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# **Initial Data Request Palo Verde License Renewal**

## **ITEM 12**

Correspondence with state or federal agencies regarding threatened and endangered species, migratory birds, critical habitats, etc.

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**EVAPORATION POND INVESTIGATION PROGRAM  
FINAL REPORT**

**BY**

**Thomas Hillmer**

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# EVAPORATION POND INVESTIGATION PROGRAM

## FINAL REPORT

July 16th, 1995

## INTRODUCTION

7 TOC +  
page 5: "mortalities during 1995  
+ 1996"

+ other pages show data  
through Aug 1996

The Evaporation Pond Investigation Program was developed in an attempt to determine all aspects that might have contributed to the cause of the mortalities of migratory birds found in Palo Verde Nuclear Generating Station's (PVNGS) Evaporation Ponds during December 1994 and January 1995. The program had as its major goal the prevention of a reoccurrence of that winter's events. In order to meet that goal a plan was developed to address the influences that could adversely effect the migratory birds and/or the evaporation ponds. One item reviewed was whether the migratory birds could have encountered some sort of a negative influence during their migration. Other areas investigated were the chemical and biological influences that might have been present in the evaporation ponds. These areas of investigation are covered in the detail section of this report.

It was suspected that the actual cause of the mortalities might not be determined since the mortalities occurred in small numbers (1 to 2 per 100 with a total population of 2,500 to 5,000 birds in residence at any one time) and at irregular rates. This lead to the assumption that, if the cause was due to conditions in the ponds and not a condition that preexisted outside of the ponds, the cause would probably be located in an isolated area(s) of the Evaporation Ponds (Evap Pond). This fact, coupled with the randomness of the die offs, also indicated that the conditions that might have lead to die-offs might not always have been present in the ponds. It was also considered possible that the condition that caused or supported the event was a seasonal condition that was present only during the winter months and the sampling and evaluation efforts would need to continue through another winter migration period. Due to these indications and the large number of variables that existed, a phased approach was developed for the program. As part of the program the University of Arizona (UofA) was contracted to assist in this effort. The University of Arizona Environmental Research Laboratory (ER Lab) and the Veterinary Diagnostic Laboratory (Vet Lab) were contracted to support our research effort.

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## EXECUTIVE SUMMARY

The overview of the investigation program is included in Attachment A. Four major areas were evaluated to determine if they had an adverse impact on the Evap Ponds. These were outside influences that might have occurred during the migration season, organic and non-organic chemistry, algae and micro-organisms in the ponds and any other influence that could be identified.

No micro-organisms or chemical parameters have yielded any indication as to the cause of the last year's mortalities. As the migratory season reached its peak in late 1995 and early 1996 and the Evap Ponds' conditions approached those of previous season, it was hoped that the sampling program that was developed would yield a possible cause. However, there was no reoccurrence of the die-offs.

After more than a year of data gathering no clear cause of the mortalities has been found. The data appears to eliminate chemical or normal resident micro-organisms. Although some blue-green algae could potentially cause symptoms in migratory birds similar to those witnessed during the die-offs no evidence has been found to support that theory as the cause.

The investigation program has given PVNGS a better understanding of the chemical and biological aspects of the Evap Ponds which will help us to better manage the ponds in the future. One outcome of the program is that the pond levels are now managed with the added insight of the effects that varying levels and inflows can have on the micro-organisms that reside in the ponds. During the first meeting with Arizona Game & Fish (AG&F) held December 8, 1994 at PVNGS it was suggested by AG&F that to prevent any reoccurrence (assuming the cause to be botulism) it would be good management practice to reduce the organic loading and the micro-organisms which the ducks feed on. This would make the ponds less desirable as a food source for the migratory birds, eliminate the organic matter that is needed by the bacteria, and can also create an anaerobic condition in the ponds. These actions, although not specifically taken, have been somewhat implemented by the new pond level management philosophy. Since no occurrence of mortalities was evident during the past migratory season it is believed that this action was a positive one and should be continued.

Based on knowledge gained during the investigation the following recommendations are made: 1)reduce the organic loading in the ponds; 2)remove or

reduce the amount of brine shrimp and algae in the ponds; 3) maintain a more even level and flow into the ponds; and 4) be prepared to implement a contingency plan that was formulated during the study period should another die-off occur. There are two aspects of the Contingency Plan. The first is if abnormal mortalities occur in the future APS will utilize the UofA Vet Lab to perform rapid necropsies and the UofA ER Lab for micro-organism analyses. This may identify the cause of the mortalities. A second part of the contingency is to implement a hazing program designed to keep the migratory birds from residing on the ponds.

## **DETAILED REVIEW**

### **Migratory Pathways**

A literature search was completed and major flyways that migratory birds could be taking to PVNGS were determined. Individuals in the states of California, Nevada and Utah were contacted in regards to die-offs of similar species that might have occurred at a time when they were in route South. No reports of significant die-offs have been reported. This may be overstated, since those contacted indicated that unless a very large number of ducks was involved they probably would not have known nor been informed. Additional data gathering from information available from the United States Nation Wildlife Health Center (USNWHC) from October 1994 through June 1995 covering migratory bird deaths nationwide yielded little additional insight into the cause of death. Reports of death of similar species as those encountered at PVNGS did occur, but in all cases the cause of death was identified. The reports from USNWHC are included in an Attachment C of this report.

The Pacific Flyway represents a general area used by migratory birds and ducks leading from their breeding grounds in eastern Alaska, Mackenzie and other interior parts of northwestern Canada. The flyway is a relatively simple one, as the majority of the ducks that use it make direct north and south journeys from the breeding grounds to their wintering quarters. The migratory ducks, with which we are concerned in this report, generally divide into two groups, one which migrates southeastward using the Central and Mississippi flyway and the other using the Pacific Flyway.

The ducks that use the Pacific Flyway use the route that runs from northwestern Canada southward through the prairie provinces along the eastern Rocky Mountain foothills then turn southwestward across northwestern Montana and the Panhandle of

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Idaho. The path then turns southward across central Oregon to the interior valley and coastline of California. The remainder of this broad flyway heads south extending from along the California coast to as far east as the western edge of the Rocky Mountains. There are two main routes used in this westerly direction, the northernmost crosses Idaho and southeastern Oregon and enters California near the California-Nevada state line. The second route runs through central Nevada and reaches the California valleys near the confluence of the Sacramento and San Joaquin Rivers. The migratory birds then continue south generally wintering within several hundred miles of the coastline anywhere along the Pacific Coast from northern California all the way to the southern most part of Mexico.

The primary ducks of interest to PVNGS are the Ruddy Duck and the Northern Shoveller. Both of these ducks breed in central and western Canada and winter along the coastline areas as described above. To help understand the habitat and feeding habits of these two ducks and give insight that may be helpful in the duck mortality some key facts about these ducks are included.

Ruddy Ducks are exclusively a North American species. They migrate in the spring by March or April and in the autumn by September. They winter in shallower and more protected bays and estuaries. The subfamily has little in common with other groups of ducks. They are sullen, ferocious, bad-tempered birds that will snap and peck viciously when captured. They are among the most active ducks in the water. The legs of the Ruddy Duck are placed well to the rear of the body and are practically useless on land. They are able to waddle along for a few steps, but fall upon their breast almost immediately and progress by shoving along in this prostrate position, pushing with both feet simultaneously. This peculiarity probably is a contributing factor in their drowning in the Evap Ponds. When they experience a reduced mobility due to sickness they are already basically unable to climb or walk onto the pond liner and get out of the water to have time to possibly recuperate. When they migrate they fly in medium to large flocks.

The food source for the Ruddy Duck is nearly three-quarters vegetable. Its normal vegetable diet is made up of pond weeds, bulrushes, sedges, and muskgrass. The normal animal food diet is made up of insects and molluscs.

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The Northern Shoveller is a well-known and widely distributed duck being common throughout North America. They are a warm-weather duck and are early migrants in autumn and late spring. It is essentially a fresh water duck of the sloughs, marshes, muddy ponds and sluggish creeks. The Shoveller is at the head of the class of surface feeders. Their broad bill and elongation of the intestine of this species are specializations for the nutritive utilization of minute organisms, such as may be found in the bottom ooze. While the Shovellers takes more of this bottom food than any other duck, a relatively small percentage of its diet is actually obtained from this source. This is a higher percentage than is consumed by any of the other surface feeders. The chief diet is from vegetable matter such as sedge seeds, pond weeds, grasses, and algae. The animal food of the Shoveller amounts to about one-third of its total diet. This is mainly comprised of molluscs, water bugs, crustaceans and fishes.

In an effort to determine if Ruddy Ducks and Shovellers were dying in other areas in the west and or along the flyway suspected as the route used by the ducks that wintered at PVNGS a review of mortality reports was undertaken. On September 23, 1994, continuing through November 2, 1994, at the Salton Sea in California about 300 water fowl, including Northern Shovellers, died of Botulism type C. On November 10, 1994, at Farmington Bay, Utah, and estimated 15,000, including Northern Shovellers and Grebes, died of Avian Cholera. On December 1, 1994, continuing through January 6, 1995, at Gray Lodge, California, an estimated 1,050 fowl, including Northern Shovellers, died from Avian Cholera. On December 2, 1994, through December 31, 1994, in Humboldt County, California, 625 water fowl died from Avian Cholera. These were the only reported die offs that occurred at the same time (December 1994 through January 1995) or just prior to PVNGS's occurrence and contained the same species of ducks that wintered at PVNGS. Since all these mortalities have had the cause identified and they have been eliminated as probable causes at PVNGS, no new information can be gleaned from these facts.

#### **Mortalities During 1995/1996**

The last duck mortality at the ponds occurred on January 26th, 1995. On February 2, 1995 and again during the month of March, discussions were held with the U.S. National Wildlife Health Center in Wisconsin. These discussions centered on obtaining the last set of data and a summary of the conclusions that the Center had made as to the cause of the mortalities. Attachment A contains a detail log of the



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activity at the Evap Ponds over the past 19 months. It also contains tables which shows the distribution and location of the species over the reporting period. Attachment B contains PVNGS reports, meeting minutes, telephone notes, and a copy of the Contingency Plan.

As a contingency, an agreement was put in place with the UofA Vet Lab in Tucson, Arizona to perform necropsies. This will allow for only a few hours delay between the time any mortalities occur and the time that the specimens arrive at the laboratory. University of Arizona believes that this may make it possible to more accurately determine the cause of death. The UofA also believes that one of the possible causes that was ruled out by USNWHC is still viable. During the month of August several hundred shore birds believed to be Wilson's Phalarope arrived at PVNGS. During the first week of their stay at PVNGS 13 birds died and were recovered. Three birds, two newly dead and one sick bird, were transported to UofA Vet Lab for analysis. The results did not identify the cause of death, but Dr. Noon, of the laboratory, stated that he believed they showed signs of dying due to an infectious disease which could not be isolated. He also believed that since they had just arrived, that the contamination or infection did not occur at PVNGS but was developed during their migration. Attachment C contains copies of USNWHC necropsies from 1994/1995 while Attachment D contains the most recent necropsies done by UofA. Throughout the remainder of 1995 and the first 6 months of 1996 no significant additional mortalities have occurred while several thousands of migratory birds have either past PVNGS on their migration South and/or wintered and now departed PVNGS on their northern migration.

#### **Micro-Organisms Present**

PVNGS Environmental initiated a contract with the University of Arizona to aid in development of a sampling program to determine: 1) algae type(s) and if they are toxic or can concentrate toxins; 2) identification of other organisms present in the ponds and if they are or can become toxic; and 3) determine type of organic compounds present and if they can directly or indirectly cause mortalities.

That sampling program which began in late June of 1995 with University of Arizona personnel visiting the site a minimum once each month since the program's initiation. That effort has identified that PVNGS has a large and highly fluctuating population of algae in Evaporation Ponds #1 and #2. The total counts of algae ranged from a low 400 cells per ml to more than 1,000,000 cells per ml of water. The

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principle algae changed over time and was indicative of a natural life cycle with the species changing from the single-celled blue-green, *Coccochloris*, which is a normal constituent of brine waters to others then returning to be the predominant species. Other more common diatoms include *Chaetoceros* and *Nitzschia*. The high algae population in the Evap Ponds was apparently due to the high nutrient levels. The Water Reclamation Facility (WRF) Reservoir had a much lower algae population of 1,200 - 130,000 cell per ml. None of the algae identified cause toxicity problems in the concentrations encountered.

During the monitoring a food chain was identified consisting of algae, brine shrimp, water boatmen, and waterfowl. Therefore, these ponds produce feeding habitat for waterfowl. Brine shrimp, *Artemia*, are found in the Evap Ponds from May to August. Brine shrimp are filter feeders and consume algae and bacteria. They can become abundant in hypersaline ponds because predators are reduced. However, they can typically over-populate and exceed the carrying capacity of such systems. This was evident in the Evap Ponds in 1996, when the brine shrimp reduced the algae counts to very low levels. When this occurs adult brine shrimp succumb to starvation. This can account for the large organic loading necessary to support the outbreak of botulinum. Literature does indicate that brine shrimp and water boatmen can concentrate toxins developed in the algae. Attachment D contains a copies of all of the University of Arizona reports.

### **Chemical Analysis**

As part of the normal monitoring efforts, data was collected at PVNGS by WRF and Chemistry Effluent Group for background radioactivity and chemical analyses in the ponds. This work was expanded to include additional chemical sampling which was initiated in March 1995. The WRF effort was supported by Environmental on a monthly basis. The sampling program also indicates the location where samples were collected and the analyses performed. Chemistry samples for specified inorganics were done monthly while radioisotopic analyses were done on a quarterly basis. As part of that program the Evap Ponds and the Water Reclamation Facility Reservoir have organic analyses performed by an offsite certified laboratory. The results of these very extensive analyses were reviewed and compared to the previous annual report to see if any correlation or apparent areas of concern were identified. That review of the 1994 data from samples taken just prior to the beginning of the mortalities indicated that only a few organic compounds were above the detectable limit. These were primarily

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trihalomethanes and found only in Evaporation Pond #2. Trihalomethanes have a recommended drinking water limit of less than 100 ppb. The sample results revealed a combined total of all trihalomethanes were about 90 ppb. A review of the toxicological data indicated that these concentrations were significantly below any adverse effect reported in literature. The 1995 and 1996 organic data show similar results. All the chemistry data collected during the investigation are contained in Attachment E. A series of graphs were developed for presentation to Arizona Game & Fish are also included in the Attachment. The graphs were developed to help aide in the identification of trends or abnormalities.

From the collected data it can be said that the Evap Ponds are both similar yet show mark differences. They are similar in that they are both highly saline, their waters contain high concentrations of Nitrate, and their temperature ranges usually very close. They do have a degree of variability. This is primarily due to two reasons. The first major contribution of change or variability in the ponds is determined by which pond is receiving the nutrient rich cooling tower blowdown stream, (the main source of water). This fact has lead to the current level and flow management philosophy. The flows are switched from pond to pond on a quarterly basis. The other major contributor to Evap Pond chemistry variability is physical design of the ponds. Pond number one is fairly uniform in depth and therefore the top and bottom samples are similar in chemical composition. Pond number two slopes, it is shallower at the north end and deeper at the south, providing the opportunity for zones or layering. Because of this layering effect, the chemical composition of the top and bottom samples are quite different at times. This also accounts for the differences between pond one and pond two from a chemical characteristic point of view.

To date, no chemical results indicate that any type of adverse chemical conditions could have resulted to the wildlife from exposure to the Evaporation Ponds. However, it is the believed that the large biomass in the Evap Ponds can significantly contribute to a reduction of the oxygen and the creation of anaerobic conditions. These conditions might promote the growth of micro-organism or bacteria which could have a negative effect.

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## POND MANAGEMENT RECOMMENDATIONS

The investigation program has given PVNGS a better understanding of the chemical and biological aspects which will help to manage the ponds. One outcome of the program is that the pond levels are now managed with the added insight of the effects that can occur on the micro-organisms that reside in the ponds. During the first meeting with Arizona Game & Fish held December 8, 1994 at PVNGS it was suggested that to prevent any reoccurrence (assuming the cause to be botulism) a good management practice would be to reduce the organic loading and the micro-organisms which the ducks were feeding on. This would make the ponds less desirable as a food source, eliminate the organic matter that is needed as the bacteria food source, and reduce the likelihood of anaerobic condition being created in the ponds.

The following recommendations are made to reduce any future occurrence of this problem 1)reduce the organic loading in the ponds; 2)remove or reduce the amount of brine shrimp in the ponds; 3)maintain a more uniform level and flow rate into the ponds; and 4)be prepared to implement a contingency plan that was formulated during the study period should another die-off occur. There are two aspects of the Contingency Plan. The first is if abnormal mortalities occur in the future APS will utilize the UofA Vet Lab to perform rapid necropsies and the UofA ER Lab for micro-organism analyses. This may identify the cause of the mortalities. A second part of the contingency is to implement a hazing program designed to keep the migratory birds from residing on the ponds.

The new management philosophy already has been implemented and addresses the level and switching of inflows into the ponds. The reduction of organic loading and brine shrimp will be further addressed in a subsequent memo regarding this issue. The final recommendation is already in effect and will only need to be implemented should the conditions warrant.

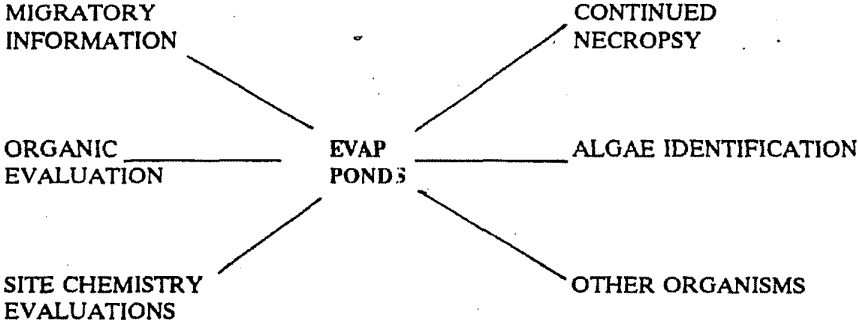
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**ATTACHMENT A**

**INVESTIGATION PLAN & DUCK MORTALITY HISTORY  
TIMELINE**

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ENVIRONMENTAL INFLUENCES ON THE MORTALITY IN THE EVAP PONDS



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**OVERVIEW OF ACTIONS FOR THE  
DUCK MORTALITY PROGRAM**

**EVAPORATION PONDS 1 & 2 BACKGROUND ORGANIC DATA IS BEING  
COLLECTED**

**TREND EVAPORATION POND KEY VARIABLES AND DETERMINE WHEN  
ACTIONS MAY BE NECESSARY**

**CONTRACT WITH UNIVERSITY OF ARIZONA FOR BIOLOGICAL SUPPORT  
TO BE DEVELOPED**

**KEEP U.S. FISH & WILDLIFE AND ARIZONA GAME & FISH INVOLVED AND  
PART OF SOLUTION**

**REPORTS BEING DRAFTED**

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**DUCK MORTALITY PROGRAM  
PROPOSED SCHEDULE**

<b>April 20, 1995</b>	<b>Hold meeting with PVNGS staff and review latest letter from NWHC.</b>
<b>April 27, 1995</b>	<b>Contact University of Arizona and discuss new scope.</b>
<b>May 1995</b>	<b>Meet with University of Arizona, Arizona Game &amp; Fish and US Wildlife &amp; Fish to discuss new scope and develop meeting schedule.</b>
<b>Ongoing</b>	<b>Assist WRF in obtaining baseline water chemistry information on Evap Ponds.</b>
<b>May 1995</b>	<b>Draft write up on migratory pathways for inclusion in final report.</b>
<b>May 1995</b>	<b>Draft contract with U of A to perform onsite analysis.</b>
<b>May 1995</b>	<b>U of A to commence onsite sampling.</b>
<b>June, Aug and</b>	<b>Attend regular scheduled meeting with Az. Game &amp; Fish and US</b>
<b>September</b>	<b>Wildlife and Fish to review latest data.</b>
<b>of 1995</b>	
<b>October</b>	<b>Hold plant meeting with WRF and Environmental to review all data and determine if any actions needs to be taken to reduce or eliminate the chance that ducks will be effected this winter.</b>



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## **MAJOR TASK OF DUCK MORTALITY PROGRAM**

### **EVAPORATION PONDS 1 & 2 BACKGROUND ORGANIC DATA WILL BE COLLECTED**

On a monthly basis both ponds will be sampled for:  
Biological Oxygen Demand (BOD) 2 samples per pond  
Total Dissolved Solids (TDS) 1 sample per pond  
pH and Conductivity 1 sample per pond  
Dissolved Oxygen (DO<sub>2</sub>) 2 samples per pond  
Ammonia 2 samples per pond

These sample will be collected the first thursday of each month.

### **TREND KEY VARIABLES AND DETERMINE WHEN ACTIONS MAY BE NECESSARY**

The above values will be reviewed and trended to give insight into the processes occurring in the ponds.

### **CONTRACT WITH UNIVERSITY OF ARIZONA FOR BIOLOGICAL SUPPORT**

A meeting will be set with University of Arizona to discuss a revised proposal for a study of the organisms that inhabit PNVGS's Evaporation Ponds. After we have formulated the scope of work for UofA a meeting will be scheduled with Az. Game & Fish and US Fish & Wildlife. We will review the direction that we are taking and discuss if they have any recommendations to be considered during our study. At that meeting will propose our plan and get their concurrence and commitment to be involved in the review of data etc.. After that meeting we will meet with UofA and finalize the scope of services for a contract for their support. At that point a detail schedule will be made and distributed.

