




Palmer
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04/23/2009 06:40 PM

To Ann Campbell/DC/USEPA/US@EPA, Brian
Frazer/DC/USEPA/US@EPA, Chris
Hoberg/R4/USEPA/US@EPA, Dawn

cc

bcc

Subject Fw: PCS - 404 Permit; Gregory Summary

History:  This message has been replied to.

Folks:

At the 4-17-09 site visit, PCS provided a draft summary of a study it commissioned that evaluates the SNHA wetland on the Bonnerton tract and questions whether or not the wetland system should be designated as "nationally significant".

Attached below is the complete evaluation received today.

It has already been forwarded to the state Natural Heritage Program expert who is reviewing it.

-Palmer

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----- Forwarded by Palmer Hough/DC/USEPA/US on 04/23/2009 06:34 PM -----

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GHOUSE@brookspierce.com, JFurness@Pcsphosphate.com, RTINSLEY@brookspierce.com
Date: 04/23/2009 10:12 AM
Subject: PCS - 404 Permit; Gregory Summary

Attached is Dr. Gregory's report on his initial assessment of the portion of




the Bonnerton tract listed by NHP along with the two maps referenced in that report. Please review the list of recipients and forward this to anyone in your agency who should have received it (these are the only addresses I have).

6-19-08 map
1-6-09 Biotic Communities

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Gregory report NRW stands 4-22-09.pdf 20090422220441160.pdf 20090422220446795.pdf



WATERSHED HYDROLOGY
CONSULTANTS

Report on

**Rapid Forest Assessment: Nonriverine Wet Hardwood
Stands on the Bonnerton Tract, PCS Phosphate Co., Inc.**

to

**Brooks, Pierce, McLendon, Humphrey, & Leonard, L.L.P.
2000 Renaissance Plaza, 230 North Elm Street
Greensboro, North Carolina 27420**

**James D. Gregory, CPSS, PWS, Ph.D.
Principal/Senior Scientist**

**Watershed Hydrology Consultants LLC
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April 22, 2009

Introduction

The purpose of the rapid forest assessment reported here is to provide qualitative and limited quantitative description of three wetland mixed hardwood stands located on the Bonnerton Tract owned by PCS Phosphate Co., Inc., Aurora, NC (PCS). The three stands are the focus of ongoing discussions between staff of PCS and staff of the U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (Corps), and N.C. Division of Water Quality (DWQ) regarding the forest type and the quality of those stands and their fate in the permitting process for expansion of phosphate mining into the Bonnerton Tract.

The three forest stands that are the subject of this report are denoted as Significant Natural Heritage Areas on the map labeled "Exhibit A, Non-Riverine Wet Hardwood Forest" and that is dated 6/2008. The stand boundaries are approximate on "Exhibit A" and are depicted accurately as Wetland Vegetation Type 7 - Wetland Hardwood Forest on the Biotic Communities map labeled: "PCS Phosphate Mine Continuation; Modified Alt L - Bonnerton Proposed Impact Boundary 12/2008 - Biotic Communities Impact" and that is dated 1/6/09. For reference purposes, the stands shall be referred to as: (1) eastern stand - easternmost of the three stands that comprise the origin of Porter's Creek and consists mostly of the W. M. Gray and W. B. Gray tracts. (2) western stand - westernmost of the three stands at the intersection of NC 306 and SR 1958 and that consists mostly of the B. B. Ross and T. W. Bonner tracts, and (3) northern stand - northernmost of the three stands that lies west of the open field with air strip. The area of nonriverine swamp forest in the western stand shall be denoted as western stand swamp forest. This is the depositional area in the western stand with strong evidence of long duration ponding of water and development of surface soils with very high organic carbon content (mucky modified mineral to muck texture).

