put his money into monitoring, modeling and the capability to characterize that signal and its effects. Better information on the context and size of the issues would help Congress decide what to do about it, or allow others to act.

Galloway thinks it is worth asking USGS and DOE about their nitrogen related programs. Haueber said EPA works closely with USGS and considers them strong partners. Lighty said that DOE looks at NOx, perhaps gasification and other ways of utilizing fuels. She doesn't think DOE spends much on nitrogen. She will follow-up.

EPA researchers with a long-standing interest in nitrogen gave the final set of presentations.

Dr. Richard Linthurst, Office of the Assistant Administrator
Office of Research and Development (20 min)

The EPA ORD Board of Scientific Counselors (BOSC) commented that ORD should focus on ecological systems and services. The MEA, *Living Beyond Our Means: Natural Assets and Human Well-Being*, is very influential. Key findings include that everyone depends on ecosystem services for a decent life, that, "even though today's technology and knowledge can reduce considerably the human impact on ecosystems. They are unlikely to be deployed fully, however, until ecosystem services cease to be perceived as free and limitless, and their full value is taken into account." The way to get to the hearts and minds of people now is to show how the consequences of changing ecosystem services affect humans.

EPA's vision is, "To transform the way we understand and respond to environmental issues by making clear the ways in which our choices affect the type, quality and magnitude of the services we receive from ecosystems -- such as clean air, clean water, productive soils and generation of food and fiber. To transform the way we understand and respond to environmental issues by making clear the ways in which our choices affect the type, quality and magnitude of the services we receive from ecosystems -- such as clean air, clean water, productive soils and generation of food and fiber. "

He described key elements in ORD's research:

- Pollutant Driven Ecosystem Services Research
  - How does a regulated pollutant affect, positively and/or negatively the collection/bundle of ecosystem services at multiple scales?

- Ecosystem Driven Ecosystem Services Research
  - How does the collection/bundle of ecosystem services provided by a single ecosystem type change under alternative management options at multiple scales?

- Place Driven Ecosystem Services Research
  - How do the collection/bundle of ecosystem services for all ecosystems within an ecosystem district change under alternative management options/drivers?

ORD is picking Nitrogen as the example pollutant, looking at four ecosystems. Each kind of landscape provides different kinds of services. By considering the different types of ecosystems and the services they provide, then forecast how they would be affected by changes in reactive nitrogen.

Dr. Jonathan Garber, Atlantic Ecology Division,
National Health and Environmental Effects Research Laboratory,
Office of Research and Development

The idea of framing the issues in terms of what people care about has the glimmer of a promise that OMB and others might understand better and become persuaded. Creating an inventory of EPA nitrogen research can be difficult given that there is no nitrogen research program. It is one thing to say where the nitrogen research is done, but another to parse out the portion of programs that is nitrogen.

In terms of thinking the problem through, there are the emissions that change concentrations of N in the environment and impact ecosystem services, including those that lead to de-nitrification back to the environment.

SABSO Director Dr. Vanessa Vu spoke about the SAB's Committee on Valuing Processes of Eco-Systems and Services (CVPESS) current study. The CVPESS economists have struggled with issues relating to ecosystem services for years and their

draft report could be quite useful. Linthurst indicated that ORD plans to apply the CVPESS approach.

After the Committee discussed the invited presentations, the chair presented the revised report outline and recommended that a fourth working group be formed under the leadership of Theis. This working group would have representation from each of the other working groups.

Friday, June 22, 2007

After the DFO reconvened the meeting and a revised agenda for the day was circulated, the chair led further discussion of the outline for Chapter 3. The working groups met separately for a while, then briefed the Committee on assignments and plans. The Committee agreed that each section of chapter 3 should have a recommendations section.

SAB Staff Office Director Dr.Vu addressed peer review of data and the use of unpublished data. For SAB reports, there are two choices. The data must be described in the appendices or the report must rely on published research. Vu said *de novo* data only analyzed in this report is a problem because the data must be available so anyone else could redo the analysis. Galloway agreed this is an issue to grapple with sooner than later.

The INC will hold its fourth meeting April 9–11, 2008

Lighty offered to help on fine particles on human health. Dickerson said they could also reference the EPA criteria document.

The DFO adjourned the meeting at 3:45

Respectfully Submitted:

/Signed/
Ms. Kathleen E. White
Designated Federal Official

Certified as True:

/Signed/
Dr. James N. Galloway, Chair
SAB Integrated Nitrogen Committee

ATTACHMENT A

Federal Register notice
INC roster
Final Agenda for the June 20-22 Public Meeting
Revised Draft Agenda for the June 20-22 Public Meeting
Nitrogen Cascade adapted for use by Phase I Working Groups
Matrix of Nitrogen Species and Ecosystem Services prepared by Theis
Overheads of Chair, June 20
Draft Outline for Chapters 1-3 of the Committee's report, distributed June 20
Boyer overheads were not made available
Overheads of Mosier
Overheads of Theis
Overheads of Robin Dennis from fact-finding call May 8, 2007
Overheads of Mosier
Two-pagers from the Environmental System Working Group on cereal crop production, swine and poultry waste and urban turfgrass
Overheads of Ray Knighton, USDA
Overheads of Mark Walbridge, USDA
3 Handouts from Mark Walbridge relating to the Conservation Effects Assessment Project
Handout from Mark Walbridge on Drainage Water Management for the Midwest
Overheads of Roberta Parry on Animal Agriculture and EPA
Overheads of Rohit Mathur and Robin L Dennis, presented by Mathur
Overheads of Richard Linthurst
Overheads of Jonathan Garber
Map of midwest study area from Linthurst
Revised agenda for June 22
Overheads of the chair revised for June 22