### **DETERMINE WHAT BIOLOGICAL DATA COULD BE COLLECTED AT PRESENT TIME AND SCOPE OF STUDY**

This will be included in the U of A scope of support that is requested.

### **SCHEDULED PROGRESS MEETING WITH U.S. FISH & WILDLIFE AND AZ GAME & FISH**

Over the next seven months PVNGS will meet every other month with the agencies to update and review with them the data that has been developed over the past 2 months. Meeting notes from these meetings will become part of the final report.

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**PRODUCE FINAL REPORT**

**A final report will be produced that summarizes duck mortalities and migration patterns. The report will be the documentation of our efforts and include all data collected and final reports from UofA. This will be the basis for showing due diligence in this project.**

SEQUENCE OF EVENTS  
EVAP POND DUCK KILL

11/30/94

Howard Doyle was contacted about a large number of dead ducks in Evaporation Pond #2. Howard Doyle and Tom Hillmer toured evap ponds and WRF reservoir to verify call. An initial estimate of dead ducks was made which yielded 162 dead water fowl in Evap Pond #2, 18 in Evap Pond #1, and 5 in the WRF reservoir. Also noted were 2 coyotes in each of the Evap Ponds and one dead skunk in Evap Pond 2. Since it was after 5 pm and was becoming too dark to do any more investigation no further action was taken. A call was made to the Arizona Game and Fish Department (942-3000) but it was after their normal working hours.

12/1/94

Toured Evap Ponds and verified that no noticeable increase in dead water fowl had occurred during the night. Howard Doyle and Tom Hillmer called Arizona Game & Fish Department to discuss the course of action that needed to be taken. Talked with Ron Engel-Wilson (789-3353 another contact is Philip Smith 789-3354) who said that the symptoms that we had observed were those of a water fowl that had contracted botulism bacteria. Told him that our estimate was 162 dead ducks in Evap Pond #2, 18 dead ducks in evap Pond #1 and 5 dead ducks in the WRF Res. We also informed him that we had 2 dead coyotes in each of the Evap Ponds. He said that due to the number we would need to retrieve the dead and dying ducks so as to reduce the spread of the disease. He said that he would need to call the US Fish & Wildlife Department and tell them since these were migratory birds. He said he would call us back and let us know how they wanted to handle the event. After he called back he said that two teams of State and Federal personnel would be out later that day or the next to assist us in the retrieval and they would handle the removal of the remains. He also gave us the name and number of an additional State employee to call if we could not get him for any questions. That individual was Tom Hilderbrand working out of the Mesa office (phone number 981-9400 ext 291).

12/1/94

State Game & Fish and US Fish & Wildlife teams arrived on site and confirmed the original thought that the symptoms were that of botulism infected ducks. Retrieval initiated after two safety meetings to discuss the safety hazards associated with the ponds. Darkness prevented completion of the gathering and a second day of collecting was set for 12/2/94. An effort to keep the ducks off the pond proved to be unsuccessful due to the large size of the pond. Game and Fish personnel used an exploding shotgun shell to drive the ducks off the ponds. They said they would try and locate Zone Guns which may be able to keep them off ponds as large as ours. Mainly collected were Shovelers and Ruddies, along with 2 Grebes and 1 Sandpiper. The US Fish & Wildlife estimated the overall duck population on the ponds to be approximately 3500.

12/2/94

The State and Federal teams and APS employees worked most of the day collecting the dead and dying ducks. A total of 313 ducks were retrieved (270 on 12/1/94 and an additional 43 on 12/2/94). Discussions with Game & Fish employees indicated that until the temperature in the ponds dropped to below 60 degrees F that the bacteria could still be a problem. They were unable to obtain any zone guns or devices to keep the ducks off the ponds. They recommended that we continue to collect ducks over the next week or so and discuss the outcome of our effort with them on Thursday 12/8/94 when they would return. Sample of the retrieved ducks were sent to Wisconsin for analysis for positive identification of the botulism. The remains were taken by Game & Fish to either be incinerated or buried in an appropriate location. Also PVNGS counted 3 ducks to verify that they did not contain high values of radionuclides. Water samples were taken and analyzed for PVNGS's normal release elements to verify that none of our usual substances were higher than allowed. All results were within normal values.

12/3/94

Retrieved 16 ducks (8 Shovelers, 6 Ruddies and 2 Grebe) and 1 coyote. Three recovered from WRF Res., 7 from Evap Pond #2, and 5 ducks and 1 coyote from Evap Pond #1. Placed in drum in Haz Mat Yard.

12/4/94

Retrieved 21 ducks (15 Shovelers, 3 Ruddies and 3 Mallards) and 1 coyote. Ten ducks were collected in WRF Res. and 11 in Evap Pond #2 along with 1 coyote.

12/5/94

Due to the rain and the dangerous conditions no collection took place. An estimate of dead or dying birds was made. In Evap Pond #2 two dying ducks, none in Evap Pond #1 and 4 dying ducks in WRF Res. Reported that a dead duck was in Unif 3 Spray Pond and that another one or two were near the cafeteria. Toured all Unit's Spray Ponds and did not locate any dead ducks but sprays were on and could not see into the center of ponds. Picked up one duck (Ruddie) in the Van Pool parking lot and one dead bird near the cafeteria that had been dead since before the current event had started so do not believe it is related. Bird was taken to Haz Mat Yard.

Informed that a hawk was hanging in power lines at the corner of Wintersburg Road and Van Buren. Drove by and verified that bird was a hawk and that it was dead. It appeared to have died due to electrocution. Contacted Nuc Reg Affairs as to who owned the lines along Wintersburg Rd. Contacted Frankie Altman of APS Claims who said she believed that the lines were APS's and she would see that we would remove it or if it was SRP's she would see that they had it removed.

Talked to Linda Glazer (602) 264-5422 of the National Biological Survey in Wisconsin. She said it would take between 5 days and 14 days to get results from the necropsy and tissue studies. This would pinpoint the cause of death. She will receive 4 birds to analyze. She also said she would not give out results but that I could get them from Ms. Martinez of (US Fish & Wildlife). Linda said she would be giving the results as each test was completed.

12/6/94

Did not collect from ponds due to rain. Did receive 1 Ruddie duck that was found on road near WRF. Total collect thus far is 352 ducks.

Arizona Radiation Regulatory Agency reported that they completed counting 20 ducks for radionuclides. Only Potassium 40 was identified. All other isotopes were less than the LLD which was 50 pico curies per kilogram.

12/7/94

Retrieved a total 15 ducks. Collected 5 Ruddies from Evap Pond #2. Also id'ed another 9 ducks that were to far from the edge to collect and one dying. Collected 1 Grebe from Evap Pond #1 and 8 Ruddies and 1 Shoveler from WRF Reservoir. Also id'ed 9 dead and one dying in WRF Receiver. Total collected thus far is 367.

12/8/94

Retrieved a total of 3 ducks.

12/9/94

Retrieved a total of 2 ducks from Evap Pond #2. Took samples from a diagonal across Evap Pond #2 at varying depths. Temperature profile indicated that the bottom of the pond was remaining at a significant elevated temperature, about 76 degrees F., as compared to the top which was a constant 54.5 degrees F. Additional results taken during sampling are attached. Samples were also sent off site for metal analysis.

12/10/94

Retrieved a total of 3 ducks (2 WRF Res. and 1 from Evap Pond #2).

12/11/94

Retrieved a total of 22 ducks. Two ducks from Evap Pond #1; 9 ducks from Evap Pond #2; and 11 ducks from WRF Reservoir.

12/12/94

Game and Fish onsite to collect an additional supply of ducks for analysis. Gave Game & Fish cooler full (25 ducks) to use for analysis. Collected a total of 21 ducks. Retrieved 8 ducks (1 Shoveler and 7 Ruddies) from WRF Reservoir, 8 (6 Ruddies and 2 Grebes) from Evap Pond #2 and 5 ducks (1 Grebe and 4 older Ruddies) from Evap Pond #1. Started new collection drum in Haz Mat Yard.

12/13/94

Collected 2 ducks.

12/14/94

No ducks found needing retrieval. New schedule put together for remainder of the year on duck collection. The new schedule reflects reduced numbers of ducks needing retrieval. Discussed with Game and Fish the options that we have if death rate increases. We are investigating the cost and effort necessary to scare the ducks off the ponds. No action is to be taken unless Game & Fish agree and not until laboratory data is available. Company that makes rockets is Pyro Techniques in Tempe, Az. also one of the Game & Fish persons makes them on his own and says that they will cost \$5 for 3 engines with charges on stick. Need to shoot off about 3 or 4 in a row at varies locations along the perimeter in all ponds. This will need to be done first thing in the morning and once or twice during the day and once at sunset.

12/15/94

One duck collected today.

12/16/94

No pickup but one retrieved from start up transformer X02 in Unit 1.

12/17/94

Collected 3 ducks (2 from the Evap Pond #1 and 1 from Evap Pond #2).

12/22/94

Collected 2 ducks.

12/23/94

No collection due to weather.

12/27/94

Collected 5 ducks from WRF Reservoir. Received preliminary data from McKenzie Labs on samples sent to have heavy metals ran on Evap Pond #2 water. All metals at near non-detectable levels.

12/28/94

Collected 23 ducks (5 ducks from WRF Res. and 17 ducks from Evap Pond #2).

12/29/94

Collected 45 ducks (7 of 45 were Grebes); 40 from Evap Pond #2 and 5 ducks from WRF Reservoir. Used boat in Evap Pond to collect those to far from water line to retrieve with hand net. Also collected one sick Grebe and placed in construction pond. Change in water seemed to make an immediate improvement.

12/30/94

None collected 2 sick in WRS Res and 8 floaters in Evap Pond #2.

---

01/3/95

Collected a total of 35 ducks (4 ducks from Evap Pond #1, none for WRF Res., and 31 from Evap Pond #2).

01/05/95

Collected 108 ducks (94 ducks from Evap Pond #2 and 14 from WRF Res.).

01/6/95

No collection due to weather.

01/07/95

Collected 97 ducks from Evap Pond #2.

01/10/95

Collected 34 ducks (5 ducks for WRF Res. and 29 ducks from Evap Pond #2). Game and Fish picked up 5 ducks for analysis.

01/13/95

Collected 2 ducks and one fox from Evap Pond #1. No collection from Evap Pond #2 since all were off shore.

01/19/95

No ducks close to shore. About one dozed floaters in Evap Pond #2 and 1 coyote floating in Evap Pond #1.

01/23/95

Collected 52 ducks from Evap Pond #2. No ducks collected from other sources.

01/26/95

No ducks collected in any location today. Checked Evap Pond levels: Evap Pond #1 at 933 feet and Evap Pond 32 at 920 feet J-Hook Pond at 923 1/2 feet.

Total to date 829 ducks collected.

Additional information follows.

Update of duck issues. On 4/18/95 submitted status report on duck mortality issue. Report and direction approved by upper management with some minor comments on additional info needed. Scheduled meeting with team for 5/7/95 to review comments.

4/24/95 called UofA veterinary school Dr. Noon at 621-2356 and discussed capabilities. He said he was not involved in the study that was proposed but that they could do necropsy work and were currently working on developing the capability to determine the toxicity of blue-green algae. He stated that very few people in the US knew much about this area. This could be a good source of information if we do start having ducks die and we need a local lab to do the study or confirm the NWHC work. They also could give us better response time so little delay in analysis occurred as has happened with NWHC.

Other numbers that Dr. Noon gave me were for Dr. Gerba 621-6906 or 621-6911 he may be the individual who did the 1991 study.

4/24/95 called Dr. Carol McIvor 621-1105 also 621-1959 or 621-1193 but not in. She wrote the first draft scope of services. Will discuss previous scope and fax copy of NWHC letter to her to use as what we need to assist in scope development.

4/24/95 received a call from Phil Smith of Game & Fish. He asked what our status was and what we had planned. I told him I had just talked to UofA and was waiting to talk to the original individuals who gave us a proposal. I told him that we had put together our proposed plan and after we had talked and received a new scope from UofA we would set a meeting. I told him I thought that late May probably would be the time frame and I would get back to him. I requested that he give me any information on flyways and histories of bird deaths that might have occurred at the same time in nearby states. He said that the NWHC puts out a report and that he would send a copy of the latest that he had for me to look at. He also said that only generalized flyways exist and that no specific one would be available in Arizona. He said that historically there was a flyway associated with the Gila River but that information was very nondescriptive and more hearsay than documented fact.

5/25/95. Over the past month had no duck mortalities. Have held meetings discussions with UofA research Dr. McIvors and also the Diagnostic Vet Labs Dr. Noon. Awaiting information from these sources. Called NWHC and Phil Smith of Az Game & Fish to give latest status.

8/15/95 Report of dead birds on Reservoir. Collected 9 (dead for several days) carcasses and 1 sick waterfowl believed to be Wilson's Phalarope.

8/16/95 The live shore bird died overnight.

8/17/95 Toured ponds. Found 1 sick bird on Reservoir no other dead or dying birds located on other ponds. Shipped it along with dead bird to UofA vet lab for analysis. Also UofA Research lab personnel on site collecting water samples from ponds.

8/18/95(Fri) picked up another sick waterfowl (believe to be Wilson Phalarope) from Reservoir late on 8/17/95. Mannie drove bird to UofA vet lab to be utilized for analysis. Tour of other ponds revealed no additional sick or dying waterfowl.

8/19/95(Sat) Called in people on overtime to survey ponds for sick or dead waterfowl, found 3 dead birds at Reservoir. Weather was overcast, air temp around 90-95 degrees. Evap pond#1 had about 30 or 40 ducks and about the same number of shorebirds.

8/20/95(Sun) Checked all ponds and found no dead waterfowl. Storm last night moved all floating material to center of Evap Ponds. Temp in 90's, overcast, broken clouds and wind out of east at 7 to 10 knots.

---

8/21/95 Called in people in on day off to tour ponds. Removed 6 dead birds (believe to be Wilson's Phalarope) from reservoir, and all badly decomposed. Collected 1 bird from Evap Pond #1. All other birds appear to be healthy.

8/22/95(Tue AM) Toured all ponds and found no dead birds. All 4 birds on ponds appear to be same as previously noted.

8/24/95(Thur AM) Toured ponds found no birds on Reservoir. Saw 3 dead birds on Evap Pond #2, unable to collect because to far off shore.

8/25/95(Fri AM) Reservoir waterfowl count: about 200-300 shore birds (Wilson's Phalarope) feeding; 20-30 Ruddies; 20-30 Grebes; and 20-30 Mallards or Mexican ducks on Reservoir. Saw about the 300 shorebirds (same species) on Evap Pond #1 but they were sleeping; 20-30 Ruddies and 20-30 grebes. On Evap Pond #2 saw about 200 shorebirds (same Species as on other ponds) feeding and about 5 Grebes.

8/29/95(Tue AM) Saw one sick Wilson's Phalarope on Reservoir. Count about the same as on Friday, several hundred shorebirds on each pond and 40-60 ducks on each pond.

8/30-31/95 in AM, Toured ponds and saw no sick or dead birds. A flock of about 500 (Black-necked Stilts) avocets have arrived on site and are standing on the liners at the shore line on the Evap Ponds. The temp is in upper 90's, overcast and winds of 10 to 15 knots.

8/30/95 talked to Dr. Noon about necropsy on waterfowl. He said he has done some analysis but was waiting for the mice so he could use the blood from the dying bird to do the botulism analysis. Should have results within two weeks.

9/1/95(Fri AM) Toured ponds and found no dead birds. Conditions and numbers the same as previous day except stilts have divided into four or five groups and are on all ponds.

9/2/95(Sat AM) Visited site to do bird count and identification. Due rain of past week the sedimentation basin had some standing water. Identified about 8 white (possibly Snowy) cranes, 8 Redeyed Ibises, one Osprey making low flights over Evap Pond #2, and several hundred Black-Necked Stilts (Avocets). Also saw about 100 Northern Shovelers on WRF Res and 20 Ruddy Ducks.

9/12/95 Received report From Dr. Noon on necropsies of the Wilson Phalaropes. No cause identified. He did say that it appeared to have been some kind of infection and that it probably was contacted off site since they died the week that they began to arrive.

9/25/95(Mon AM) Tour of WRF Res and Evap Ponds yielded no dead birds. Most Stilts have migrated on and only a couple of egrets were seen. About 90% of the previous duck population identified have also left the site.

10/5/95(Thur PM) Toured ponds and found no dead birds.



10/6/95 (Fri AM) Results of tour and bird count:

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	50	200	400
Ruddies	0	0	50
Eared Grebes	200	100	100
Coots	0	0	100
Shore Birds	200	200	0
Others	0	2 Western Grebes	2 Redhead Ducks

The weather was clear temperature low last night 56 F degrees and the high expected to be 90 F degrees. All birds appear to be healthy and feeding. When I went out to do the count at 8AM there was a very large flock of birds (200-300) circling the ponds and heading southwest from the site.

10/16/95 (Wed AM) Results of tour and bird count:

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	50	90	600
Ruddies	0	50	10
Eared Grebes	50	300	100
Coots	0	200	100
Shore Birds	100	200	0
Others	0	9 Gulls	2 Redhead Ducks & 5 American Avocets

The weather was clear temperature low last night 63 F degrees and the high expected to be 98 F degrees. All birds appear to be healthy and feeding. When I went out to do the count at 8AM there was a very large flock of birds (200-300) circling the ponds and heading southwest from the site.

November

Counts and reviews of ponds during sampling efforts indicated that approximately 1,000 to 2,000 water fowl are present at any given time. Species very variable during month. Migration in progress for many species. Most seem to be just stopping for a rest while on their migration.

11/29/95 Wed

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	75	50	700
Ruddies	0	50	100
Eared Grebes	50	200	200
Coots	25	50	100
Shore Birds	50	0	0
Others	4 Canadian Geese		2 Bufflehead Ducks

The weather was clear temperature low last night 45 F degrees and the high expected to be 70 F degrees. All birds appear to be healthy and feeding. First time observed Northern Shovelers feeding in Evap Pond #2. Count made at 1:00pm. Obtain UofA samples during observation period. Seems to be larger floating mat then previous week also large amount of feathers in Evap Pond #2.

11/30/95

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	30	0	700
Ruddies	0	0	100
Eared Grebes	100	200	300
Coots	10	0	100
Shore Birds	50	0	50
Others			2 Canadian Geese

The weather conditions the same as yesterday, sky clear, temperature low last night 35 F degrees and the high expected to be 70 F degrees. All birds appear to be healthy and feeding. Observed Northern Shovelers feeding in Evap Pond #1. Count made at 11:00am.

12/5/95

Inspected ponds and took samples. About 800 ducks on WRF Res., about 100 on Evap Pond #1 and 50 on Evap Pond #2. All ducks in good condition. Clear high expected in high 70's and low near 50 F.

12/8/95 (Fri) Howard Doyle while doing well samples in the area of the WRF Res. noticed what appeared to be a sick duck. It appeared to have similar symptoms as the ducks that died last year. Could not retrieve duck since he was well enough to stay away from capture. Initiated daily inspections of the ponds and determined coverage for over the weekend.

12/9-12/95 (Sat-Tue) found no sick ducks. Either the sick duck got well, it flew off or was eaten by predators.

12/12/95

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	30	0	600
Ruddies	0	0	100
Eared Grebes	10	10	100
Coots	10	0	100
Shore Birds	50	0	50
Others		Hawk of some kind	Gray Hawk

12/15/95 One male Northern Shoveler found dying. Same kind and sex as identified as being sick on 12/8/95 but may or may not be same duck. Doing daily inspections to identify any additional sick or dead ducks.

12/16-19/95 No sick or dead ducks identified.

12/20/95

Weather clear High in mid 60's low in upper 30's. Very little activity on Evap Ponds.

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	30	3	600
Ruddies	20	4	100
Eared Grebes	70	6	100
Coots	10	0	100
Shore Birds	50	0	10
Others			

About 180 ducks on EP#1, 13 ducks on EP#2, and about 900 ducks on WRF Res. all appear healthy.

12/22/95 Weather is clear high near 60 low last night upper 30's. Count taken at 9:00am. All ducks on WRF appear to be feeding. Increase in number of ducks on site since count on Wed.

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	80	12	600
Ruddies	50	5	200
Eared Grebes	100	7	50
Coots	10	0	50
Shore Birds	50	0	100
Others	20 Buffle Heads	2 Redtailed Hawks & 3 Sea Gulls	1 Redtailed Hawk & 12 Buffle Heads

No additional sick or dead ducks identified during week. The Northern Shoveler that was collected last week will not be sent to UofA for analysis. Contacted David Moore of UofA and obtained his home phone number so if we do have an outbreak of illness during the holiday's we will be able to contact someone at UofA for assistance.

12/26/95 Weather is clear high near 60 low last night upper 30's. Count taken at 9:00am. All ducks on WRF appear to be feeding and healthy. No dead or dying birds noted over holiday weekend. When approached Evap Pond #1 about 30 Buffle Head ducks moved from #1 onto Evap Pond #2. They are included in the #2 pond totals.

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	50	20	600
Ruddies	20	10	100
Eared Grebes	80	10	50
Coots	10	0	50
Shore Birds	50 (small Plover like)	0	100
Others	40 Buffle Heads	2 Redtailed Hawks, 1 American Kestrel & 12 Sea Gulls	50 Buffle Heads

1/3/96

Weather clear High in mid 60's low in lower 40's.