The goal of this assessment was to collect descriptive information on the three forest stands using rapid field surveys of the stands in order to provide a report promptly. More intensive and statistically valid inventories of the stands will be conducted in the near future when land expansion is complete to ensure accurate identification of the trees, saplings, and seedlings in the stands. Specific objectives of the assessment were to:

1. Determine the species composition of the canopy trees of the stands and the relative density of the key species that determine the forest type.
2. Compare the tree species composition of the three stands to the N.C. Natural Heritage Program (NHP) and the EPA/Corps definitions of the nonriverine wet hardwood forest type. The NHP definition is found in *Classification of the Natural Communities of North Carolina: Third Approximation* (Schafale and Weakley 1990). The EPA/Corps definition is found in "Memorandum: Application of Best Management Practices to Mechanical Silvicultural Site Preparation Activities for the Establishment of Pine Plantations in the Southeast" (EPA/Corps 1995), a guidance document issued on November 28, 1995. The memorandum was also published in the *Federal Register* (Vol. 61, No. 39, pp. 7242-7245) on February 27, 1996. For additional information regarding the characteristics of the wetland forest types described in the EPA/Corps guidance memorandum that occur in North Carolina, see Gregory (1995).

3. Examine the soil profile to confirm the presence of hydric soils, confirm the mapped soil series, and to examine soils evidence of the hydrologic regime of the stands.
4. Assess the presence of hydrology indicators that provide evidence of the hydrologic regime.

Definitions of the Nonriverine Wet Hardwood Forest Type

A key issue in the regulatory agencies' decision regarding the fate of the three stands that have been labeled as nonriverine wet hardwood stands by NHP is the character and quality of those stands in relation to the NHP and EPA/Corps definitions of the forest type and in relation to other examples of the forest type across its natural range. Both of those definitions focus on certain wet site oak species in the canopy as both forest type indicators and stand quality indicators. Of course, relative tree density, tree size, and tree health of the key indicator species are also considered in characterizing stand quality. A standard measure of tree density in a forest stand that is referred to throughout this report is basal area per acre. The basal area per acre of a forest stand is the average per acre of the sum of the cross-sectional areas of the trees measured at 4.5 feet above ground or breast height. Tree diameter measured at the standard height of 4.5 feet is called diameter breast height or dbh.

NHP

The NHP definition of nonriverine wet hardwood in Schafale and Weakley (1990) is:
Vegetation: Forest dominated by various hardwood trees typical of bottomlands. Typical species include Quercus michauxii, Q. laurifolia, Q. pagoda (falcata var. pagodaefolia), Liriodendron tulipifera, Liquidambar styraciflua, Ulmus americana, Acer rubrum, and Nyssa biflora.

The key indicator species of high quality stands are the three oak species: swamp chestnut oak (*Quercus michauxii*), laurel oak (*Quercus laurifolia*), and cherrybark oak (*Quercus pagoda*). The NHP definition does not indicate what "dominated" means in regard to relative density of the key indicator species or of the common associated tree species in a stand. However, Schafale's writings about the stands that have been inventoried by NHP and labeled as the nonriverine wet hardwood forest type indicate that he considers dominance by the three key indicator oak species as essential to the definition of nonriverine wet hardwood. For example, in a January 2008 update on the status of nonriverine wet hardwood stands in North Carolina, Schafale (2008) states:

Nonriverine Wet Hardwood Forests are naturally dominated by some of the same trees as bottomland hardwood forests along large brownwater rivers: swamp chestnut oak (Quercus michauxii), laurel oak (Quercus laurifolia), and cherrybark oak (Quercus pagoda). Water oak (Quercus nigra), sweetgum (Liquidambar styraciflua), loblolly pine (Pinus taeda), red maple (Acer rubrum), and tulip poplar (Liriodendron tulipifera) have increased with past logging and are often abundant.

In a later paragraph in the same report, Schafale (2008) reinforces his contention that:
The presence and abundance of oaks therefore serves both as an indicator that a community is a nonriverine wet hardwood forest rather than a nonriverine swamp forest and as an indicator of its natural condition. But then Schafale states that: Given current conditions, examples with oaks comprising more than 10% of the basal area per acre or of the canopy cover should be considered good examples.

The reference to "natural condition" in the above paragraph raises the question of just how "natural" the wet hardwood forests on the Bonnerton Tract are. In the Introduction to *Classification of the Natural Communities of North Carolina. Third Approximation*, Schafale and Weakley (1990) state that:

This document presents a framework for the classification of natural communities in North Carolina. A natural community is defined as: "a distinct and reoccurring assemblage of populations of plants, animals, bacteria, and fungi naturally associated with each other and their physical environment." While the above definition of natural communities includes all assemblages that may occur, this document restricts its scope to those communities which may be considered natural in a narrower sense. We are primarily interested in communities whose characteristics and functioning are shaped by the processes of evolution and ecological interactions of long periods of time, without the overriding influence of modern human activities. The level of alteration allowed before a community occurrence can no longer be considered natural may vary with factors such as the nature of the alteration or disturbance, the community's resilience to that type of disturbance, and the existence of other examples that are less altered. It also will depend on our ability to recognize what the natural state is.

EPA/Corps

The EPA/Corps guidance focuses on high quality examples of each of the forested wetland types listed (EPA/Corps 1995). Nonriverine forest wetlands are defined as: "wetlands in this group are rare, high quality wet forests, with mature vegetation located on the Southeastern coastal plain, whose hydrology is dominated by high water tables. Non-riverine Wet Hardwood Forests -- poorly drained mineral soil interstream flats (comprising 10 or more contiguous acres), typically on the margins of large peatland areas, seasonally flooded or saturated by high water tables, with vegetation dominated (greater than 50% of basal area per acre) by swamp chestnut oak, cherrybark oak, or laurel oak alone or in combination.

Thus the EPA and Corps define nonriverine wet hardwood stands worthy of being protected from (or at least requiring a permit for) intensive site preparation and planting to pine as "rare, high quality wet forests, with mature vegetation that are dominated (greater than 50% of basal area per acre) by swamp chestnut oak, cherrybark oak, or laurel oak alone or in combination." The EPA/Corps definition is more specific than the NHP one and defines dominant species as those comprising greater than 50 % of basal area per acre in a forest stand. The latter definition is the standard one in the forestry profession when characterizing a stand with a forest type name. For example, a loblolly pine (*Pinus taeda*) stand has greater than 50 % of the basal area per acre in loblolly pine. A sweetgum (*Liquidambar styraciflua*) – red maple (*Acer rubrum*) stand has greater than 50 % of the stand basal area per acre in a combination of sweetgum and red maple.

The EPA/Corps Guidance provides more insight into the meaning of high quality: *The term "high quality" used in this characterization refers to generally undisturbed forest stands, whose character is not significantly altered by human activities (e.g., forest management). Non-riverine forest wetlands dominated by red maple, sweetgum, or loblolly pine alone or in combination are not considered to be of high quality, and therefore do not require a permit.*

Thus, to meet the NHP or EPA/Corps definition of high quality nonriverine wet hardwood forest, a stand must have more than 50 % of the basal area per acre in mature swamp chestnut oak, and/or laurel oak, and/or cherrybark oak and whose character is not significantly altered by human activities. Poorly accessible virgin forests in eastern North Carolina generally were harvested during the late 19th century and the early part of the 20th century. Therefore, examples of the nonriverine wet hardwood forests described above that are genuine second-growth and have not been disturbed (converted to agriculture for a time or harvested one or more additional times) would have an overstory that exceeded 75 years of age and dominant trees that likely would exceed 20 inches dbh. "Mature vegetation" implies dominants of even greater age and size.

In my view, to qualify as one of the best examples extant of the nonriverine wet hardwood forest type, a stand must have all three of the indicator oak species combining for more than 50 % of the basal area per acre of the stand in mature trees, many of which are 24 inches dbh or larger. The best example stands also should be second or third growth with little evidence of past agricultural use or recent harvesting disturbance. Only a few of the known and inventoried stands in North Carolina meet that threshold (Rheinhardt and Rheinhardt 2000).

Methods

Two rapid site surveys have been conducted to gather data for this report:

1. On April 9, 2009, I visited the three wet hardwood stands guided by Jeff Furness, Senior Scientist at PCS. We conducted a traverse through each stand generally along the long axis with some lateral traversing in order to see a significant portion of each stand. We stopped frequently at randomly selected locations where I examined the forest canopy, examined the soil profile with a soil auger to depths of 20-30 inches, and noted any indicators of the hydrologic character of each stand.
2. On April 13, 2009, Seth Ward, Senior Forester of Environmental Services, Inc., Washington, NC estimated the average basal area per acre of the trees in the three wet hardwood stands. He measured basal area per acre (total per acre and basal area per acre in each of the oak species) in 10 well distributed and randomly located wedge prism plots in each stand. A wedge prism is a type of angle gauge that is used to estimate basal area per acre in variable diameter plots. Setting the prism on a point, each tree in the vicinity is checked by turning a circle. Each tree that is within the gauge's angle of view (called an "in tree", meaning in the plot) represents an estimate of 10 square feet of basal area per acre. The shortcoming of this method is that tree diameter is not recorded. A smaller tree closer to the plot center may be "in" as well as a much larger tree at greater distance from that plot center. So, as noted above, a more intensive inventory will be conducted with measurements of tree dbh in order to characterize the diameter distributions and tree density/acre by species in addition to acquiring more accurate basal area per acre data.