Species	Evap Pond #1	Evap Pond #2	WRF Reservoir
Northern Shovelers	30	0	200
Ruddies	50	0	40
Eared Grebes	70	6	20
Coots	10	0	40
Buffle Heads	60	0	50
Others			

About 220 ducks on EP#1, 6 Grebes on EP#2, and about 350 ducks on WRF Res. all appear healthy. No indication of where the previous ducks have relocated to.

1/4/95 Conditions and bird count approximately the same as on 1/3/96. UofA on site collecting samples. Two reports from previous sampling efforts given to EH&S. All birds appear healthy.

2/5/95 Continuing monitoring on a weekly basis. General population is about 300 ducks. Will only update status report when differing information is available. UofA schedule set through June. Next meeting with AG&F set for April 26th, 1996.

3/12/96 UofA on site sampling. Only about 200 birds on site most on WRF. Most are Grebes with some Buffle heads and a few shovelers. Conditions and count about the same throughout the month.

4/2/96 While collecting the UofA samples identified 12 Avocets (Stilts) and 2 cranes. This is the first observation of them since the first week of September. Assume that they are on a migration North.

5/2/96 Major change is the reduction of algae in both Evap ponds and the increase in Brine Shrimp population. About 20 ducks on Evap Ponds and 100 or so on the WRF.

6/19/96 No dead or sick ducks on ponds. Brine Shrimp population still increasing about the same population of ducks as last month.

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**ATTACHMENT B**

**APS REPORTS, MEETING MINUTES & CONTINGENCY PLAN**

Arizona Public Service Company

PALO VERDE NUCLEAR GENERATING STATION  
P.O. BOX 52004 • PHOENIX, ARIZONA 85072-2004

291-00858-TPH

June 20, 1995

Mr. David Moore  
Environmental Research Laboratory  
University of Arizona  
2601 East Aripport Drive  
Tucson, AZ 85706

Dear Mr. Moore:

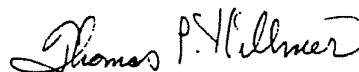
**Subject: Duck Mortality Status Report**

I would like to thank you for the time you spent with me discussing the duck mortalities that have occurred at Palo Verde Nuclear Generating Station. I have included a copy of the current status report that I have written which will give you some additional background on the issue. I will be waiting to hear from you on your proposed scope of services, the sample protocols, pricing, and other diagnostic capabilities that may be available through your laboratory.

I also have included the latest data that is not included in the report.

If you need additional information, please contact me at 393-5765.

Sincerely,



Thomas P. Hillmer.  
Consultant, EH&S

TPH/rkj  
Attachments

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**DUCK MORTALITY  
PRESENTATION AND STATUS REPORT**

**by**

**Thomas Hillmer**

**5/16/95**



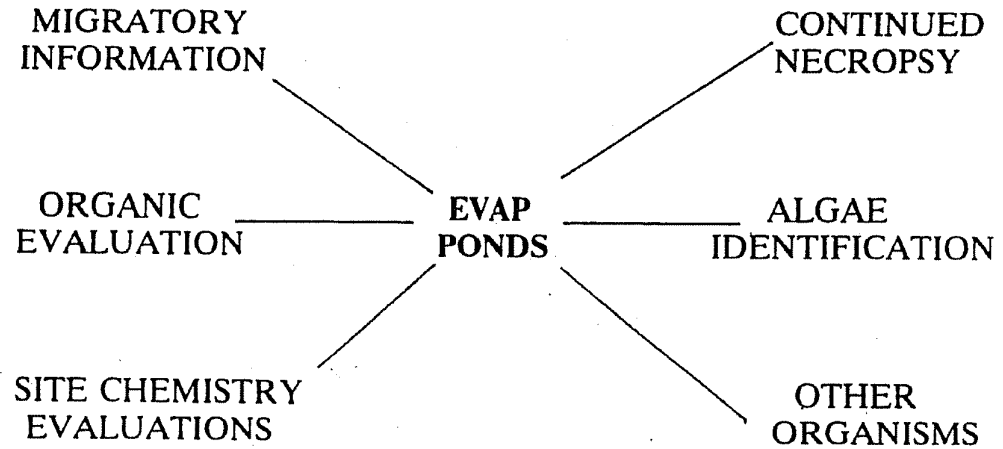
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ENVIRONMENTAL INFLUENCES ON THE MORTALITY IN THE  
EVAPORATION PONDS



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**OVERVIEW OF ACTIONS FOR THE  
DUCK MORTALITY PROGRAM**

**EVAPORATION PONDS 1 & 2 BACKGROUND ORGANIC DATA IS  
BEING COLLECTED**

**TREND EVAPORATION POND KEY VARIABLES AND DETERMINE  
WHEN ACTIONS MAY BE NECESSARY**

**CONTRACT WITH UNIVERSITY OF ARIZONA FOR BIOLOGICAL  
SUPPORT TO BE DEVELOPED**

**KEEP U.S. FISH & WILDLIFE AND ARIZONA GAME & FISH  
INVOLVED AND PART OF SOLUTION**

**REPORTS BEING DRAFTED**

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**DUCK MORTALITY PROGRAM  
PROPOSED SCHEDULE**

- April 20, 1995**    **Hold meeting with PVNGS staff and review latest letter from USNWHC.**
- April 27, 1995**    **Contact University of Arizona and discuss new scope.**
- May 1995**            **Meet with University of Arizona, Arizona Game & Fish and US Wildlife & Fish to discuss new scope and develop meeting schedule.**
- Ongoing**            **Assist WRF in obtaining baseline water chemistry information on Evap Ponds.**
- May 1995**            **Draft write up on migratory pathways for inclusion in final report.**
- June 1995**            **Draft contract with U of A to perform onsite analysis.**
- July 1995**            **U of A to commence onsite sampling.**
- July and  
September 1995**    **Attend regular scheduled meeting with Az. Game & Fish and US Fish and Wildlife to review latest data.**
- October 1995**        **Hold plant meeting with WRF and Environmental to review all data and determine if any actions needs to be taken to reduce or eliminate the chance that ducks will be affected this winter.**
- Beyond October**    **Continue to schedule meeting with Az. Game & Fish and US Wildlife as well as U of A if needed.**

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## **MAJOR TASKS OF DUCK MORTALITY PROGRAM**

### **EVAPORATION PONDS 1 & 2 BACKGROUND ORGANIC AND INORGANIC DATA WILL BE COLLECTED**

**On a monthly basis both ponds will be sampled for:**  
**Biological Oxygen Demand (BOD) 2 samples per pond**  
**Total Dissolved Solids (TDS) 1 surface and 1 bottom sample per pond**  
**pH and Conductivity 1 surface and 1 bottom sample per pond**  
**Dissolved Oxygen (DO<sub>2</sub>) 3 samples per pond**  
**Ammonia and Total Nitrogen 1 surface sample and 1 bottom sample per pond**  
**Temperature measurements 1 surface sample and 1 bottom sample at 3 locations**

**Other specific analysis performed by offsite laboratory may be added as more information is gathered.**

**These samples will be tentatively collected the second Wednesday of each month.**

### **TREND KEY VARIABLES AND DETERMINE WHEN ACTIONS MAY BE NECESSARY**

**The above values will be reviewed and trended to give insight into the processes occurring in the ponds on a monthly basis. These trends will be communicated to PVNGS management and various state, federal agencies and possibly other groups in the future.**

---

**CONTRACT WITH UNIVERSITY OF ARIZONA FOR BIOLOGICAL SUPPORT**

**A meeting will be set with University of Arizona to discuss a revised proposal for a study of the organisms that inhabit PNVGS's Evaporation Ponds. After we have formulated the scope of work for U of A a meeting will be scheduled with Az. Game & Fish and US Fish & Wildlife. We will review the direction that we are taking and discuss if they have any recommendations to be considered during our study. At that meeting will propose our plan and get their concurrence and commitment to be involved in the review of data etc.. After that meeting we will meet with U of A and finalize the scope of services for a contract for their support. At that point a detail schedule will be made and distributed.**

**DETERMINE WHAT BIOLOGICAL DATA COULD BE COLLECTED AT PRESENT TIME AND SCOPE OF STUDY**

**This will be included in the U of A scope of support that is requested. This may include additional organic or inorganic analysis.**

---

**SCHEDULED PROGRESS MEETING WITH U.S. FISH & WILDLIFE  
AND AZ GAME & FISH**

**Over the next seven months PVNGS will meet every other month with the agencies to update and review with them the data that has been developed over the past 2 months. Meeting notes from these meetings will become part of the final report. After every meeting an interim status report will be written which will document activities and update trend information.**

**PRODUCE FINAL REPORT**

**A final report will be produced that summarizes duck mortalities and migration patterns. The report will be the documentation of our efforts and include all data collected and final reports from U of A. This will be the basis for showing due diligence in this project.**

---

## DUCK MORTALITY HISTORY

- 11/30/94 . EH&S got initial call about dead ducks on Evaporation Pond #2
- 12/1/94      Contacted Game & Fish about die off  
              Ducks collection begins: 270 collected
- 12/2/94      Ducks picked up to be sent to the United States National Wildlife  
              Health Center (USNWHC)  
              PVNGS performed isotopic analysis on 3 ducks - No man-made  
              radioactivity detected  
              Ducks will be given to Arizona Radiation Regulatory Agency  
              (ARRA) to analyze - Initial results indicate only naturally  
              occurring Potassium 40 was detected above background (Lower  
              Level of Detection is 50 pico curies/kilogram)
- 12/5/94      Called USNWHC to get results (Ducks not received yet)
- 12/6/94      USNWHC report #13230 indicates:  
              Negative for botulism type C, Liver lead Non-detectable, No  
              bacteria growth, Cholinesterase in normal levels,  
              Histopathologic levels mild, 1 duck had mild schistosome  
              parasitism and samples contained casings and eggs, these  
              were negative for botulism C.
- ARRA counting of ducks complete - only naturally occurring  
              Potassium 40 identified.
- 12/9/94      Temperature measurements made of Evap Pond #2 - results were  
              that the surface temperature was about 54.5 degrees F while the  
              bottom was 76 degrees F at the deepest level. Also sent samples  
              to McKenzie Labs for RCRA total metals analysis.
- 12/12/94     Az. Game & Fish picked up cooler of 25 ducks for analysis.



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12/13/94 USNWHC in Wisconsin receives 5 ducks for analysis. Report # 13249 indicates:

No type C Botulism detected, samples may have been frozen, no significant bacteria was isolated from liver tissue, one duck lung tissue showed light growth of *Pasteurella multocida* the pathogenic organism that causes cholera but not cause of death, and ducks appear to have drowned. Suggested that a determination be made as to whether the ducks could have been caught in an underwater drain and drowned.

12/27/94 McKenzie laboratory of Arizona had results available, total RCRA metals results on all samples near or below detection limits.

1/10/95 Az. Game & Fish picked up 5 more ducks for analysis. USNWHC in Wisconsin. report #13276 associated with this pickup.

1/31/95 Summary from USNWHC in Wisconsin, data sheets listed above indicated that test ruled out:

- Botulism C & E
- Bacterial infections
- Viral infections
- Sodium toxicity
- Exposure to pesticides (organophosphorus and carbamate)
- Lead poisoning

3/17/95 Summary letter, including Report #13276, from USNWHC in Wisconsin, with recommendations:

The sources identified in data sheets are ruled out as causes.

Recommended analyzing for inorganic compounds (ions and metals), organic compounds, pH, dissolved solids, Bio organisms be identified and their potential to produce toxins be evaluated.

---

EVAPORATION POND INVESTIGATION PROGRAM  
STATUS REPORT  
April 15th 1995

This program is being developed to determine all aspects that might be contributing to the cause of the mortalities of migratory birds found in PVNGS's Evaporation Ponds. It is highly probable that the actual cause may not be determined since the mortalities have occurred in small numbers (1 to 2 per 100 with a total population of 2,500 to 5,000 birds) and at irregular times intervals (0 to 300 per week). This could lead to the assumption that if the cause is due to conditions in the pond and not a condition that preexisted outside of the ponds, it is located in an isolated area(s) of the evaporation pond(s). The randomness of the die offs also indicate that the conditions that might lead to the die offs may not always be present in the ponds. Due to these indications and the large number of variables that exist, a phased approach is being recommended to the program. The University of Arizona, School of Veterinary Medicine laboratory will work only progressively through each sampling scheme and only when it is determined that the next phase offers the potential for more informative results. A brief history of the activities are provided in Attachment 1.

ACTIONS PLANNED AND TAKEN

**PLANNED** A literature search will be made to determine the possible flight paths the ducks might have taken to PVNGS. From this search a phone survey of various states that the migratory birds traversed on their way to PVNGS will be made to determine if die offs occurred along the flight path.

**TAKEN MARCH 95** Literature has been reviewed and major fly ways that ducks could be taking to PVNGS has been determined. The individuals in the states of California, Nevada and Utah have been contacted in regards to die offs of similar duck species at a time when they could have been in route was discussed. No reports of significant die offs have been reported. This may be over stated since those contacted indicated that unless a larger number of ducks than died at PVNGS occurred, they probably would not have known nor been informed. Additional data gathering will be undertaken and results will be reviewed with Az. Game & Fish personnel.

**PLANNED** Environmental will continue to work with US Fish & Wildlife to supply fresh samples (when available) and additional information that we develop to help determine the possible cause of death.

TAKEN MARCH 95

The last pickup of a duck at the ponds occurred on January 26th, 1995. Since no new mortalities have occurred, contact with the agencies has been only verbal. On February 2, 1995 and again during the month of March discussions were held with the National Wildlife Health Center in Wisconsin. These discussions centered on obtaining the last set of data and a summary of the conclusions that the center has made as to the cause of the mortalities. This information has been added to the matrix of data that has been generated in regard to this program.

PLANNED We will initiate a contract with the University of Arizona to aide in development of a sampling program to determine:

- 1) algae type(s) and if they are toxic or concentrate toxins.
- 2) identification of other organisms and if they are or can become toxic
- 3) determine type of organics and source of organics and if they can directly or indirectly cause mortalities.

TAKEN FEBRUARY 95 Initial contact with U of A on their proposal has been made (see Appendix B for proposal). Since it appeared that they had not been supplied with the latest data by US Fish & Wildlife the proposal was deemed to be in need of revision. A scope will be prepared after PVNGS management agree with the proposed program. After approval a new scope will be drafted and contact made with U of A to discuss details and make possible changes. After the basic scope has been worked out and an estimated price determined a meeting will be scheduled with the agencies to get their input and approval on the direction being undertaken.

PLANNED The Evaporation Ponds are being monitored on a monthly basis to determine baseline conditions and possible trends.

TAKEN MARCH 95

Data is currently being collected at PVNGS by Water Reclamation Facility (WRF) and Chemistry Effluents Group for background radioactivity in the ponds. The WRF effort is being supported by Environmental on a monthly basis. An Evaporation Pond sampling program was developed as a result of meetings with WRF (see Appendix C). The sampling program also indicates the location and analysis that is being collected and performed. Chemistry samples for specified inorganic and organics are being done monthly while

APPENDIX A

DUCK MORTALITY HISTORY

- 11/30/94 EH&S got initial call about dead ducks on Evaporation Pond #2
- 12/1/94 Contacted Game & Fish about die off  
Ducks collection begins: 270 collected
- 12/2/94 Ducks picked up to be sent to the United States National Wildlife Health Center (USNWHC)  
PVNGS performed isotopic analysis on 3 ducks - No radioactivity detected  
Ducks will be given to Arizona Radiation Regulatory Agency (ARRA) to analyze - Initial results indicate only naturally occurring Potassium 40 was detected above background (Lower Level of Detection is 50 pico curies/kilogram)
- 12/5/94 Called USNWHC to get results (Ducks not received yet)
- 12/6/94 USNWHC report #13230 indicates:  
Negative for botulism type C, Liver lead Non-detectable, No bacteria growth, Cholinesterase in normal levels, Histopathologic levels mild, 1 duck had mild schistosome parasitism and samples contained casings and eggs, these were negative for botulism C.
- ARRA counting of ducks complete - only naturally occurring Potassium 40 identified.
- 12/9/94 Temperature measurements made on Evap Pond #2 - results were that the surface temperature was about 54.5 degrees F while the bottom was 76 degrees F at the deepest level. Also sent samples to McKenzie Labs for RCRA total metals analysis.
- 12/12/94 Az. Game & Fish picked up cooler of 25 ducks for analysis.
- 12/13/94 USNWHC in Wisconsin receives 5 ducks for analysis. Report # 13249 indicates:  
No type C Botulism detected, samples may have been frozen, no significant bacteria was isolated from liver tissue, one duck lung tissue showed light growth of Pasteurella multocida the pathogenic organism that causes cholera but not cause of death, and ducks appear to have drowned. Suggested that a determination be made as to whether the ducks could have been caught in an underwater drain and drowned.
- 12/27/94 McKenzie laboratory of Arizona had results available, total RCRA metals results on all samples near or below detection limits.
- 1/10/95 Az. Game & Fish picked up 5 more ducks for analysis. USNWHC in Wisconsin, report #13276 associated with this pickup.

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1/31/95

Summary from USNWHC in Wisconsin, data sheets listed above indicated that test ruled out:

- Botulism C & E
- Bacterial infections
- Viral infections
- Sodium toxicity
- Exposure to pesticides (organophosphorus and carbamate)
- Lead poisoning

3/17/95

Summary letter, including Report #13276, from USNWHC in Wisconsin, with recommendations:

The sources identified in data sheets are ruled out as causes.

Recommended analyzing for inorganic compounds (ions and metals), organic compounds, pH, dissolved solids, Bio organisms be identified and their potential to produce toxins be evaluated.

APPENDIX B

ARIZONA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT  
NATIONAL BIOLOGICAL SURVEY  
THE UNIVERSITY OF ARIZONA  
ARIZONA GAME AND FISH DEPARTMENT  
U.S. FISH & WILDLIFE SERVICE  
WILDLIFE MANAGEMENT INSTITUTE

BIOLOGICAL SCIENCES EAST  
UNIVERSITY OF ARIZONA  
TUCSON, ARIZONA 85724

602-621-1959

Memorandum

20 February 1995

To: Potential Cooperators  
From: Carole McIvor, Steve DeStefano  
Re: Preliminary proposal for investigation of waterbird die-off

Please find attached a brief preliminary proposal regarding an investigation of the recent die-off of waterbirds at the Palo Verde Nuclear Power Facility in Maricopa County, Arizona. This proposal is meant as a starting point for further discussions on if and how we may want to proceed with an investigation. Project scope and budget will vary, depending on objectives and available funding. Please let us know, at your earliest convenience, how you think we might best proceed.

Thank you.

cc. T. Hillmer, K. King, G. Naughton

Draft Proposal, 2/15/94

**Title: PRELIMINARY INVESTIGATION OF WATERBIRD DIE-OFF AT THE PALO VERDE NUCLEAR POWER FACILITY, ARIZONA**

Submitted by: Dr. Carole McIvor, Assistant Unit Leader (Fisheries)  
Dr. Stephen DeStetano, Assistant Unit Leader (Wildlife)  
Arizona Cooperative Fish and Wildlife Research Unit  
104 Biological Sciences East, University of Arizona  
Tucson, AZ 85721

Field technician: to be named

**Introduction**

During the winter of 1994-95, large numbers of ruddy ducks (*Oxyura jamaicensis*), northern shovelers (*Anas chryseus*), grebes, and other waterbirds were found dead or dying on water impoundments associated with the Palo Verde Nuclear Power Facility, Maricopa County, Arizona. To date, a sample of 12 carcasses have been sent to the National Biological Service's National Wildlife Health Center (NWHC) in Madison, Wisconsin for necropsy (L. Glaser, NWHC, pers. comm.). Preliminary diagnoses have not identified the specific cause of death. Most of the birds showed signs of having drowned, but this is obviously not the primary cause of mortality. Avian botulism (C and E), saline toxicity, and death due to pesticide contamination have been ruled out. There were also no signs of viral or bacterial infection, and the guts of examined birds contained only grit and no food. The presence of empty guts likely indicates that the birds were too ill to feed in the hours immediately preceding death.

Similar die-offs of large numbers of grebes and other waterbirds have been recorded recently at several other sites (C. J. Brand, NWHC, pers. comm.). At the Salton Sea in southern California about 150,000 birds were found dead; avian cholera was implicated, but other biotoxins may have been involved. At Bear River, Utah, thousands of grebes died of

cholera, and at Mono Lake, California, several birds were picked up in emaciated condition. At both the Salton Sea and Mono Lake, the cause of mortality was not ascertained.

### **Objectives**

The objectives of this pilot study are to collect background information on similar die-offs of waterbirds throughout the United States and baseline field data on the conditions and species involved at the Palo Verde site. Specifically, we will (1) examine the literature and animal disease center records for similar occurrences involving waterbirds, (2) conduct searches and collect dead and moribund birds on site for necropsy, (3) collect water, invertebrate, aquatic plant, and sediment samples for screening for toxins, (4) conduct a survey of avian and aquatic (i.e., putative food) species, and (5) monitor environmental variables that may be associated with the die-off. Finally, we will examine both the site and the nuclear plant standard procedures for additional clues as to the cause of the die-off.

### **Methods**

A field technician will be assigned to conduct a review of the literature and case studies, and to collect samples, survey birds, fish, and aquatic vertebrates in and around the ponds, and monitor environmental variables in the field. Sample collection will follow protocols recommended by the NWHC, and specific survey and monitoring methods will be developed by the field technician in conjunction with project investigators and cooperators.

### **Schedule**

A rapid response would be advantageous so that fresh carcasses can be collected. We will attempt to hire a field technician and have that person at the site by 1 April or earlier. A field visit by NWHC personnel at the same time would also be advantageous, so that



collection protocols can be set in place. The technician will continue with sample collection for 3-6 months, depending on conditions and numbers of birds involved. If the situation warrants, the field technician may develop this problem into a graduate program. At that time, Unit personnel and cooperators would meet to discuss project objectives and goals.

### **Budget**

A firm budget estimate is impossible to derive at present because the precise nature of the investigation has yet to be determined by Arizona Public Service and the project cooperators. We therefore present three budget ranges for studies of fundamentally different duration and intent. Level I involves having a student technician to collect additional samples for analysis, a preliminary literature review. Work would be completed in 3 months; cost is approximately \$2,000 assuming no charge for sample processing. Level II involves putting a technician on site for 3 months to collect a series of samples for analysis by the NWHC, sample processing by that group, and report preparation, including a more detailed literature review; cost is approximately \$10,000. Level III involves a 4 year PhD project (stipend, equipment and supplies, sample analysis, technical help, travel, report preparation). Cost for all aspects excluding sample analysis is approximately \$100,000. Depending on the number of samples and type of analyses conducted, sample analysis might cost an additional \$40,000-65,000.

APPENDIX C  
EVAPORATION POND SAMPLING PROGRAM  
(preliminary plan 3 20 95)

**GRAB SAMPLES**

The two grab samples are to be collected at least once per month from approximately the middle of each pond (refer to attached illustration of sample locations). At each location, one sample will be collected approximately one foot below the water's surface and the other approximately one foot above the bottom of the pond. The sample depth and total depth will be recorded for each grab sample.

Sufficient sample volume should be collected to support the required analyses. No preservatives are required to be added to the samples. The sample collection containers and equipment will be provided by WRF personnel. Each sample collection container will include the date/time of sample collection and a sample location description and/or identifier traceable to the original field data sheets.

The grab samples will be analyzed for pH, Total Dissolved Solids, Conductivity, Ammonia, and Total Nitrogen.

**COMPOSITE SAMPLES**

(not to be collected until sampling frequency and analyses are determined)

Two composite samples will be collected by combining, in equal portions, two grab samples collected from the middle of each pond (refer to attached illustration of sample locations). At each sample location, one of the grab samples will be collected approximately one foot below the water's surface and the other approximately one foot above the bottom of the pond. The sample depth and total depth will be recorded for each grab sample.

The sample frequency, volume, preservation techniques, and analyses to be performed will be determined at a later date.

**DISSOLVED OXYGEN AND TEMPERATURE PROFILE MEASUREMENTS**

Dissolved oxygen (DO) and temperature are to be measured at least once per month at a depth of approximately one foot below the water's surface and one foot above the bottom of the pond at three locations in each pond. The measuring locations are approximately 1/4, 1/2, and 3/4 the distance across the diagonal of each pond (the 1/2 way point is approximately the middle of the pond which coincides with the grab/composite sampling location described earlier). Refer to the attached illustrations for the measuring locations. The measurement depths and total depth of each sampling location will be recorded.

Instrumentation serial numbers and calibration data/dates will be recorded, as applicable.

APPENDIX D  
Table 1A

DATA EVALUATION SHEET

<i>BIOLOGICAL TOXINS - NECROPSY</i>	13230 *	13249 *	13276 *	NWHC 3/17/95	PVNGS 5/23/91	McKen zie
BOTULISM C	ND	ND	ND	ND		
BOTULISM E				ND		
BACTERIAL INFECTIONS	ND	ND		ND		
VIRAL INFECTIONS (DVE)	ND	ND		ND		
PASTEURELLA MULTOCIDA (CHOLERA)		ND				
<i>VIRUS AND OR PARASITE ANALYSIS</i>						
FECAL COLIFORM					2	
FECAL STREPTOCOCCI					<2	
STANDARD PLATE COUNT (COLONIES/ml)					14	
LEGIONELLA					None	
ENTERIC VIRUS (PER 40 LITERS)					2	
GIARDIA LAMBLIA (PER 40 LITERS)					0	
ASCARIS LUMBRICOIDES					Neg.	
BIO OXYGEN DEMAND (mg/l)					9	
<i>PESTICIDES</i>						
CARBAMATE				ND		
ORGANOPHOSPHORUS				ND		

NWHC = NATIONAL WILDLIFE HEALTH CENTER LABORATORY SUMMARY LETTER

\*13230 = NWHC DATA REPORT #13230

\*13249 = NWHC DATA REPORT #13249

\*13276 = NWHC DATA REPORT #13276

PVNGS = ONSITE and OFFSITE ANALYSIS from 5/23/91 Evap Pond Study

McKenzie = OFFSITE ANALYSIS AT ARIZONA CERTIFIED LAB

ND = NOT DETECTED, NEAR DETECTION LIMIT OR NOT FOUND

APPENDIX D  
Table 1B

DATA EVALUATION SHEET

<i>CHEMISTRY-CHEMICAL TOXINS</i>	13230*	13249*	13276*	NWHC 3/17/95	PVNGS	McKen zie
<b>HEAVY METALS*</b>						ND
LEAD POISONING				ND		
HYDRAZINE					ND	
SODIUM TOXICITY				ND		
pH						8.5
NITRATE/NITRITE AS N						160
GROUND H2O QUALITY PROTECTION PERMIT ANALYSIS						ND
<b>PHYSICAL CHARACTERISTICS</b>						
TEMP DIFFERENCES - DELTA SURFACE TO BOTTOM in degrees F (12/94)					54.5 76.0	
TEMP DIFFERENCES - DELTA SURFACE TO BOTTOM in degrees F (2/95)					68.0 63.5	
<b>ORGANISMS - ALGAE</b>						
<b>ISOTOPIC ANALYSIS - OF DUCKS</b>					ND	

NWHC = NATIONAL WILDLIFE HEALTH CENTER LABORATORY

\*13230 = NWHC REPORT #13230

\*13249 = NWHC REPORT #13249

\*13276 = NWHC REPORT #13276

PVNGS = ONSITE ANALYSIS

ND = NOT DETECTED, NEAR DETECTION LIMIT OR NOT FOUND

MCKENZIE = OFFSITE LAB. VALUES ARE IN PPM OR pH UNITS AS APPROPRIATE

HEAVY METALS = As,Br,Ca,Cr,Pb,Hg,Se,and Ag

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APPENDIX E

Migratory Pathways

The Pacific Flyway represents a general area used by migratory birds and ducks leading from their breeding grounds in eastern Alaska, Mackenzie and other interior parts of northwestern Canada. The flyway is a relatively simple flyway, as the majority of the ducks that use it make direct north and south journeys from the breeding grounds to their wintering quarters. The migratory ducks, which we are concerned with in this report Ruddy Ducks and Northern Shovellers, generally divide into two groups one which migrates southeastward using the Central and Mississippi flyway and the other the Pacific Flyway.

The ducks that use the Pacific Flyway use the route that runs from northwestern Canada southward through the prairie provinces along the eastern Rocky Mountain foothills then turn southwestward across northwestern Montana and the Panhandle of Idaho. It then turns southward across central Oregon to the interior valley and coastline of California. The remainder of this broad flyway heads south extending from along the California coast to as far east as the western edge of the Rocky Mountains. There are two main routes used in this westerly direction, the northernmost crosses Idaho and southeastern Oregon and enters California near the California-Nevada state line. The second route runs through central Nevada and reaches the California valleys near the confluence of the Sacramento and San Joaquin Rivers. The migratory birds then continue south generally wintering within several hundred miles of the coastline anywhere along Pacific Coast from northern California all the way to the southern most part of Mexico.

The primary ducks of interest to PVNGS are the Ruddy Duck and the Northern Shoveller. Both of these ducks breed in central and western Canada and winter along the coastline areas as described above. To help understand the habitat and feeding habits of these two ducks and give insight that may be helpful in the duck mortality some key facts about these ducks are included.

Ruddy Ducks are exclusively a North American species. They migrate in the spring by March or April and in the autumn by September. They winter in shallower and more protected bays and estuaries. The subfamily has little in common with other groups of ducks. They are sullen, ferocious, bad-tempered birds that will snap and peck viciously when captured. They are among the most active ducks in the water. The legs of the Ruddy Duck are placed well to the rear of the body and are practically helpless on land. They are able to waddle along for a few steps, but fall upon their breast almost immediately and progress by shoving along in this prostrate position, pushing with both feet simultaneously. This peculiarity probably is a contributing factor in their drowning in the evaporator ponds. When they experience a reduced mobility due to sickness they are already basically unable to climb or walk onto the pond liner and get out of the water and have time to possibly recuperate. When they migrate they fly in medium to large flocks. The food source for the Ruddy Duck is nearly three-quarters vegetable. It's normal vegetable diet is made up of

pond weeds, bulrushes, sedges, and muskgrass. The normal animal food diet is made up of insects and molluscs.

The Northern Shoveller is a well-known and widely distributed duck being common throughout North America. They are a warm-weather duck and are early migrants in autumn and late spring. It is essentially a fresh water duck of the sloughs, marshes, muddy ponds and sluggish creeks. The Shoveller is at the head of the class of surface feeders. Their broad bill and elongation of the intestine of this species are specializations for the nutritive utilization of minute organisms, such as may be found in the bottom ooze. While the Shovellers takes more of this bottom food than any other duck, a relatively small percentage of its diet is actually obtained from this source. This is a higher percentage than is consumed by any of the other surface feeders. The chief diet is from vegetable matter such as sedge seeds, pond weeds, grasses, and alae. The animal food of the Shoveller amounts to about one-third of its total diet. This is mainly comprised of molluscs, water bugs, crustaceans and fishes.

In an effort to determine if Ruddy Ducks and Shovellers were dying in other areas in the west and or along the flyway suspected as the route used by the ducks that wintered at PVNGS a review of mortality reports was undertaken. On September 23, 1994, continuing through November 2, 1994, at the Salton Sea in California about 300 water fowl, including Northern Shovellers, died of Botulism type C. On November 10, 1994, at Farmington Bay, Utah, and estimated 15,000, including Northern Shovellers and Grebes, died of Avian Cholera. On December 1, 1994, continuing through January 6, 1995, at Gray Lodge, California, an estimated 1,050 fowl, including Northern Shovellers, died from Avian Cholera. On December 2, 1994, through December 31, 1994, in Humboldt County, California, 625 water fowl died from Avian Cholera. These were the only reported die offs that occurred at the same time or just prior to PVNGS's occurrence and contained the same species of ducks that wintered at PVNGS. Since all these mortalities have had the cause identified and they have been eliminated as probable causes at PVNGS no new information can be gleaned from these facts.

As additional information is uncovered about duck mortalities it will be added to this report.

APPENDIX F  
TABLE

MONTHLY EVAPORATION POND ANALYSES

EVAP POND 1	LEVEL	LOCATION	DO	TEMP °C	PPM			COND	TDS	BOD	NO <sub>3</sub> as N	TIME
					NH <sub>3</sub>	pH	PPM					
3-22-95	931'	SE	8.6	19.0	1.5	9.2	46,430	44,773	N/A		0951	
			TOP									
			BOTTOM	0.8	15.0	7.0	49,330	47,543	N/A		0944	
			TOP	2.5	20.6	1.0	45,800	43,355	29.7		1020	
		MIDDLE										
		BOTTOM	2.0	18.8	7.5	48,800	47,587	3.7		1016		
		NW	4.0	18.0	1.5	46,400	43,885	N/A		1035		
			1.5	19.8	1.5	46,600	32,588	N/A		1039		

EVAP POND 2	LEVEL	LOCATION	DO	TEMP °C	PPM			COND	TDS	BOD	NO <sub>3</sub> as N	TIME
					NH <sub>3</sub>	pH	PPM					
3-22-95	923'	SW	4.0	21.1	1.0	9.8	58,000	58,918	N/A		1100	
			TOP									
			BOTTOM	1.5	22.2	10.8	82,100	91,230	N/A		1105	
			TOP	4.0	20.6	1.0	58,600	57,617	23.8		1110	
		MIDDLE										
		BOTTOM	2.0	21.7	6.5	78,400	83,773	25.8		1115		
		NE	6.5	20.6	1.0	59,000	62,992	N/A		1125		
			2.0	21.7	6.8	74,250	81,837	N/A		1130		

Depth - All top samples taken 1 ft. below top of pond surface.  
All bottom samples taken 1 ft. from above pond bottom

Field Notes

\* D.O. Meter failed to measure in field. Brought samples back to Lab. and measured D.O. by Chemtrics, Inc., test kit. (Results could be slight off). We are working on the D.O. issue. 4/25/95

\* Please consider these results 2.1 ppm

(Handwritten signature)

APPENDIX F  
TABLE

MONTHLY EVAPORATION POND ANALYSES

EVAP POND 1	LEVEL	LOCATION	PPM °C				PPM				NO, as N	TIME
			* DO	TEMP	NH <sub>3</sub>	pH	COND	TDS	BOD			
4-13-95	930'	SE	7.0	16.8	3.0	9.2	49,300	47,585	N/A		0930	
		BOTTOM	6.0	14.5	4.0	9.1	49,580	47,816	N/A		0932	
		TOP	7.0	15	2.5	9.2	49,600	46,320	24.2		0955	
		BOTTOM	5.5	15	5.0	9.0	49,700	51,310	19.2		0958	
		TOP	6.0	15	3.0	9.1	49,700	46,279	N/A		1006	
		BOTTOM	7.0	14.5	3.0	9.2	49,600	51,444	N/A		1009	

EVAP POND 2	LEVEL	LOCATION	PPM °C				PPM				NO, as N	TIME
			* DO	TEMP	NH <sub>3</sub>	pH	COND	TDS	BOD			
4-13-95	924'	SW	7.0	18.5	<.001 <sup>B</sup>	10.0	60,700	58,312	N/A		1058	
		BOTTOM	3.0	19.0	9.0	8.7	77,500	79,560	N/A		1101	
		TOP	7.0	18.5	<.001 <sup>B</sup>	10.0	61,300	62,567	20.2		1113	
		BOTTOM	3.0	18.5	7.0	8.7	79,900	81,212	17.2		1116	
		TOP	6.5	16.5	<.001 <sup>B</sup>	10.0	61,500	60,299	N/A		1130	
		BOTTOM	3.5	18.0	5.5	8.9	75,600	76,971	N/A		1137	

Depth - All top samples taken 1 ft below top of pond surface  
All bottom samples taken 1 ft from above pond bottom

\* D.O. Meter failed to measure D.O., maybe because of high salt. Meter is being checked out + manufacturer will be called for suggestions, in dealing with high salt. Measured D.O. in Lab in bottle with some probe after some maint. (Results maybe slight off). We are working on the D.O. issue <sup>4/25/95</sup>

⊕ Please consider these numbers <.1 ppm <sup>NW</sup> 4/25/95



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Mck. nze ID	PVNGS No	Date Sampled	Specific Conductance @ 25 C	Total Alk mg/L CaCO3	mg/L OH	mg/L CO3	mg/L HCO3	mg/L Arsenic (diss)	mg/L Barium (diss)	mg/L Boron (diss)	mg/L Cadmium (diss)	mg/L Calcium (diss)	mg/L Chloride	mg/L Chromium (diss)	mg/L Copper (diss)	mg/L Fluoride	mg/L Iron (diss)
E94-0386	1	10/26/94	1792	96	5.0*	40	56	0.005*	0.01*	0.31	0.010*	27	310	0.015*	0.020*	1.4	0.010*
E94-0387	2	10/26/94	54750	280	5.0*	190	90	0.025	0.036	3.9	0.010*	650	15000	0.015*	0.020*	22	0.010*
E94-0388	3	10/26/94	92000	360	5.0*	220	140	0.015	0.020	7.1	0.010*	490	30000	0.015*	0.020*	24	0.010*
E94-0756	4	11/02/94	13140	460	5.0*	5.0*	600	0.044	0.040	4.7	0.010*	150	2500	0.093	0.020*	12	0.010*
E94-0757	5	11/02/94	21100	310	5.0*	5.0*	380	0.045	0.015	6.6	0.010*	210	5500	0.082	0.020*	6.2	0.020
E94-0758	6	11/02/94	10190	190	5.0*	5.0*	230	0.016	0.029	2.2	0.010*	330	2500	0.015*	0.020*	5.0	0.018
E94-0759	7	11/02/94	21300	210	5.0*	5.0*	260	0.015	0.036	2.9	0.010*	780	5600	0.015*	0.020*	2.6	0.024
E94-0760	8	11/02/94	8250	560	5.0*	90	470	0.100	0.035	3.9	0.010*	56	1100	0.015*	0.020*	20	0.010*
E94-0761	9	11/02/94	8510	640	5.0*	5.0*	760	0.055	0.033	5.8	0.010*	10	1500	0.015*	0.020*	19	0.010*
E94-0762	10	11/03/94	41000	110	5.0*	5.0*	130	0.009	0.014	7.4	0.016	1100	14000	0.019	0.020*	2.1	0.010*
E94-0763	11	11/03/94	10530	400	5.0*	5.0*	490	0.029	0.070	5.1	0.010*	99	2300	0.015*	0.020*	7.4	0.010*
E94-10543	12	11/21/94	2245	190	5.0*	10	180	0.042	0.077	1.4	0.010*	9.8	430	0.10	0.020*	5.4	0.010*
E94-11073	16	12/06/94	633	170	5.0*	5.0*	210	0.005	0.094	0.60	0.010*	38	84	0.015*	0.020*	1.6	0.010*

9386 = WRF Reservoir  
 9387 = Evap Pond #1  
 9388 = Evap Pond #2  
 11073 = J Hook

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Page 1

McKenzie ID	PVNGS No.	Date Sampled	mg/L Lead (diss)	mg/L Manganese (diss)	mg/L Mercury (diss)	mg/L Nitrate	pH	mg/L Potassium (diss)	mg/L Selenium (diss)	mg/L Silver (diss)	mg/L Sodium (diss)	mg/L TDS@180C	mg/L Sulfate	mg/L Zinc (diss)	% Cation/Anion
E94-9366	1	10/26/94	0.050*	2.5 0.005*	0.0002*	12	8.8	18	0.005*	0.010*	360	1000	180	0.010	114
E94-9367	2	10/26/94	0.050*	55 0.003*	0.0002*	580	9.1	520	0.030	0.010*	17000	48000	14000	0.010*	103
E94-9368	3	10/26/94	0.050*	100 0.005*	0.0002*	210	8.7	880	0.041	0.010*	31000	88000	28000	0.035	96
E94-9756	4	11/02/94	0.050*	91 0.003*	0.0002*	54	8.1	8.4	0.021	0.010*	3100	9000	1400	0.012	128
E94-9757	5	11/02/94	0.050*	160 0.007	0.0002*	89	8.0	4.5	0.031	0.010*	5000	15000	3100	0.010*	104
E94-9758	6	11/02/94	0.050*	130 0.005*	0.0002*	53	8.0	3.3	0.024	0.010*	2100	7000	1200	0.010*	110
E94-9759	7	11/02/94	0.050*	430 0.005*	0.0002*	140	7.5	2.4	0.058	0.010*	4100	16000	3100	0.010*	104
E94-9760	8	11/02/94	0.050*	5.2 0.005*	0.0002*	37	8.7	1.0*	0.012	0.010*	1500	4000	790	0.010*	109
E94-9761	9	11/02/94	0.050*	6.0 0.005*	0.0002*	66	8.4	1.0*	0.020	0.010*	2200	5700	1100	0.010*	117
E94-9762	10	11/03/94	0.050*	840 0.005*	0.0002*	290	7.4	7.8	0.060	0.010*	9400	32000	4000	0.010*	103
E94-9763	11	11/03/94	0.050*	45 0.029	0.0002*	88	8.4	1.0*	0.005	0.010*	2600	8900	1200	0.010*	117
E94-10543	12	11/21/94	0.050*	5.1 0.005*	0.0002*	18	8.4	1.4	0.005*	0.010*	530	1300	150	0.010*	122
E94-11073	16	12/08/94	0.050*	5.9 0.005*	0.0002*	1.1	8.1	2.7	0.005*	0.010*	96	380	24	0.022	105

\* Detection Limit

# McKENZIE

Arizona Public Service Company-PVNGS  
Attn: T. Hillmer  
P. O. Box 52034, M/S 7626  
Phoenix, AZ 85072-2034

Date Sampled: 09 Dec 94  
Date Received: 09 Dec 94  
Date Reported: 03 Jan 95  
McKenzie I.D.: E94-11068

Client Identification: EP#2 CW

<u>Parameter</u>	<u>Units</u>	<u>Result</u>	<u>MRL</u>	<u>EPA Method</u>	<u>Date Analyzed</u>
Physicals					
pH	S.U.	8.6	N/A	150.1	13 Dec 94
Metals					
Arsenic	mg/L	<0.10	0.10	200.7	20 Dec 94
Barium	mg/L	0.06	0.05	200.7	20 Dec 94
Cadmium	mg/L	<0.02	0.02	200.7	20 Dec 94
Chromium	mg/L	<0.05	0.05	200.7	20 Dec 94
Lead	mg/L	<0.05	0.05	200.7	20 Dec 94
Mercury	mg/L	<0.0002	0.0002	245.1	15 Dec 94
Selenium	mg/L	<0.10	0.10	200.7	20 Dec 94
Silver	mg/L	<0.05	0.05	200.7	20 Dec 94
Non-Metals					
Ammonia-Nitrogen	mg/L	3.3	0.05	350.3	22 Dec 94
Nitrate/Nitrite as N	mg/L	180	0.10	353.2	29 Dec 94