Results

Stand Composition

The preliminary basal area per acre data noted in Table 1 indicates that the wet hardwood stands on the Bonnerton Tract are not dominated by swamp chestnut oak and laurel oak as stated

in Schafale's (undated) report on those stands. The third key indicator wet site oak species, cherrybark oak, is conspicuously absent in all three of the stands. More detailed descriptions of each of the wet hardwood stands are provided below.

Table 1: Basal area in average number of square feet per acre of the trees in the three wet hardwood stands. Preliminary data obtained via wedge prism plots.

Stand	Swamp Chestnut Oak	Willow Oak	Water Oak	Laurel Oak	Southern Red Oak	% BA in SCO + LO	% BA in SCO + LO + WiO + WaO	Total Basal area per acre
eastern	15	4	3	1	0	16	23	73
western	5	8	8	0	5	5	21	92
northern	12	2	3	1	0	13	18	66

Eastern Stand

Stand Character

In the eastern stand, only 16 % of the total stand basal area per acre is in swamp chestnut oak and laurel oak. There are no cherrybark oak trees in this stand. Adding water oak (*Quercus nigra*), and willow oak (*Quercus phellos*) brings the total basal area per acre in wet site oaks to just 23 % of the total stand basal area per acre. The swamp chestnut oak, laurel oak, water oak, and willow oak trees of the eastern stand are relatively large, impressive trees with wide spreading canopies that seem to dominate the stand canopy. The oaks and the associated species have many trees in the > 12 inch dbh category, some in the 18-20 inch dbh category, and a few over 20 inches dbh. There is not a distinct two or three layered canopy indicating that it has been a considerable length of time since the last harvest. The hardwoods may be relatively even-aged having been the residual stand after the large pines once present were harvested.

Evidence of past agricultural use is lacking though there is one central east-west ditch through the stand that is likely an outlet ditch for areas to the west that were in tillage at one time. However, the remains of many large pine stumps indicates that this stand either did sustain a period of agricultural use or many pines were in the second growth stand following harvest of the virgin timber.

I rate the eastern stand as excellent quality due to the relatively even-aged canopy that has sustained no recent timber harvesting or other disturbance, likely for at least 75 years, and the large evenly distributed oak trees. The stand does not meet the criteria of the EPA/Corps Guidance to be classified as high quality. In my opinion, the lack of cherrybark oak trees keeps the stand from being classified among the best nonriverine wet hardwood stands in North Carolina.

Soils

Most of the area of the eastern stand is mapped as Tomotley fine sandy loam (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults) and my examination of the profiles confirmed the presence of that series. All of my boreholes had a positive hydric soil indicator, though Tomotley is poorly drained and is on the dry end of the wetland hydrology range. Tomotley has a relatively thin (30 inches thick on average) and moderately permeable B horizon

of sandy clay loam, overlain and underlain by sandy loam, indicating that the soil likely does not perch a near surface saturated zone during and after rainfall. Low organic carbon content in the A horizon is indicative of relatively short periods of near surface saturation that may not occur every winter/spring.

Hydrology

The water table throughout all three of the wet hardwood stands was much lower than I expected for this time of year, thus confirming that groundwater levels have not recovered from the extended drought. Though digging bore holes up to 30 inches deep, I did not find a saturated zone anywhere in the surface zone of the soil of the eastern stand. Free water in the cracks between the peds of the B horizon was a wetting front from recent rainfall but the interior of the peds was very low in soil moisture. Except for the low-lying area at the origin of Porter's Creek, there is no evidence that inundation ever occurs anywhere in the eastern stand.

Western Stand

Stand Character

In the western stand, only 5 % of the total basal area per acre of the stand consists of swamp chestnut oak and laurel oak trees. There are no cherrybark oak trees in this stand. Adding water oak and willow oak brings the total basal area per acre in wet site oak species to just 21 % of the total stand basal area per acre. A slightly higher elevation and dryer area in the western stand has a number of southern red oak (*Quercus falcata*) trees (FACU-) that are most commonly found on moderately well-drained and well-drained soils.