MRL = Minimum Reporting Limit

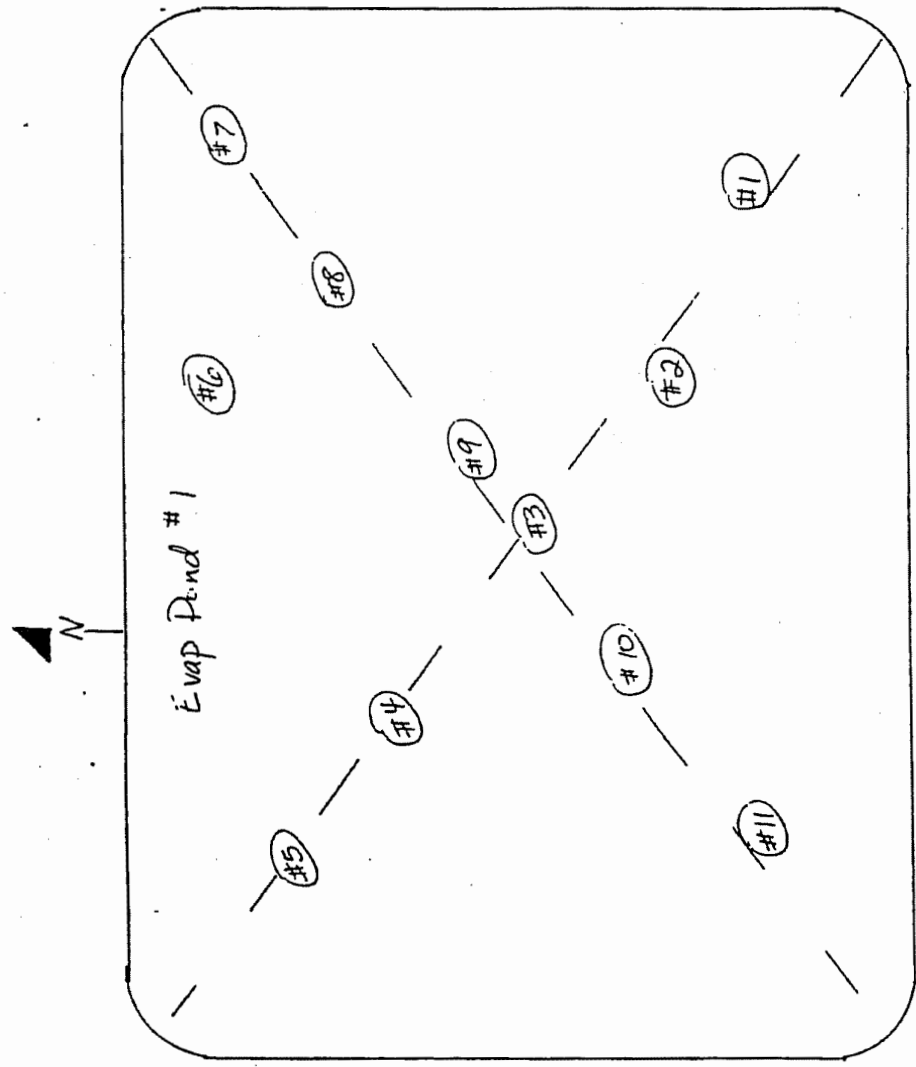
*Maja Chadwick*  
Maja Chadwick, Inorganic Lab Manager

APS11065.DOC SJ

These are our sampling locations for our samples, both sludge & chemicals.

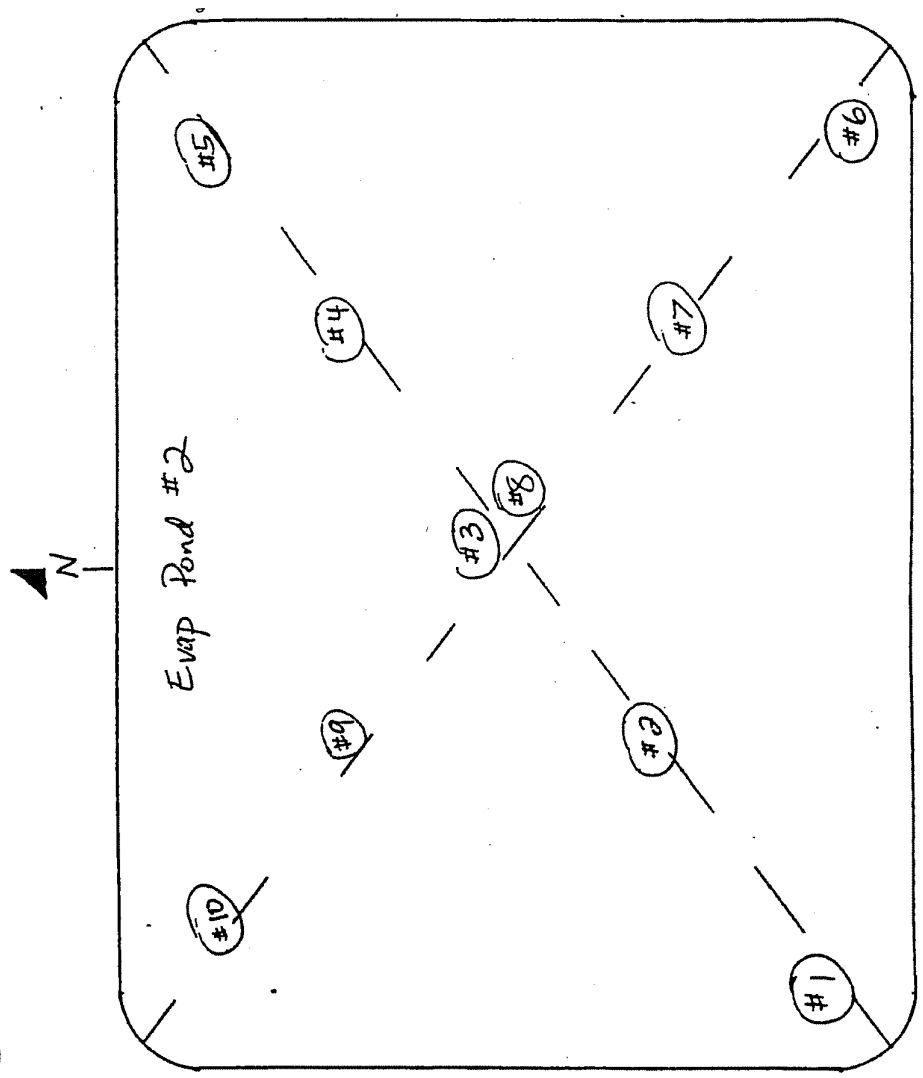


BY Louis Drinovsky	DATE 3-30-95	SUBJECT Evap Pond 1 Sludge Samples (taken 3-16-95)	SHEET NO 1 of 1
CHECKED BY	DATE		JOB NO.



Evap Pond #1 bottom sludge samples collected at indicated locations on 3-16-95 between 1020 and 1210.

CHECKED BY <i>Louis Drinovsky</i>	DATE <i>2-21-95</i>	SUBJECT <i>Evap Pond 2 sludge samples</i> <i>(taken 2-17-95)</i>	SHEET NO. <i>1 of 1</i>
CHECKED BY	DATE	SUBJECT	JOB NO.



Evap Pond #2 bottom sludge samples collected at indicated locations  
 on 2-17-95 between 0900 and 1145.

Meeting held with Arizona Game & Fish and ERA representatives.

In attendance were Ron Engel-Wilson, Mar Dahlberg and Philip Smith of Az. Game & Fish and Gary DeClue, Howard Doyle and Thomas Hillmer of APS.

The meeting was held on December 8, 1994 at PVNGS.

The meeting center around possible actions APS could take to reduce the duck kill currently being experienced at PVNGS. It was generally felt by the Game & Fish personnel that the condition should clear itself up with in the next few weeks. APS requested other possible actions that could be taken to accelerate the termination of the current situation. These options will be evaluated as data is collected to determine if any actions would have a positive impact on the situation.

#### OPTIONS FOR CONTROLLING/REDUCING DUCK KILL

- 1)USE CHEMICALS TO KILL BACTERIA
- 2)REDUCE ORGANIC LOADING
- 3)REMOVE OR KILL SHRIMP
- 4)STOCK POND WITH FISH TO FEED ON SHRIMP AND ALGAE
- 5)CHANCE DUCKS OFF EVAP PONDS
  - A)USE ROCKETS/AIR CANNONS
  - B)USE RADIO CONTROLLED AIR PLANE
- 6)MONITOR AND COLLECT
  - A)DO BACKGROUND DATA COLLECTION TO UNDERSTAND CAUSE OF PROBLEM
  - B)CONTINUE COLLECTING DUCK AND MONITOR EVAP POND TEMPERATURE

#### BACKGROUND SAMPLES TO BE TO RAN:

CHLORIDE  
TEMPERATURE PROFILE  
HYDRAZINE  
OXYGEN  
HEAVY METALS  
BOD & COD

WE ARE TO COLLECT DUCKS EVERY DAY AND ONCE A WEEK CONTACT GAME & FISH ON OUR RESULTS OF WHAT HAS BEEN COLLECTED.

APS will collect water samples for the above mentioned chemical analysis and continue to collect dead ducks. Arizona Game & Fish will supply results of testing that they are having done on both the water from Evap Ponds and the ducks. They also will pick up what we have collected.

## Duck meeting Minutes

5/9/95 held meeting to discuss status of duck mortality efforts. After discussion of the status the following actions were assigned:

Tom Hillmer will continue efforts with UofA to obtain scope of services and an agreement to do work for APS.

Tom Hillmer will contact Chemistry (Larry Johnson) and determine which Unit is doing Retention Basin analysis this month and see if they will do hydrazine analysis. Will also determine sample size and contact person of Chemistry to have sample delivered to. If possible sample to be pulled tomorrow with regular samples. *< 50.0 PPB in each Pond*

Bill LaBelle will write-up a discussion of why pumpback is not going to create a problem with results.

Bill LaBelle will be scheduling a meeting to discuss WRF and Evap Pond issues and at that meeting discussions on why evap pond levels are not equal and will not be equal in the future. In order for the levels to be equal changes in operational philosophy in operation of the evap ponds will be required.

During our sampling effort over the summer split samples will be taken for nitrite and nitrates to verify that our kit results are adequate. Bill LaBelle thought that our BOD and DO results were adequate and no additional offsite samples would be needed.

Tom Hillmer will put together data packets for UofA to help them in understanding the environment in the evap ponds.

Tom Hillmer will schedule a meeting with US Fish & Game and Az. Game & Fish as soon as input is received from UofA and it is reviewed by the team.

Additional information. New level in Evap Pond 1 is a minimum of 925 feet and 922 feet (previous level was 918 feet) for Evap Pond #2. These levels are required due to the increase of activity that was recently allowed. These levels will not allow WFR to operate with a single pond since the maximum volume will not be able to be contained in one pond. Additional analysis would be required at the time of liner repair if either of the ponds needed to be drained. The analysis is costly and takes some time which will affect the time to do the job. The current agreement to keep the ponds near the same level has occurred since the plan to drain Pond #1 down to the level necessary to allow inspection of the blowdown line has not yet occurred and the level will remain near the current level or at the minimum level required.

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To: Distribution 6/29/95

Subject: Meeting Minutes for AZ. Game & Fish meeting

Attendees: From Arizona Game & Fish Department:  
Phil Smith, Ron Engel-Wilson and  
From University of Arizona:  
David Moore and Kevin Fitzsimmons  
From Arizona Public Service:  
William LaBelle, Mannie Carpenter and Thomas Hillmer

Location: The meeting was held at the offices of Arizona Game & Fish Department, 2221 W. Greenway Road, Phoenix, Arizona.

Agenda: See attached agenda that was handed out at meeting.

Meeting: The meeting followed the agenda that is attached. A general discussion on the aspects of what our studies was covered. Mr. Moore and Mr. Fitzsimmons discussed their portion of the evaluation. They also discussed the samples that PVNGS gave them just prior to the meeting. Arizona Game and Fish said they were satisfied with the program that we are engaged in and had no suggestions on what else should be evaluated at this time. They suggested that our next meeting not take place until mid to late October, 1995. At that time we will several months of data and possible trends to review.

We also discussed the past sample results. They said that they had not seen the last sample report from the National Wildlife Health Center and would like to have a copy of that to review. It was requested that if something unusual or able normal develop or be revealed during the next few months of sampling that we let them know. Game & Fish said that they would inform US Fish & Wildlife of the details of the meeting. No other action were generated as a result of this meeting. A copy of the last laboratory report will be included along with the minutes going to Arizona Game & Fish.

Dist. Attendees  
G. DeClue  
H. Lesan  
W. Doyle



**Arizona Public Service Company**

PALO VERDE NUCLEAR GENERATING STATION  
P O BOX 52034 • PHOENIX ARIZONA 85072-2034

291-00869-TPH

July 05, 1995

To: Tom Hillmer  
APS/PVNGS  
M.S. 7626

From: T.P. Hillmer  
Arizona Public Service/PVNGS  
P.O. Box 53999  
Phoenix, Arizona 85072-3999  
M.S.7626  
602)393-5765

**Subject: Meeting Minutes for Az. Game & Fish meeting**

Attendees: From Arizona Game & Fish Department:  
Phil Smith, Ron Engel-Wilson and Marc Dahlberg  
From University of Arizona:  
David Moore and Kevin Fitzsimmons  
From Arizona Public Service:  
William LaBelle, Mannie Carpenter and  
Thomas Hillmer

Location: The Meeting was held on June 28, 1995, at the  
offices of Arizona Game & Fish Department,  
2221 W. Greenway Road, Phoenix, Arizona 85023-4312

Agenda: See attached agenda that was handed out at meeting.

Meeting: The meeting followed the agenda that is attached.  
A general discussion on the aspects of what our  
program was covered. Mr. Moore and Mr. Fitzsimmons  
discussed their portion of the evaluation. They  
also discussed the samples that PVNGS gave them  
just prior to the meeting. Arizona Game & Fish  
said they were satisfied with the program that we  
are engaged in and had no suggestions as to what  
other items should be evaluated at this time. They  
suggested that our next meeting not take place  
until mid to late October, 1995. At that time we  
will have several months of data and possible  
trends to review.

---

We also discussed the past sample result. They said that they had not seen the last sample report from the National Wildlife Health Center and would like to have a copy of that to review. It was also requested that if something unusual or abnormal develops or is revealed during the next few months of sampling that we let them know. Game & Fish said that they would inform U.S. Fish & Wildlife of the details of the meeting. They also invited our team members to attend a disease identification training class they will be having August 14 and 15, 1995. This is the first time in 5 years that it will be offered. A portion of the class will be taught by Linda Glaser, from the NWHC, who is the individual who has been working on our duck necropsies. No other actions were generated as a result of this meeting. A copy of the last laboratory report will be included along with the minutes going to Arizona Game & Fish.

TPH/pak



## GAME & FISH DEPARTMENT

2221 West Greenway Road, Phoenix, Arizona 85023-4399 (602) 942-3000

**Governor**  
Fife Symington

**Commissioners:**

**Chairman, Arthur Porter, Phoenix**  
Nonie Johnson, Snowflake  
Michael M. Gullightly, Flagstaff  
Herb Guenther, Tucson  
Fred Belman, Tucson

**Director**

Duane L. Shroufe

**Deputy Director**

Thomas W. Spalding

July 13, 1995

8 45

T.P. Hillmer  
Arizona Public Service/PVNGS  
P.O. Box 53999  
Phoenix, AZ 85072-3999  
M.S. 7626

Dear Mr. Hillmer:

I have reviewed the minutes of the meeting of June 28, 1995. I concur with the minutes. I feel that as long as nothing unusual or abnormal develops, the collecting of baseline water quality data is the appropriate course of action at the present. Hopefully, the individuals at the University of Arizona will identify the problem before the ducks return in the fall. This study in progress will allow us to respond to any problems quickly. Thank you for your cooperation.

Sincerely,

Ronald Engel-Wilson  
Small Game Supervisor  
Game Branch

REW:11

---

To: Gary DeCLue  
Subject: Meeting Minutes

Meeting held at Az. Game & Fish offices on October 20, 1995.

Attendees: AZ. Game & Fish  
Mr. Phillip Smith  
Mr. Marc Dahlberg  
University of Arizona  
Dr. Ed Glenn  
Arizona Public Service  
Mr. Gary DeClue, Mr. Thomas Hillmer and Mr. Bill LaBelle

The meeting was held to review APS's efforts at characterizing the ponds located at the Palo Verde Nuclear Site near Tonopah, Arizona. These ponds are frequented by migratory birds during the winter months. In an effort to identify any adverse factors that might affect the birds an increased sampling program was begun in March of 1995. On a monthly basis both chemical and biological samples were taken and analyzed. The chemical and biological analyses were presented at the meeting. The results to date are inconclusive. However, the biological data show no adverse trends nor have they identified any organisms of concern. UofA suggested that since the flows are now being routed mainly back into Evap Pond #1 that a weekly sample be taken for the next month to see what change the influence has on the algae population. The detailed sample results are contained in an October report entitled "Evaporation Pond Investigation Program Status Report" which is attached.

Action items that were generated as a result of the meeting are as follows:

- 1) Copy of sample data and UofA biological report will be forwarded to AZ. Game & Fish and US Fish & Wildlife.
- 2) In November the annual groundwater organic samples are due to be taken. As part of that program composite samples of the water and sludge will be taken for comparison.
- 3) A meeting will be scheduled for December 15, 1995 to review all the data that is available at that time. It is hoped that the results of the November organic analysis will be complete by then so it can be reviewed.
- 4) AG&F recommended that we develop a contingency plan to keep the birds off the ponds should mortalities began this winter. They suggested that a 12ft boat and 10 hp gas motor might produce enough noise and have the speed to chase the birds off the Evap Ponds. If it does not work then the use of guns or pyrotechnics noise makers would be needed.
- 5) UofA will collect samples once a week for the next four weeks rather than once per month. This increased sampling frequency will begin on October 24, 1995.

---

To: Gary DeCLue  
From: Thomas Hillmer  
Date: December 20, 1995

Subject: Meeting Minutes

Meeting held at Arizona Game & Fish offices on December 15, 1995.

Attendees: Arizona Game & Fish (AG&F)  
Mr. Philip Smith  
Mr. Marc Dahlberg  
U.S. Fish & Game (USF&W)  
Mr. Kirk  
University of Arizona (UofA)  
Mr. David Moore  
Mr. Kevin Fitzsimmons  
Arizona Public Service  
Mr. Thomas Hillmer  
Mr. Mannie Carpenter  
Mr. Bill LaBelle

The meeting was held to review additional data collected since the October 24th 1995, meeting. PVNGS ponds are frequented by migratory birds during the winter months. In an effort to identify adverse factors that might affect the birds an increased sampling program was begun in March of 1995. On a monthly basis both chemical and biological samples were taken and analyzed. At the October meeting UofA suggested that the changing of inflows into the evap ponds might affect the ecosystem of the ponds and that additional sampling, for at least 4 weeks, might be beneficial. Additional biological sampling did take place once per week over a seven week interval ending on November 29, 1995. The chemical and biological analyses covering this time frame were presented at the meeting. Copies of the UofA Summary of Observations Report were handed out at the meeting. The results to date are inconclusive. However, the biological data show no adverse trends nor have they identified any organisms present in sufficient quantity to be of concern. The detailed chemical sample results and graphs are attached.

We briefly discussed the contingency plan that was requested at the prior meeting. We informed AG&F that all arrangements had been made and that we had secured the use of a boat and motor from UofA. The boat and motor are at PVNGS should the plan be implemented.

AG&F and the USF&W representatives, when asked, could not identify any additional actions that needed to be taken other than what is contained in the action section below. Action items that were generated as a result of the meeting are as follows:

- 1) The peak ammonia concentrations for sample sites that are coincident with wind blown

---

accumulations of debris and algae remains were of concern. UofA was requested to do a literature search to determine if concentrations of ammonia as high as 70 ppm are toxic to waterbirds.

2) Az. Game & Fish wanted to know the concentration of un-ionized ammonia. Bill LaBelle will perform calculations to determine the percentage and thus the concentration.

3) A meeting will be scheduled for April 16, 1996 to review all the data that is available at that time. This will represent a review of one year of chemical data and 9 months of biological data.

4) PVNGS will contact AG&F and USF&W if mortalities begin. Additional meeting will be scheduled if changes in conditions warrant.



Arizona Public Service Company  
COMPANY CORRESPONDENCE

291-01065-TPH  
DATE: May 01, 1996  
TO: Gary DeClue  
Sta #: 7626  
Ext #: 6401  
FROM: Thomas Hillmer  
Sta #: 7626  
Ext #: 5765 *Tom*

SUBJECT: MEETING MINUTES AT ARIZONA GAME & FISH OFFICES ON APRIL 26, 1996

Attendees:	Arizona Game & Fish (AG&F) Mr. Philip Smith	U. S. Game & Fish (USF&W) *Mr. Kirk could not attend*
	University of Arizona (UofA) Dr. Ed Glenn	Arizona Public Service (APS) Mr. Thomas Hillmer Mr. Bill LaBelle

The meeting was held to review additional data collected since the December 15, 1995 meeting. PVNGS ponds are frequented by migratory birds during the winter months. In an effort to identify adverse factors that might affect the birds an increased sampling program was begun in March of 1995. On a monthly basis both chemical and biological samples were taken and analyzed. The chemical and biological analyses covering this time frame were presented at the meeting. Copies of the presentation material and the UofA Summary of Observations Report that were handed out at the meeting are attached. The results to date are inconclusive. However, the biological data show no adverse trends, nor have they identified any organisms present in sufficient quantity to be of concern.

I briefly discussed the APS plan to discontinue the additional sampling and biological reviews that have been in the progress for more than one year. Mr. Phil Smith said that "he agreed that we could only sample so long and that it seemed to him to be appropriate to stop". I informed AG&F that we wanted to setup a meeting for mid June or July to present our final report. We requested that AG&F coordinate with USF&W the date to ensure that USF&W can attend. Mr. Phil Smith said he would and contact me with the date.

At the last meeting UofA was requested to do a literature search to determine if the high concentrations of ammonia are toxic to waterbirds. At the meeting UofA reported that those concentrations were not harmful to waterbirds. They even stated that those concentrations would not be harmful to most fish. No further action was requested on this issue.

Action items that were generated as a result of the meeting are as follows:

- 1) Az. Game & Fish will contact USF&W and determine the best date for the final meeting. Mr. Phil Smith will contact me when he has determined the date.
- 2) PVNGS will contact AG&F and USF&W if mortalities occur during the remaining sampling period.

TPH  
Attachments

cc:  
Bill LaBelle  
1000.3.2

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**PALO VERDE NUCLEAR GENERATING STATIONS  
EVAPORATION PONDS MONITORING PROGRAM**

**PRESENTATION**

**PAST HISTORY by Tom Hillmer**

**CHEMICAL DATA REVIEW by Bill LaBelle**

**MICRO-ORGANISMS by Dr. Ed Glenn  
of University of Arizona**

**FUTURE ACTIONS by Tom Hillmer**



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## HISTORY

**December 1994 & January 1995 duck mortalities occurred**

**In March developed Evap Pond Monitoring Program**

**Goal of program is to prevent reoccurrence**

**Work with the concurrence of Arizona Game & Fish  
and US Fish & Wildlife**

**Presentation developed to inform  
Az Game & Fish and U.S. Fish & Wildlife of current status**

**No reoccurrence of the mortalities has occurred over the past year**

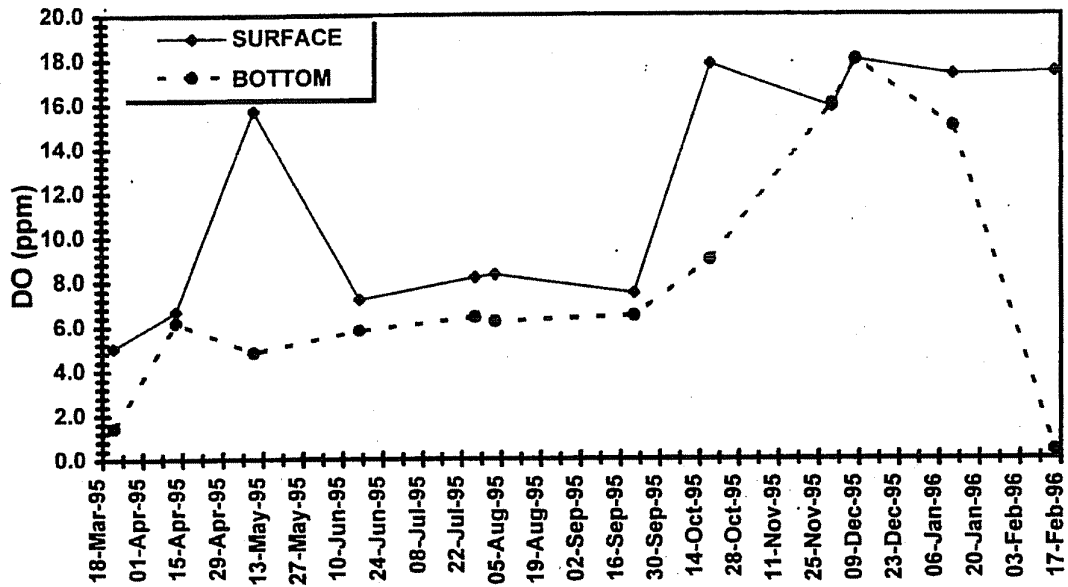
**On April 4th about a dozen Black-necked Stilts visited the site for 3 days  
this is the first sighting of Stilts since August 30, 1995**

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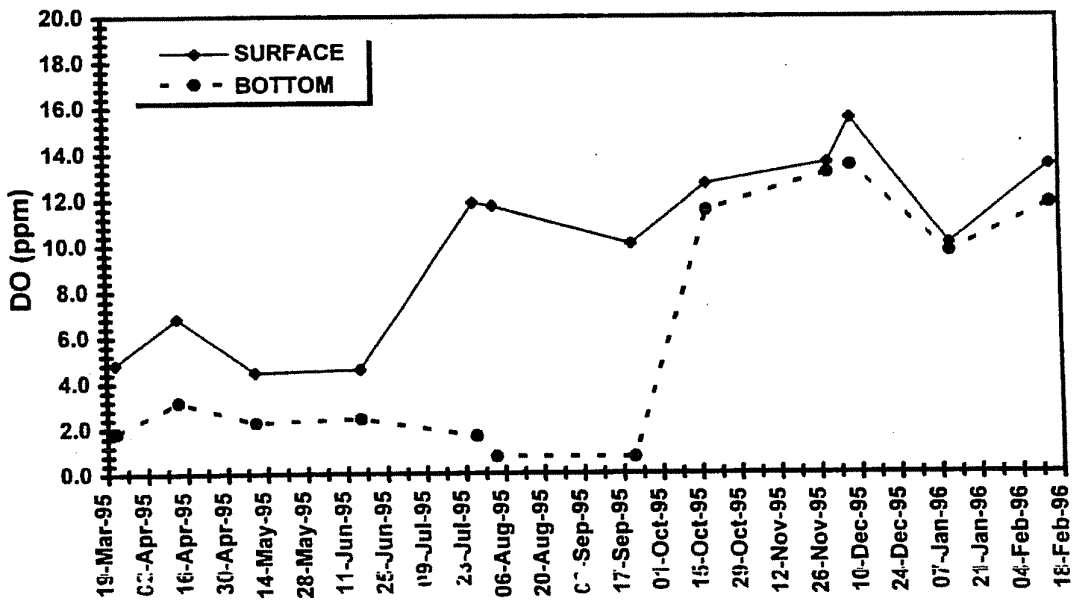
**CHEMISTRY**

**TRENDS AND GRAPHS**

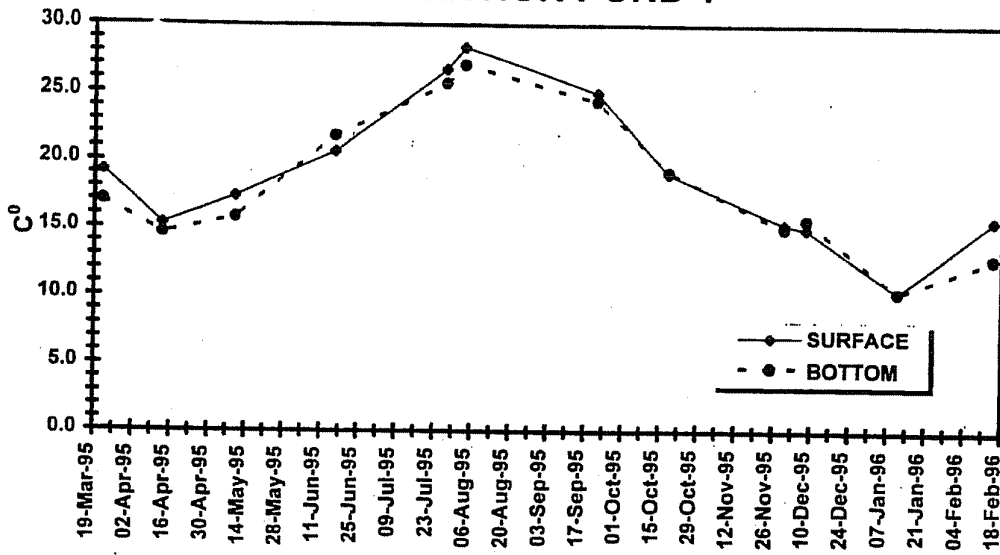
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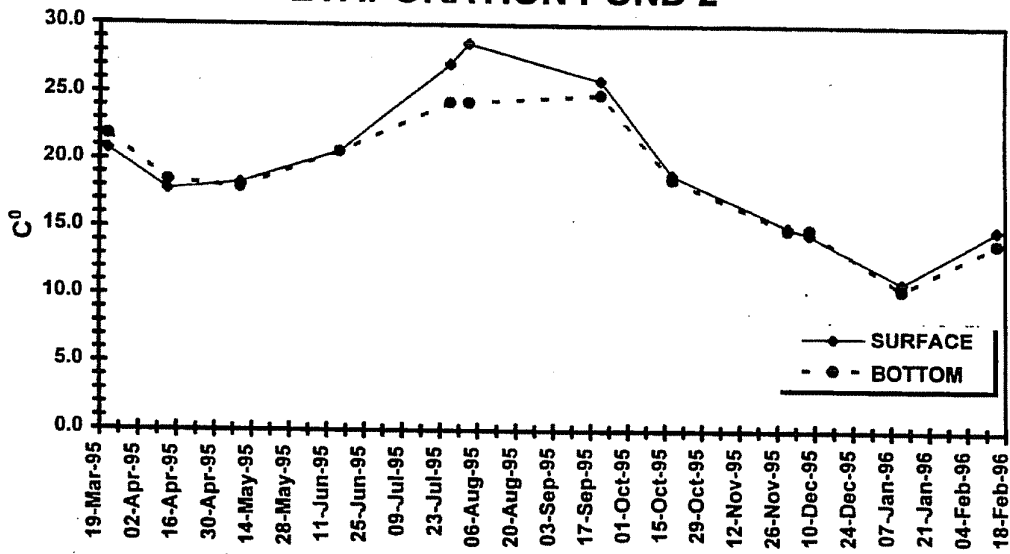
## AVERAGE DISSOLVED OXYGEN EVAPORATION POND 2



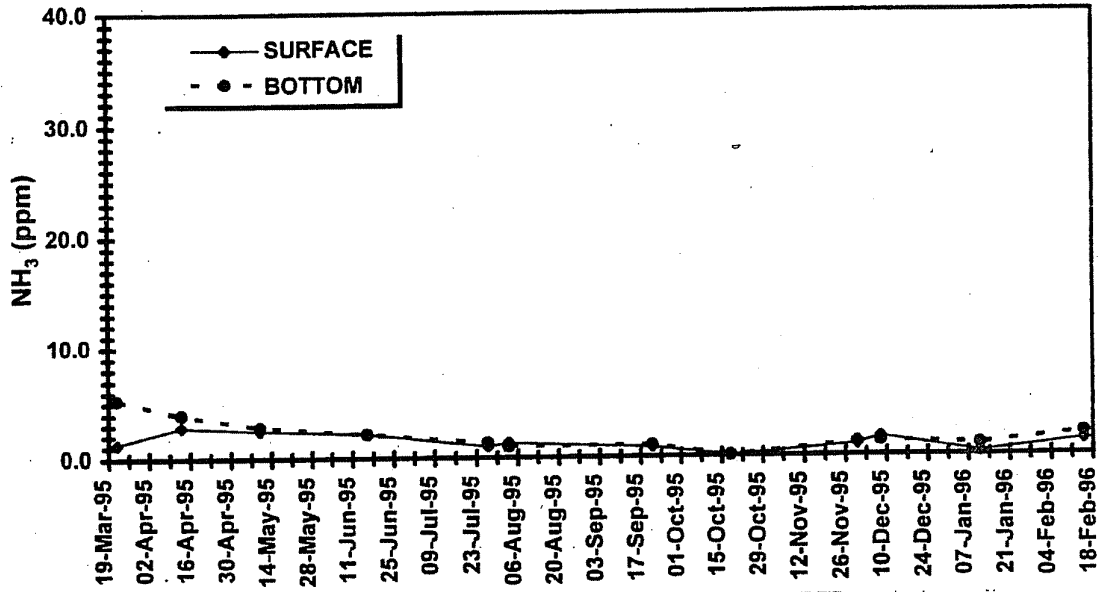
### AVERAGE TEMPERATURE EVAPORATION POND 1



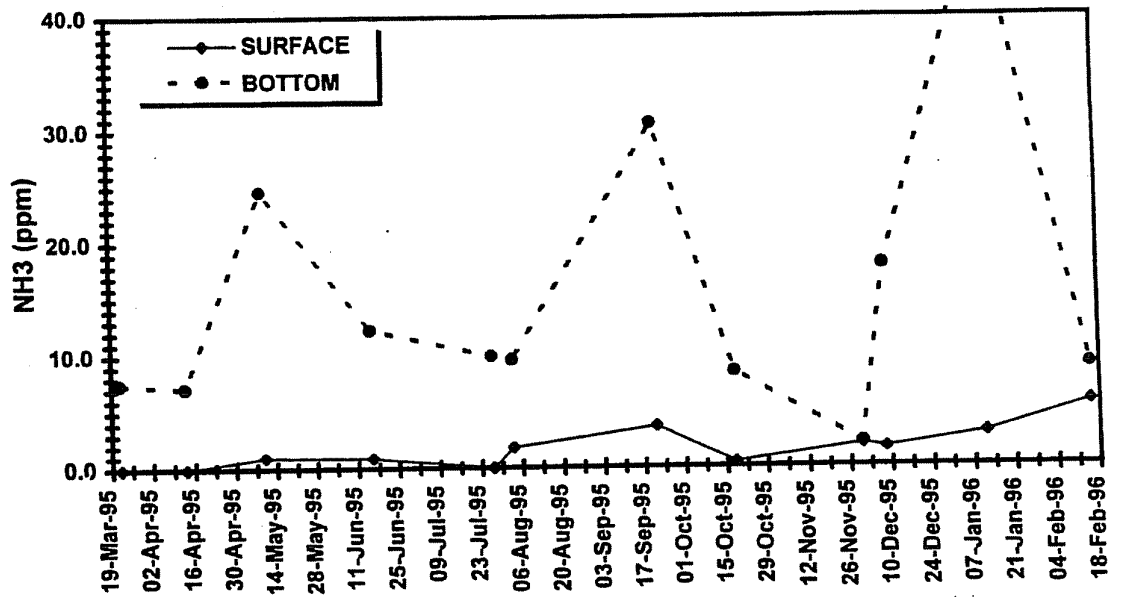
### AVERAGE TEMPERATURE EVAPORATION POND 2



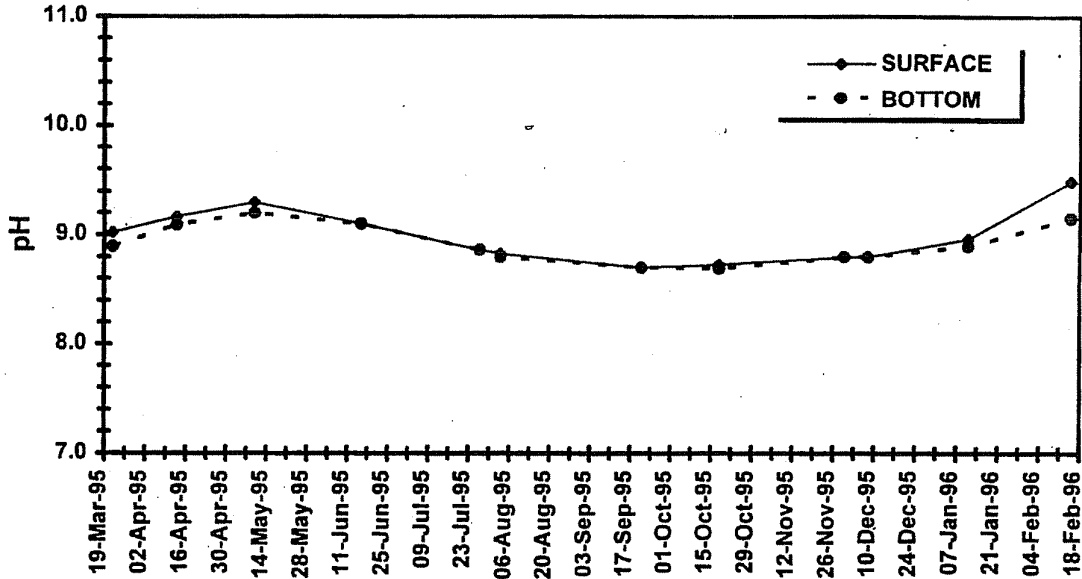
## AVERAGE AMMONIA EVAPORATION POND 1



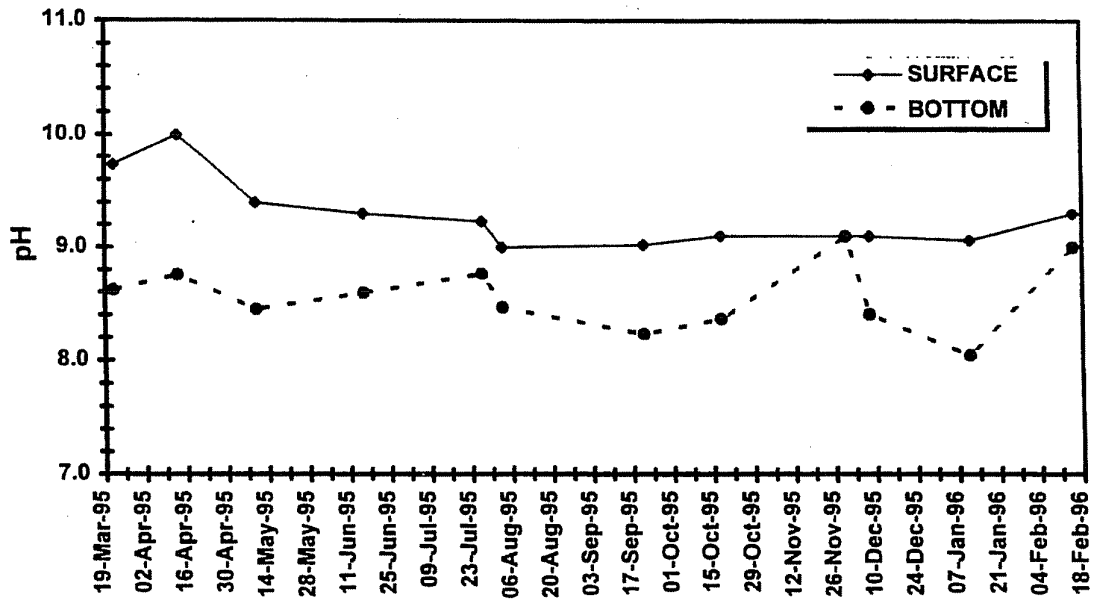
## AVERAGE AMMONIA EVAPORATION POND 2



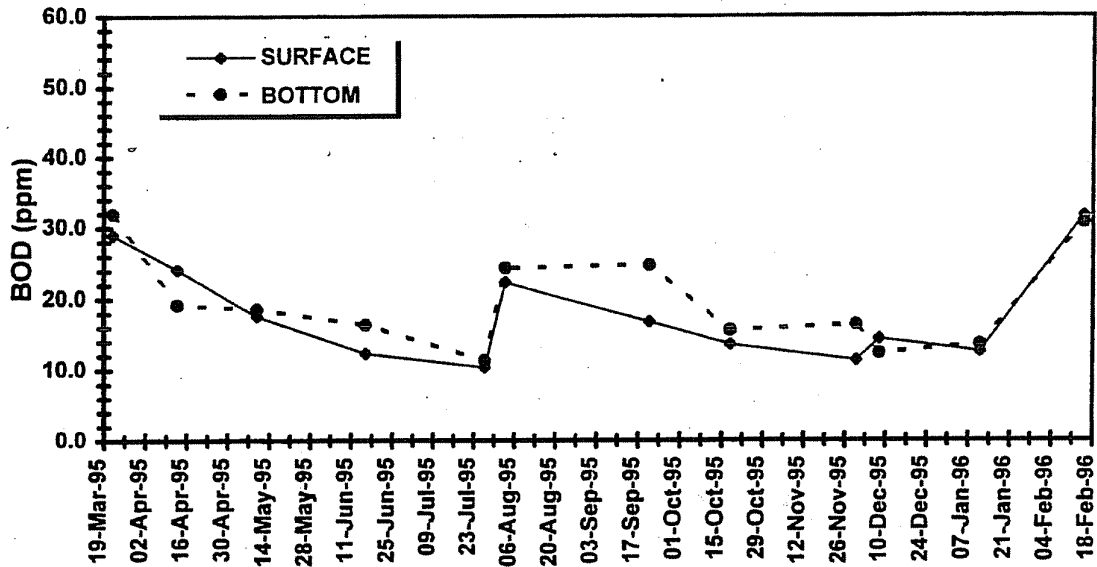
## AVERAGE pH EVAPORATION POND 1



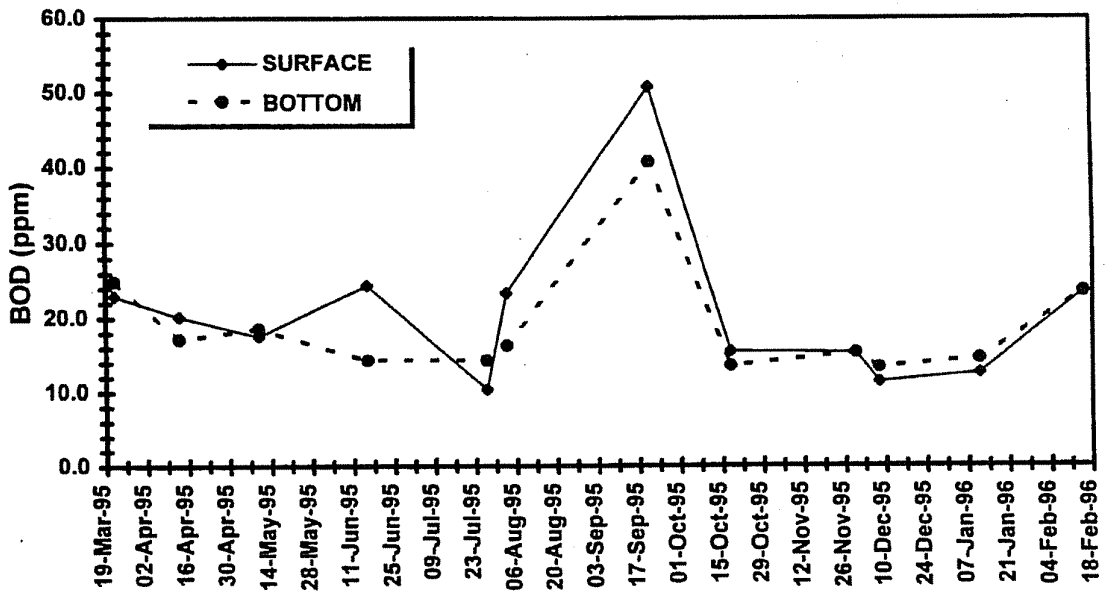
## AVERAGE pH EVAPORATION POND 2



## BIOLOGICAL OXYGEN DEMAND EVAPORATION POND 1



## BIOLOGICAL OXYGEN DEMAND EVAPORATION POND 2



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**UNIVERSITY OF ARIZONA  
BIOLOGICAL DATA**