The western stand has much more evidence of historical and recent disturbance than in the eastern stand. A network of old drainage ditches indicates that the area was once in agricultural use. Evidence of skid trails attests to frequent and relatively recent timber harvesting activity. The forest stand is a two-storied or two-aged one. Most of the oaks are part of the older and taller trees that make up the oldest canopy layer, trees that were left behind in the last harvest, likely due to poor quality or undesirable species. The trees in this layer have a scattered and patchy distribution. The lower canopy layer of younger trees, likely about 30-40 years old has few oaks.

I rate the western stand as poor to moderate quality. It does not meet the criteria of either NHP or the EPA/Corps to be labeled as a nonriverine wet hardwood stand.

Soils

Most of the area of the western stand is mapped as Tomotley fine sandy loam (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults) and my examination of the profiles confirmed the presence of that series. All of my boreholes had a positive hydric soil indicator. A shallow depressional area within the western stand has a different soil type than Tomotley and has indicators of much wetter conditions than in the remainder of the stand. The soil in that depression has much organic carbon accumulation in the surface horizon with textures ranging from mucky modified mineral to muck.

Hydrology

I did not find a saturated zone in the upper 30 inches of the soil profile of the western stand until I neared the Suffolk scarp where the lateral or upward hydraulic head of groundwater discharge from the uplands to the west of the scarp is greater than farther east. The depressional area in the western stand had extensive areas of ponded water. Except for the depressional area, there is no evidence that inundation ever occurs anywhere in the western stand.

Northern Stand

Stand Character

In the northern stand, only 13 % of the total basal area per acre consists of swamp chestnut oak and laurel oak trees. There are no cherrybark oak trees in this stand. Adding water oak and willow oak brings the total basal area per acre in wet site oak species to just 18 % of the total stand basal area per acre.

The northern stand is the most recently and dramatically disturbed of the three wet hardwood stands. A high density harvest occurred in the very recent past. Large openings among the few, scattered larger, older and often low quality trees are filling in with young trees, most of undesirable species from a timber production standpoint.

I rate the northern stand as poor quality. It does not meet the criteria of either NHP or the EPA/Corps to be labeled as a nonriverine wet hardwood stand.

Soils

Most of the area of the western stand is mapped as Tomotley fine sandy loam (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults) and my examination of the profiles confirmed the presence of that series. All of my boreholes had a positive hydric soil indicator.

Hydrology

I did not find a saturated zone in the upper 30 inches of the soil profile of the western stand and there is no evidence that inundation ever occurs anywhere in the western stand.

Conclusions

Among the three wet hardwood stands on the Bonnerton Tract, the eastern stand is the only one that comes close to meeting the NHP and Corps/EPA criteria to be labeled nonriverine wet hardwood. The eastern stand is an excellent quality one with large and high quality wet site oak species, though those oaks only comprise 23 % of the basal area per acre of the canopy trees. The western and northern stands both do not meet either the NHP or the EPA/Corps criteria for the nonriverine wet hardwood forest type. The western stand is of poor to moderate quality due to the very low percent basal area per acre of swamp chestnut oak and laurel oak and the scattered patchy nature of the distribution of the oak trees. The northern stand is a very disturbed, poor quality stand of the type commonly referred to by foresters as "green junk".

In my opinion, regardless of the label, the three wet hardwood stands (singly) and the three stands collectively are not "significant" examples of the nonriverine wet hardwood forest

type as contemplated by NHP. While portions of the Eastern Tract are excellent quality, none of the Tracts are "exemplary," "unique," or "outstanding."

The hydrologic character of the three wet hardwood stands on the Bonnerton Tract is typical of several mineral flat wetland hardwood stands that I know very well. The hydrology of the three stands is on the dry end of the range of wetland water table hydroperiod. That means that those stands never experience inundation and have relatively short periods of saturation within 12 inches of the surface during late winter/early spring that very likely do not occur every year. Some of the higher elevation areas likely do not have water table hydroperiods that meet the Corps wetland hydrology technical standard (Corps 2005).