**PRINCIPLE ALGAE  
Chaetoceros**

**EVAPORATION PONDS**

**Total Algae Count Ranged 60,000 to 500,000 Cells/ml  
Other Organisms such as Brine Shrimp & Water Boatmen  
Remained in Low Abundance Since the Beginning of the Year**

**WRF RESERVOIR**

**Total Algae Count Ranged 1,000 to 8,000 Cells/ml**

**Overall, EVAPORATION PONDS appear healthy  
from a Biological perspective**



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## **FUTURE**

**Continuing efforts at Evaporation Pond characterization  
with final sampling taking place in June**

**Plan to write final report after June sampling complete**

**Present final report in late June or July**

**Contingency plan will remain in place for UofA Vet Lab for necropsy**

Phone Note

Phone notes from 2/2/95 with Linda Glaser of the National Wildlife Health Center in Madison, Wisconsin. I called to review the diagnostic services case report numbers 13249 and 13230. These reports were given to APS during a meeting with AZ Game & Fish and the US Fish & Wildlife Service held on 2/1/95. She reviewed the data and reaffirmed that the cause of death in most of the ducks probably due to drowning. They had not identified the cause but had ruled out specific diseases. I ask her if she could determine what the ducks were feeding on prior to death. She reviewed the stomach and gizzard contents for each duck that they have analyzed. The lack of any contents suggested that they may have been sick for a period long enough for them to have passed all food or that they died prior to feeding. The more likely would be that they died after they digested the food source. She said that the final results were not complete on the last set of ducks case number 13278 but the result to date were the same as for the other ducks studied. She suggested that we try to supply fresh ducks that we ship direct in overnight fed express. That might help in the analysis. She also said that we need to get an expert to review the water organisms and see if they are toxic or could concentrate toxins. She also wanted to see what we have analyzed for in the past. She said that she could do a liver scan for organics to see if that might have concentrated a toxin.

Associated phone numbers US Fish & Wildlife

Linda Glaser (608) 271-4640 fax (608) 264-5431  
Kirk King (602) 640-2720  
Cynthia Martinez (602) 640-2720  
Mike Lucckino (602) 379-6443 (enforcement)

Arizona Game & Fish

Ron Engle-Wilson 789-3353  
Phil Smith 789-3354  
Marc Dahlgerg 789-3260

California Fish & Game

Dan Connelly (916) 653-6640  
Bob Hare (916) 657-4609

Phone Notes from 2/15/95: Talked to several professors from U of A about doing a potential study to assist APS in determine the cause of the duck mortalities that previously occurred at PVNGS. Was told that U of A was already working on a proposal for an investigation of the die-offs as requested by Fish & Wildlife. They said that the proposal should be done within a week. They also said that since they were requested to write a proposal that they did not want to talk to us until they had given it to Fish & Game. Told them that we were not getting any more die-offs and that the pond had turned over and that should be factored into their proposal.

Received fax from Dr. DeStefano of U of A a copy of proposal that was sent to Fish & Game and APS. Proposal will be reviewed with plant staff and Bill Staudenmaier and a meeting setup to discuss it with Fish & Wildlife and Game and Fish personnel.

From: Z21248 --APSVMB60 Date and time 02/02/95 15:24:26  
To: Z99013 --APSVMB60 DE CLUE, GARY L. Z47777 --APSVMB60 HILLMER, THOMAS P.  
Z33507 --APSVMB60 DOYLE JR, WARNER H

---

OM: Mannie Carpenter  
subject: MOHAVE POWER STATION

I spoke with Ken Smith at Southern California Edison's Mohave Power Station this afternoon regarding their experience with ducks. Mohave is located near Laughlin, Nevada and had evaporation ponds similar to ours. He said that they have a large number of waterfowl that occupy their evaporation ponds during the winter, including a large number of geese. He said that he had read about our duck problems in a newspaper article, which had prompted him to take a look at their ponds. He reported that they have never encountered a problem like ours, though.

Mohave utilizes nine evaporation ponds, which are smaller in size than ours. The source of their cooling water is from the Colorado River, which typically contains less than 500 ppm TDS when it comes into their plant. They routinely allow their evaporation ponds to evaporate to dryness and remove the solids for onsite disposal. They have not had any problems with their sludge exceeding TCLP limits. He said that he would send me a fax of their typical evaporation pond water analysis. He also reported that they have significant quantities of brine shrimp and other aquatic creatures in their evaporation ponds as well.

Ken's telephone number is (702) 298-1197.

---

Update of duck issues. On 4/18/95 submitted status report on duck mortality issue. Report and direction approved by upper management with some minor comments on additional info needed. Scheduled meeting with team for 5/7/95 to review comments.

4/24/95 called UofA veterinary school Dr. Noon at 621-2356 and discussed capabilities. He said he was not involved in the study that was proposed but that they could do necropsy work and were currently working on developing the capability to determine the toxicity of blue-green algae. He stated that very few people in the US knew much about this area. This could be a good source of information if we do start having ducks die and we need a local lab to do the study or confirm the NWHC work. They also could give us better response time so little delay in analysis occurred as has happened with NWHC.

Other numbers that Dr. Noon gave me were for Dr. Gerba 621-6906 or 621-6911 he may be the individual who did the 1991 study.

4/24/95 called Dr. Carol McIvor 621-1105 also 621-1959 or 621-1193 but not in. She wrote the first draft scope of services. Will discuss previous scope and fax copy of NWHC letter to her to use as what we need to assist in scope development.

4/24/95 received a call from Phil Smith of Game & Fish. He asked what our status was and what we had planned. I told him I had just talked to UofA and was waiting to talk to the original individuals who gave us a proposal. I told him that we had put together our proposed plan and after we had talked and received a new scope from UofA we would set a meeting. I told him I thought that late May probably would be the time frame and I would get back to him. I requested that he give me any information on flyways and histories of bird deaths that might have occurred at the same time in nearby states. He said that the NWHC puts out a report and that he would send a copy of the latest that he had for me to look at. He also said that only generalized flyways exist and that no specific one would be available in Arizona. He said that historically there was a flyway associated with the Gila River but that information was very nondescriptive and more hearsay than documented fact.

---

Phone Notes: 6/5/95

Talked to Dr. Noon who said that his director suggested that they do not handle the contracting of work for the other algae lab that he has suggested. He said that he had talked to Dr. Lightener, a renowned shrimp man who said that David Moore at the Environmental Research Laboratory at the Tucson airport could be used to do initial identification and collection of algae and invertebrates. He is out of town until after June 19, 1995, and I should contact him then. He said that from his initial discussions that he could be available one day a week with an estimated cost of about \$12,500 per year. They will want a contract in place. They are somehow connected to the UofA and may have been planned on being used if needed by the UofA Fisheries Research Department or whomever they are. David Moore's phone number is (520) 741-1990.

Dr. Noon said that they still would be the ones to do duck mortalities and would send concentrated algae samples off to the laboratory in Illinois that has the capability to do toxin identifications. He will not need a contract and will send any info on sampling and cost at his lab to me some time in the future. He suggested that we give him the data to file so if we do need work they will have all the info necessary to help id the cause. Based on this I will talk to Moore as soon as I can and will not set a meeting with Az. Game & Fish until I have some info about his capability and when he can do some work for us.

6/8/95

Talked to Dr. Noon about specifics of sampling and also latest information on analysis. He said that he had talked to the Illinois Lab and that they supplied some prices and additional information on the algae. He suggested the following program based on the new information:

1) Contract with David Moore to do routine sampling. The Ill. Lab recommended weekly due to the rapid change in the toxic nature of the blue/green algae. He said Moore is capable of identifying both algae and invertebrates. This would give some background and let you know when conditions were ripe for toxin production.

2) Perform Bio Assay when blue/green algae found dead. This may also be done when we have a brine shrimp dieoff occurs. This will tell if the blue green is fatal. They will inject mice and determine a LD for them. If they do die at a low concentration then samples will be sent to the Illinois Lab to determine which type of algae and which exact toxin were the cause. These analysis cost \$875.00 per sample.

3) The Illinois Lab will not do routine samples but he thinks they will do one or two background samples which should give them a better idea what to look for if we have a brine shrimp dieoff or some other cause to believe toxins are being produced. When we have this indication we need to send samples off site to Ill. The vet lab will do this if we deliver to them. Price depends on effort to determine toxin. Cost could be about \$1000.00 to more per sample.

Instructions:

For ducks, pack in double bags in ice but do not freeze. Deliver same day as died if possible.

For Algae, 1) 10 ML SAMPLE 1/2 CONCENTRATED ALGAE AND 1/2 BUFFERED FORMALIN.

2) 1 LITER OF CONCENTRATED ALGAE - FROZEN

3) 100 ML CONCENTRATED SAMPLE KEPT ON ICE FOR CULTURE

To concentrate take 3 or 4 (if not more) liters of pond water and filter via some kind of filter paper such as a coffee filter to concentrate the algae. Best is to sample down wind to accumulate as much concentrated algae as possible prior to filtering.

Item one (10 ml) is what would be needed on the regular basis for algae IDing and item 3, I think, would be used for mice testing. With items 1, 2, and 3 being taken for the Ill. Lab when needed.

When samples are taken identify time, temperature, pH on samples also if possible note wind direction and speed.

The Illinois Lab guy could fly out during a die off of ducks if absolutely necessary but it would be costly.

**Hillmer, Thomas P.(THILLMER)**

---

**From:** Labelle, William P.(WLABELLE)  
**To:** Hillmer, Thomas P.(THILLMER)  
**Subject:** RE: Chem. Sum. , Duck Mortality, Attachment  
**Date:** Thursday, July 18, 1996 2:13PM

As follows:

#1 to #2, 1-11-95

#2 to #1, 9-28-95

#1 to #2, 3-7-96

# 2 to #1, 6-14-96 Please make a permanent note of it. Thanks Bill

---

**From:** Hillmer, Thomas P.(THILLMER)  
**To:** Labelle, William P.(WLABELLE)  
**Subject:** RE: Chem. Sum. , Duck Mortality, Attachment  
**Date:** Wednesday, July 17, 1996 10:28AM

Can you get me the dates or approximate dates that the flows were switched between the ponds. I did not record those anywhere. I just passed them along to UofA.

---

**From:** Labelle, William P.(WLABELLE)  
**To:** Hillmer, Thomas P.(THILLMER)  
**Subject:** Chem. Sum. , Duck Mortality, Attachment  
**Date:** Monday, July 15, 1996 3:25PM

Tom,

Sorry again! Here's my shot at a summary. Please review and critique. I will be available to make changes from about 0930 til we leave to go to Game and Fish. Also, please let me review our final rendition of the graphs before we go. Thanks Bill

<<File Attachment: DUCKY.DOC>>

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**ATTACHMENT C**

**U.S. NATIONAL WILDLIFE HEALTH CENTER LABORATORY  
RESULTS**

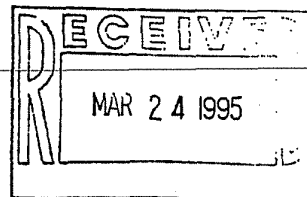




IN REPLY REFER TO:

## United States Department of the Interior

NATIONAL BIOLOGICAL SERVICE  
National Wildlife Health Center  
6006 Schroeder Road  
Madison, Wisconsin 53711-6223



March 17, 1995

Mr. Tom Hillmer  
Arizona Public Service  
Palo Verde Nuclear Generating Station  
Mail Station 7627  
5801 S. Wintersburg Road  
Tonopah, Arizona 85354

Dear Tom:

In response to your request from our phone conversation, I have provided in writing below recommendations regarding the continuation of the investigation of waterfowl mortality on the ponds at the Palo Verde Nuclear Generating Station.

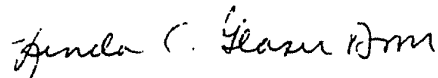
First, I would like to summarize our diagnostic findings from carcasses submitted to our Center from the plant. We received a total of 12 waterfowl carcasses from the plant, 8 ruddy ducks and 4 shovelers, and 2 water samples containing invertebrate casings (exoskeletons) and eggs. The first group of 4 carcasses and 2 water samples was received on 12/01/94. The birds were collected by shotgun. The cause of death in all 4 birds was due to trauma from being shot but additional tests ruled out other factors that may have affected birds including: (1) botulism type C, (2) exposure to organo-phosphorus or carbamate pesticides, (3) bacterial infection, and (4) lead poisoning. Tissues were collected and examined microscopically and no abnormalities were found (tissues affected by shotgun were not examined). Because of the method of collection, it is difficult to determine if these birds were healthy enough so that signs or lesions of a disease process were not as evident as they might have been in birds found dead or sick enough to be captured by hand. Invertebrate contents in the water sample were tested for the presence of botulism type C toxin and were negative. Additional carcasses were requested for diagnostic evaluation, preferably freshly dead birds or birds sick enough to be caught and euthanized. Five carcasses, all found dead, were submitted on 12/12/94 and evaluated. Again, tests were run that eliminated certain causes of death including; (1) botulism type C, and (2) bacterial infections. Microscopic examination of tissues did not reveal any abnormalities to attribute to a cause of death. One shoveler from this group died due to drowning. Drowning was the cause of death but in a waterfowl species this is usually an indication of debilitation or conditions so severe that the bird is unable to behave normally. We could not determine what may have caused the initial debilitation of this bird. The next group of 3 birds was submitted on 12/23/94. Two of the three ruddy ducks had evidence of trauma. One bird had a crushed beak and fractured ribs with hemorrhage in the air sac, the other had evidence of predation before it died. Other factors were ruled out as contributing to the cause of death including; (1)

botulism type C & E, and (2) salt toxicity. In this last case we have submitted a tissue sample for analysis to detect the presence of organic contaminants. The final report is pending this result.

Barring a finding in the tissue analysis for organic compounds which may point to a cause for mortality, I recommend the following steps be taken to continue the mortality investigation. First, an assessment of water content be done to include a fairly detailed water quality analysis with inorganic (especially ions and metals) and organic compounds, pond water condition (i.e., pH, dissolved solids), and identification of biological organisms in the water (e.g., plant, algae, and invertebrate species). Organisms present in the pond would be reviewed to determine if any of these species have the potential to produce toxins under the particular pond conditions. We discussed previous water sample analyses over the phone and with this cursory review, there does not seem to be unusually high chemical compound levels or contents of concern that you have measured but I would encourage you to have the ion and metal levels evaluated. Secondly, increase monitoring of the area to collect additional carcasses in the best possible postmortem condition for immediate shipment (chilled - not frozen) for diagnostic evaluation. Although we have ruled out a number of causes of mortality, I believe the carcasses would still provide the best clues. Collecting carcasses in good postmortem condition would give us the best sample to work with and examination of additional birds may provide new information. Tissue received in better condition will provide more detail for microscopic examination. Microscopic examination (histopathology) is a valuable tool in the diagnostic process because cellular changes or toxic insults can be seen at the microscopic level that may not be discernable at a gross necropsy level. This tissue damage can often point to an etiological agent. An example of new information would be carcasses that contain esophageal or stomach contents. These samples can be used for food item identification and be a valuable sample to analyze for presence of specific toxic compounds. Lastly, part of the continued investigation would be an on-site field investigation by myself or another member of our field investigation team at the Center. This recommendation along with the recommendations listed above were made to USFWS-EC personnel earlier in February, however, mortality has not occurred since that time and from our phone conversation, it sounds like pond conditions have changed also. I believe a field investigation at this time or when mortality is not occurring would not be productive. A field investigation would be warranted if mortality occurs again this year or next fall or winter.

I hope this information is helpful in your continuing investigation of waterfowl mortality on the ponds. I will be in contact with you regarding the pending case final report and to further discuss options for assistance in your investigation.

Sincerely,



Linda C. Glaser, D.V.M.  
Wildlife Disease Specialist

LCG:mb

Copy to: RHT Leader (Roffe), NWHC

ARIZONA GAME AND FISH DEPARTMENT  
INTEROFFICE MEMO

TO: Phil Smith, Waterfowl Biologist

FROM: Jim DeVos, Chief of Research

SUBJECT: Duck mortalities at Palo Verde

DATE: February 1, 1995

After we discussed the above issue yesterday, I was able to contact both Dr. Carlos Reggiardo and Dr. Ted Noon to see if the University of Arizona was interested and able to assist in this project. By way of background, Dr. Reggiardo is the Director of the Vet Diagnostic Lab and Dr. Noon is the diagnostician at the lab. Both indicated that they were very interested in assisting the Department and APS with investigating this issue. (602) 621-2356

Dr. Noon indicated that there were three primary sources of mortality for waterfowl at the cooling ponds: biological toxins, disease, or acute chemical poisoning. They are able to investigate all of these sources of mortality.

There are several things that are needed to assist in the identification of the causes of mortality. First, we need to have someone who has observed these animals prior to death to provide a detailed report on behavior patterns exhibited. I don't know if some of our field personnel could provide this or maybe someone from Palo Verde, but this will be invaluable in diagnosing the cause of mortality. Secondly, if the Wildlife Health Lab has provided written reports we need to forward these to Dr. Noon.

As we discussed this issue, Dr. Noon felt that we didn't want to rule out some of the common causes of waterfowl mortality such as botulism without some additional testing on very fresh mortalities. He suggested that if it were possible to collect a few specimens prior to death that this would be very helpful. These animals could be shipped to the U of A via courier that picks up specimens daily. If this is of interest, I can provide some detailed instructions on the methods of collection and sample preservation. With these fresh samples, the lab could do a better job of assessing if infectious disease may be responsible of the mortalities that have been observed.

There are some other considerations that need to be considered in this issue. First, when you and I reviewed the problem yesterday, you indicated that there are periodic blooms of algae. This indicates that there is abundant organic compounds in the cooling ponds. This may be the result of chemical treatments that may be

Phil Smith  
February 1, 1995  
2

used. We need to determine the source and type of these organics as they may directly or indirectly cause the mortalities. To assist in this portion of the investigation, we

would like to have a list of the chemical treatments that may be applied to the water at Palo Verde. It will likely be necessary to collect water samples from the ponds to determine levels of any toxic compounds present.

If an algal bloom occurs, it is important to collect a sample of the algae for identification. It is possible that toxic algae are produced and cause the mortalities.

This is a stepwise approach to investigating the mortalities at Palo Verde. If the results of each of these areas of investigation fail to detect the cause of mortality they will progress to the next issue.

At this time we have the ability to assist APS with identification of the problem. The Department has an account with the Vet Diagnostic Lab. If this arrangement is of interest to you and the personnel from APS, we could formalize an agreement with APS for this investigation. I anticipate that all of the lab costs would be approximately \$1-2,000. Please let me know if there is any additional information that you need.

JDV:jd

NATIONAL WILDLIFE HEALTH CENTER  
MADISON, WI

FAX  
Comm - (608) 264-5431  
FTS- (608) 264-5431

PHONE  
Comm - (608) 271-4640  
FTS- (608) 264-5411

FAX TRANSMITTAL SHEET

Date: 5/24/95

Number of pages: 3  
(Including this one)



To: Tom Hillmer - AZ Public Service  
Palo Verde Nuclear Generating Station  
FAX number: 602-393-5879

From: Linda Glaser

Message: Attached is the final report of  
the last case of carcasses  
submitted to our Center from  
the station.

I will be in contact with you in  
the near future.

NOTE: If any of these FAX copies are illegible, or you do not receive the same number of pages as stated above, please contact us immediately.

NATIONAL BIOLOGICAL SERVICE  
NATIONAL WILDLIFE HEALTH CENTER  
6006 Schroeder Road  
Madison, Wisconsin 53711-6223  
608-271-4640 FAX 608-264-5431

DIAGNOSTIC SERVICES CASE REPORT

Case: #13278, 001-003

EpiZOO: #94-164

RHT: LCG

Submitter:  
Cynthia Martinez  
USFWS-EC  
2321 W. Royal Palm Rd., Suite 103  
Phoenix, AZ 85019

Specimen description/identification:  
Ruddy Duck (001 - 003)

Date Submitted: 12/23/94

Location: Collected in 12/94 at Nuclear Power  
Plant, Maricopa County, Arizona

General Diagnosis:

001: Trauma  
002: Euthanised  
003: Predation

Comments:

background information accompanying these carcasses did not state whether the birds were found moribund and euthanised, or were found dead.

001: This subadult, male ruddy duck was in excellent flesh. The carcass was crushed with extensive fractures and internal hemorrhage. Gizzard worms and proventricular worms were present; these were incidental, unrelated to the cause of morbidity. Microscopic examination revealed chronic inflammation of undetermined cause in the liver and intestine, and mild degenerative changes in the kidney. Neither Type C nor Type E botulinus toxin were detected in a sample of blood from the heart. The concentration (1520 ppm ww) of salt in a sample of brain tissue was within normal limits. Algal toxins (microcystin and neo-saxitoxin) were not detected in a sample of liver tissue. Trauma was the cause of death. The injuries associated with euthanisation are usually more localized than the injuries in this carcass.

002: This adult, male ruddy duck was also in excellent flesh. The neck was broken which might have been a method of euthanisation. Microscopic examination of liver revealed mild, subtle, acute necrosis of inapparent cause. As in the previous accession, mild inflammatory changes were present in the intestine. Neither Type C nor Type E botulinus toxin were detected in a sample of blood from the heart. No bacterial pathogens were isolated from samples of liver or intestine. The concentration (1560 ppm ww) of salt in a sample of brain tissue was within normal limits. Microcystin was not detected in a sample of liver tissue; neo-saxitoxin was present at a concentration of 25.9 ppb; our algal toxicity consultant advises that this concentration is below the values associated with toxicity. Assuming this bird was captured alive and euthanised by cervisection, the cause of morbidity was not determined.

003: This adult, male ruddy duck was also in excellent flesh. Wounds on the right shoulder were associated with hemorrhage indicated predation as a terminal event. Results of laboratory tests were essentially the same as the preceding accessions. Neither Type C nor

Type E botulinus toxin were detected in a sample of blood from the heart. No bacterial pathogens were isolated from samples of liver or intestine. The concentration (1500 ppm ww) of salt in a sample of brain tissue was within normal limits. Microcystin was not detected in a sample of liver tissue; neo-saxitoxin was present at a concentration of 30.8 ppb; our algal toxicity consultant advises that this concentration is below the values associated with toxicity. Predation was the proximal cause of death.

Salt toxicity and botulism were eliminated as possible causes of morbidity for these ducks. The subtle and acute inflammatory changes in the livers and intestines of these ruddy ducks suggest the possibility of an acute toxic process. We saved frozen samples of liver and gastro-intestinal content should it be desired to conduct further toxicological testing.

Final Report (05/09/95)  
date

See attached necropsy records for individual specimen observations.

Note: Copies of this report have been sent to:

USFWS Regional Office (RO-2)

Attention:

Migratory Bird Coordinator

F & W Enhancement: Endangered Species

F & W Enhancement: Environmental Contaminants Coordinator

*Lou Sileo*  
Pathologist: Lou Sileo, Ph.D.

*Linda C. Glaser DVM*  
If you have questions regarding this case, contact: Linda C. Glaser, DVM  
at 608-271-4640. Include above Case Number. Diagnostic findings may not be used for  
publication without the pathologist's knowledge and consent.

NATIONAL WILDLIFE HEALTH CENTER  
MADISON, WI

FAX  
Comm - (608) 264-5431  
FTS - (608) 264-5431

PHONE  
Comm - (608) 271-4640  
FTS - (608) 264-5411

FAX TRANSMITTAL SHEET

Date: 2/1/95


Number of pages: 5  
(including this one)

To: Kirk King - EC Specialist  
Phoenix, AZ  
FAX number: 602-640-2730

From: Linda Glaser

Message: Attached is a summary  
note and the final  
reports from 2 of the  
3 shipments of birds we  
have received from Maricopa  
county, AZ. The other report case  
has not been completed yet.

**RECEIVED**  
FFR 1 1995  
USFWS - AESO  
PHOENIX, AZ



NOTE: If any of these FAX copies are illegible, or you do not receive the same number of pages as stated above, please contact us immediately.



January 31, 1995

Kirk,

Attached are two final reports (NWHC cases 13249 & 13230) from two of three shipments of birds submitted to our Center from the site of the Palo Verde Nuclear Generating Plant in Maricopa county. The diagnostic tests on the last shipment of birds (NWHC case 13276) are not completed. As you can see from the reports we have not yet determined a cause of death for the birds submitted from this area. However, complete necropsies with subsequent laboratory testing have ruled out several disease entities as the problem. The diseases ruled out as a cause of death include ~~Bacterial, Fungal, Parasitic, and Viral Infections~~. Tissues have also been examined histologically to look for evidence of cellular damage.

The next steps to ~~to understand the cause of mortality at these sites should~~ involve a closer examination of the site. I would be interested in receiving information on water analysis to evaluate water contents and their levels for possible impacts on birds. Also sampling and identifying ~~any organisms in the water and conducting a field investigation of the site would be additional steps~~ in understanding the environmental conditions. If you will be pursuing this mortality event further and would like additional assistance from our lab, please contact me. I would be interested in investigating this incident.

Linda Glaser



NATIONAL BIOLOGICAL SURVEY  
NATIONAL WILDLIFE HEALTH CENTER  
6006 Schroeder Road  
Madison, Wisconsin 53711-6223  
608-271-4640 FAX 608-264-5431

DIAGNOSTIC SERVICES CASE REPORT

Case: #13249, 001-005

Epizoo: #94-164

RHT: LCG

Submitter:  
Cynthia Martinez  
USFWS - EC  
2321 W. Royal Palm Rd., Suite 103  
Phoenix, AZ 85019-4951

Specimen description/identification:  
Ruddy Ducks and Shovelers.

Date Submitted: 12/13/94

Location: Maricopa Co., AZ.

General Diagnosis: 001 to 005: Undetermined.

Comments:

001: This adult male ruddy duck was in excellent flesh. No lesions were noted at necropsy. No significant bacteria were isolated from samples of liver tissue and Type C botulinus toxin was not detected in a sample of blood from the heart. The cause of death was not determined.

002: This adult, female shoveler was also in excellent flesh. The lungs were wet and frothy on cut surface and there was dirt in the trachea. These findings suggest that the shoveler aspirated water and perhaps drowned. A light growth of *Pasteurella multocida*, the pathogenic organism that causes avian cholera, was obtained from microbiologic cultures of lung tissue. Since the growth was light, and none of the lesions that we associate with avian cholera were present in the carcass, we believe the organism is not responsible for the cause of death in this bird. Type C botulinus toxin was not detected in a sample of blood from the heart. Drowning was a possible terminal event, but an explanation for why the duck might have drowned was not apparent.

003: This adult, male shoveler was in excellent flesh. There were small ulcerative lesions on the bottoms of the feet that were of minor significance. Again the lungs and tracheal lining were wet suggesting terminal aspiration of water. No significant bacteria were isolated from samples of liver tissue and Type C botulinus toxin was not detected in a sample of blood from the heart. The cause of death was not determined.

004: This adult, male shoveler was in excellent flesh. Again the lungs and tracheal lining were wet suggesting terminal aspiration of water. An area of the small intestine was cysted, but microscopic examination revealed thing remarkable. No significant bacteria were isolated from samples of liver tissue and Type C botulinus toxin was not detected in a sample of blood from the heart. The cause of death was not determined.

005: This adult, female ruddy duck was in excellent flesh. Results of the necropsy and laboratory tests were essentially identical to the preceding accessions. The cause of death was not determined.

Case No.: 13249F

P 2

Cont.

Comment: Drowning is a common occurrence in waterfowl that succumb to a disease process while on a body of water. The moribund birds drop their heads beneath the surface. Drowning is difficult to confirm in carcasses that have been frozen; but we suspect that most of the birds in this case aspirated water before death. In waterfowl, drowning is usually not the primary problem, but a sequela of some other problem, for instance botulism. You may wish to confirm that waterfowl are not being caught in an underwater drain or structure.

Final Report (01/30/95)  
date

See attached necropsy records for individual specimen observations.

Note: Copies of this report have been sent to:

USFWS Regional Office (RO-2)

Attention:

Migratory Bird Coordinator

F & W Enhancement: Endangered Species

F & W Enhancement: Environmental Contaminants Coordinator

Pathologist: Lou Sileo  
Lou Sileo, Ph.D.

If you have questions regarding this case, contact: Linda C. Glaser, DVM  
at 608-271-4640. Include above Case Number. Diagnostic findings may  
not be used for publication without the pathologist's knowledge and consent.

NATIONAL BIOLOGICAL SERVICE  
NATIONAL WILDLIFE HEALTH CENTER  
6006 Schroeder Road  
Madison, Wisconsin 53711-6223  
608-271-4640 FAX 608-264-5431

DIAGNOSTIC SERVICES CASE REPORT

Case: #13230, 001-006

Sex: ♀

RHT: LCO

Submitter:  
Cynthia Martinez  
USFWS - EC  
3616 W. Thomas Rd, Suite 6  
Phoenix, AZ 85019

Specimen description/identification:  
Shoveler (001); Ruddy Duck (002-004)

Date Submitted: 12/06/94

Location: Palo Verde Nuclear Generating  
Plant, Maricopa County, Arizona.

General Diagnosis: Undetermined.

Comments: 001-004: Three ruddy ducks and one shoveler were examined. All birds were in good flesh and had abundant fat reserves. The birds were negative for botulism type C. ~~Lead was not detected. Liver cultures were negative for bacterial growth.~~ Cholinesterase levels were within normal limits for these species. Histopathologic changes were mild and non-specific and are not believed to be related to the cause of death. The shoveler had microscopic evidence of mild schistosome parasitism, but this is also believed to be unrelated to the cause of death.

005-006: Water samples containing invertebrate casings and eggs were negative for *Clostridium botulinum* type C toxin.

Final Report (02/01/95)  
date

See attached necropsy records for individual specimen observations.

Note: Copies of this report have been sent to:

USFWS Regional Office (RO-2)

Attention:

Migratory Bird Coordinator

F & W Enhancement: Endangered Species

F & W Enhancement: Environmental Contaminants Coordinator

Pathologist:   
Roger E. Brannian, DVM, MS  
Diplomate American College of Zoological Medicine

  
Linda C. Glaser, DVM

If you have questions regarding this case, contact: Linda C. Glaser, DVM  
at 608-271-4640. Include above Case Number. Diagnostic findings may not be used for  
publication without the pathologist's knowledge and consent.

**Quarterly Wildlife Mortality Report.** The following highlights wildlife mortality reported to the National Wildlife Health Center (NWHC) from October through December, 1994. In October, NWHC reorganized data reporting from US Fish and Wildlife Service Migratory Bird Flyways to National Biological Service regions. This mortality report reflects that change and is arranged accordingly (see attached map).

In mid December, NWHC received a report of bald eagle morbidity and mortality occurring on DeGray Lake, a Corps of Engineer lake near Arkadelphia, Arkansas. Between late November and mid January, 27 bald eagles were found sick or dead. Sick birds were reported to have seizures progressing to flacid paralysis and difficulty flying. Birds necropsied by three diagnostic facilities were in good body condition with few, if any, gross lesions. Extensive microbiological and toxicological analysis have been completed with no consistent findings. More tests are pending and the case remains open.

The Southeastern Cooperative Wildlife Disease Study reported residents of Escambia county, Florida, describing hundreds of "black" birds falling dead out of the sky in early December. Examination and analysis of common grackle stomach contents revealed poisoning by diazinon and chlorpyrifos. The source of the toxins remains unknown.

Unusual morbidity with mortality is being reported in American robins from one residential area in Tulsa, Oklahoma. Robins have migrated through this area the last two winters and feed on persimmon trees. Robins are observed with a white powdery substance on the legs. This appearance progresses to scab formation and proliferative appearing growths. Eventually some birds lose of all or part of the leg or legs. Diagnostic evaluation has determined Knemidocoptes mites to be the cause of the leg lesions. The species has not been confirmed but is suspected to be K. mutans, also known as the scaly-leg mite. This species of mite is very contagious and in advanced cases can cause considerable deformity and crippling. K. mutans has been reported in a number of avian species including bullfinches, goldfinches, parakeets and passerine birds. An estimated seven hundred birds have been affected, however mortality due to this infection is unknown. Susceptibility to predation and inability to feed increases the likelihood of mortality once birds have lost part of their legs.

Avian cholera was diagnosed from several areas in California this quarter. The Sacramento National Wildlife Refuge (NWR) Complex in California reported losses of an estimated 5,000 waterfowl on Butte Sink Waterfowl Management Area (WMA). The primary species affected were wigeon, coots and pintails from an estimated population at risk of over 500,000 at Butte Sink alone. The heavy rains that hit California in early January increased waterfowl habitat and helped to disperse birds and slow the mortality. Lower Klamath NWR, lost an estimated 4,370 waterfowl, 80% of which were mallards. The large eagle population (200-300) in the area scavenged carcasses making the initial carcass pickup difficult. California Department of Fish and Game - Wildlife Investigations Laboratory (CFG-WIL) reported avian cholera mortality of 625 birds, primarily coots, collected from three separate areas in Humbolt County. CFG-WIL also reported mortality in waterfowl at Gray Lodge Waterfowl Management Area near Butte Sink NWR. The breakdown of affected species is similar to that of Butte Sink.

Waterfowl using the Farmington Bay area of the Great Salt Lake in Utah began dying of avian cholera in November just as an avian botulism outbreak was ending. This first reported epizootic of avian cholera on the Great Salt Lake resulted in the loss of an estimated 5-10,000 northern shovelers and 4,000 eared grebes out of a record high population of 500,000 eared grebes using the Lake. Other species of waterfowl in the area were not affected to the same extent.

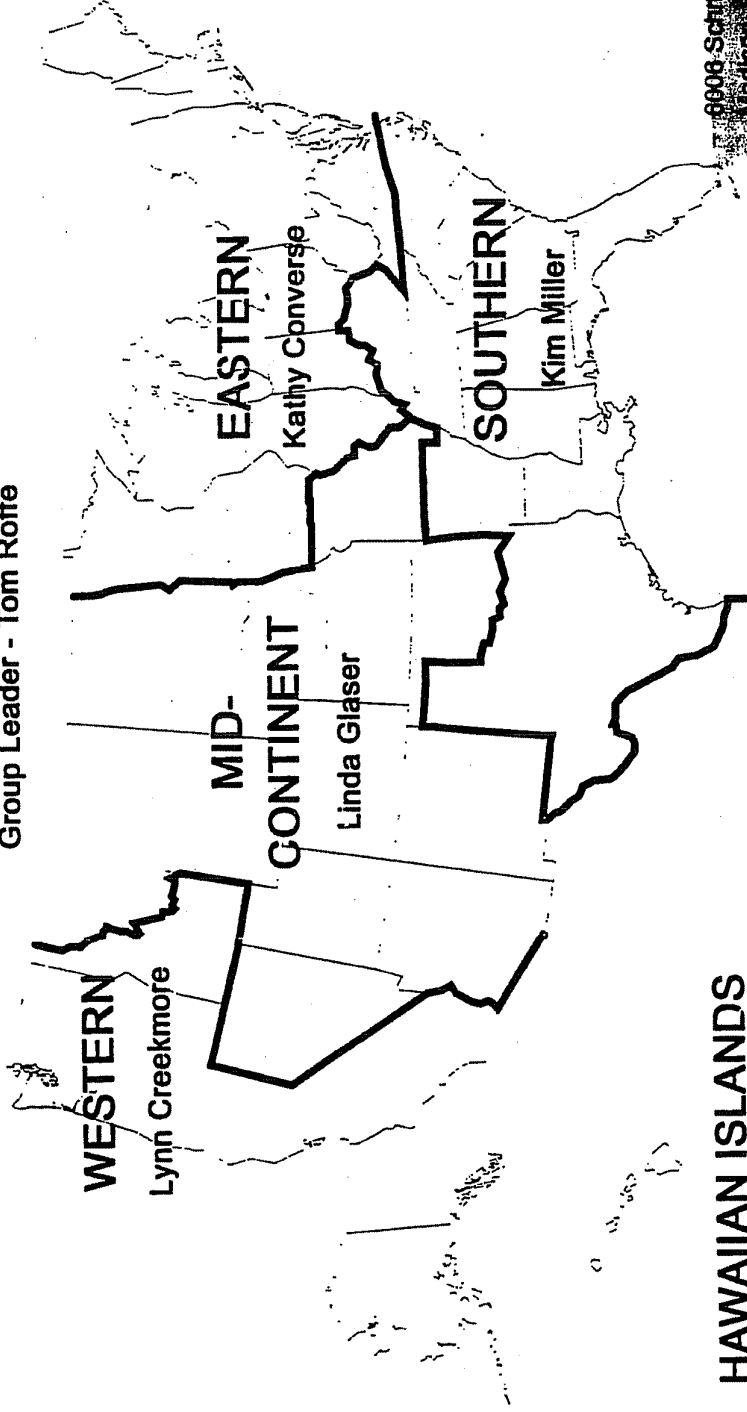
The Upper Mississippi NWR reported finding about 1,500 American coots dead below a dam near Fulton, Illinois. Refuge staff suspected coots were caught in the water vortex at dam gates and baffles. NWHC necropsy findings were consistent with drowning. Dam workers frequently see coots float over the dam when winter water and ice are released but have not noted any large scale mortality in the past. Birds are seen sitting on the ice until it starts moving over the dam.

# National Biological Service Regions

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QUARTERLY WILDLIFE MORTALITY REPORT  
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LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
<u>Eastern Region</u>						
Riverton	IA	12/05/94-12/21/94	Snow Goose Ross' Goose American Coot	300 (e)	Avian cholera	NW
Upper Mississippi MNR	IL	11/14/94-11/15/94	American Coot	1,500 (e)	Drowning suspect	NW
Glen Ellyn	IL	10/27/94-10/31/94	Canada Goose	10	Esophageal Impaction	NW
Columbia	MO	01/01/94-03/29/94	House Sparrow	15 (e)	Salmonellosis	MOA
Minnesota Valley MNR	MN	10/03/94-10/04/94	American White Pelican Double-crested Cormorant Green-winged Teal American Coot	8	Trauma	NW
Kragero	MN	11/13/94-11/15/94	Canada Goose	4	Esophageal Impaction	NW
Tonawanda	NY	10/10/94-10/24/94	Unidentified Duck	40 (e)	Botulism suspect	NYS
Sidney	OH	10/17/94-10/20/94	Canada Goose	8	Esophageal Impaction	NW
Ottawa MNR (Boggy Bottoms)	OH	11/05/94-11/05/94	Ring-necked Duck	14	Toxicosis: organophosphorus compound	NW
Providence	RI	10/04/94-10/05/94	Herring Gull American Crow Northern Cardinal American Robin	6	Aspergilliosis	NW
Shenandoah County	VA	05/28/94-06/03/94	Unidentified Blackbird	20 (e)	Starvation	SC
Brown/Keansee County line	WI	09/27/94-09/29/94	Pekin Duck Mallard	15	Aspergilliosis	NW
Grafton	WI	10/14/94-11/04/94	Canada Goose	46	Aspergilliosis	WI
Wausville	WI	10/26/94-10/28/94	Canada Goose	12	Aspergilliosis	WI
<u>Southern Region</u>						
De Gray Lake	AR	11/24/94-01/15/95	Bald Eagle	27	Open	NW
Hillsborough Bay	FL	11/09/94-11/26/94	Northern Shoveler Blue-winged Teal Green-winged Teal	434	Open: botulism suspect	NW

continued.....

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LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
<u>Southern Region cont.</u>						
Upper Keys-Florida Bay	FL	11/15/94-01/13/95	Double-crested Cormorant	26	Emaciation	NU
Escambia County	FL	12/01/94-12/02/94	Common Grackle	800 (e)	Toxicosis: diazinon & chlorpyrifos	SC
Lubbock	TX	11/29/94-12/15/94	Canada Goose Northern Pintail Green-winged Teal Hallard	25	Avian cholera	NU
<u>Mid-Continent Region</u>						
[REDACTED]	AZ	11/29/94-ongoing	Ruddy Duck Northern Shoveler Unidentified Shorebird Eared Grebe	980	Open	NU
Glendale	AZ	11/22/94-12/02/94	Inca Dove	15 (e)	Toxicosis suspect	NU
Central Missouri	MO	11/28/94-12/07/94	Snow Goose Hallard	300 (e)	Avian cholera	NU
Moonan	ND	11/01/94-11/07/94	Snow Goose	150 (e)	Necrotizing enteritis	NU
Harlan County Reservoir	NE	11/01/94-11/15/94	Double-crested Cormorant	200 (e)	Parasitism: renal coccidiosis	NU
Schilling	NE	12/05/94-12/15/94	Snow Goose	40 (e)	Avian cholera	NU
Bitter Lake NWR	NH	11/05/94-11/30/94	Snow Goose Rose' Goose	20 (e)	Avian cholera	NU
Lake Mead Marina	NV	10/15/94-10/30/94	Hallard	20 (e)	Botulism type C	NU
Tulsa	OK	11/15/94-ongoing	American Robin	10 (e)	Parasitism: <i>Knemidocoptes</i> mite	NU
Wagon Wheel Bay	TX	11/10/94-12/26/94	Northern Shoveler Eared Grebe California Gull	15,000 (e)	Avian cholera	NU
Salton Sea NWR	CA	09/23/94-11/02/94	American White Pelican Western Sandpiper Northern Shoveler Brown Pelican Green-winged Teal	300 (e)	Botulism type C	NU

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