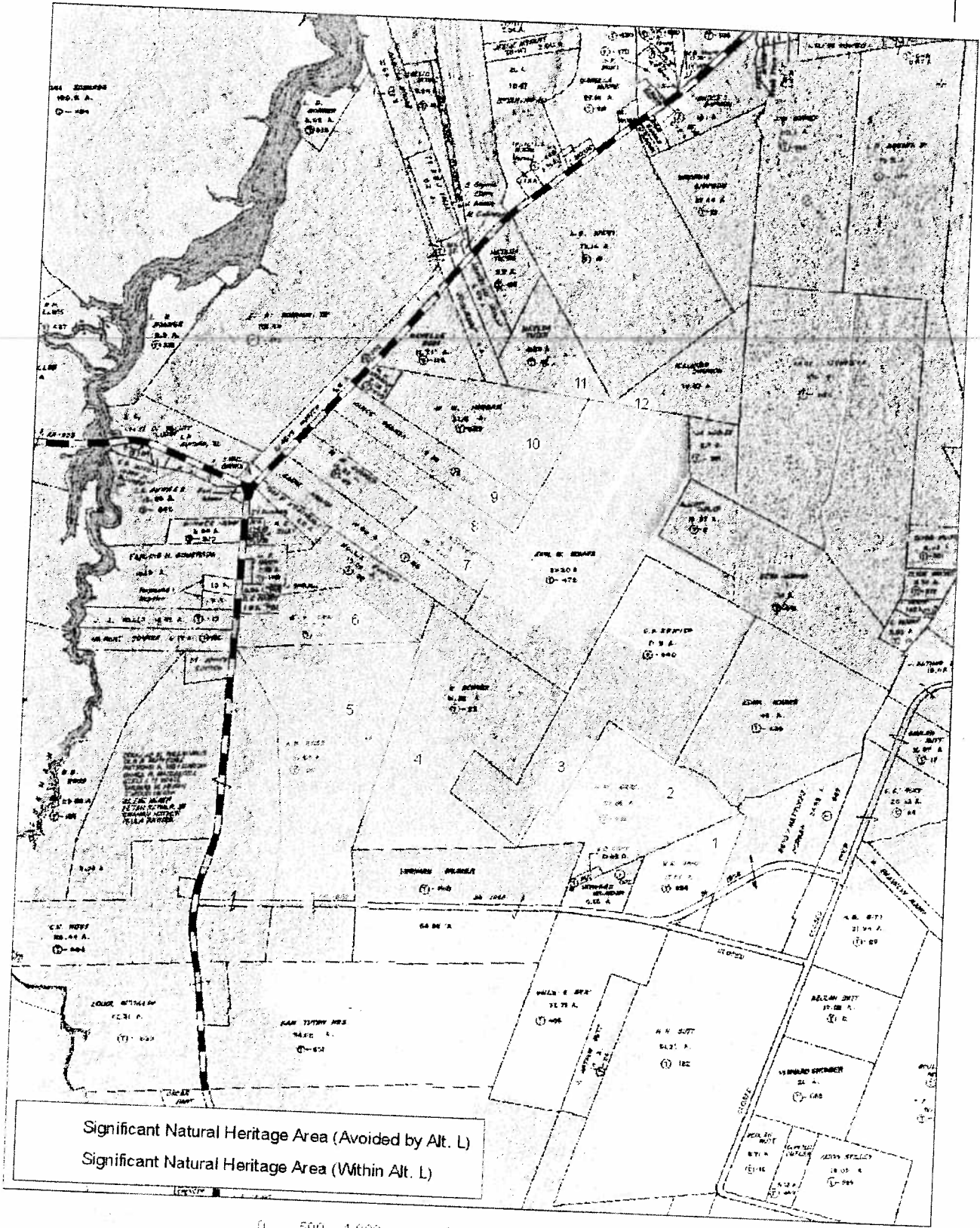
The relatively "dry" wetland hydrology of many sites that have swamp chestnut oak, laurel oak, and cherrybark oak trees means that those tree species are wetland adapted but not wetland dependent. Those tree species are adapted to survive, grow, and out-compete many other tree species when the water table is close to the surface but are also adapted to survive long periods of low soil moisture during the summer.

Literature Cited

- Corps. 2005. Technical standard for water-table monitoring of potential wetland sites. ERDC-TN-WRAP-05-2. Wetlands Regulatory Assistance Program, U.S. Army Corps of Engineers, Vicksburg, MS.
- EPA/Corps. 1995. Memorandum: Application of Best Management Practices to Mechanical Silvicultural Site Preparation Activities for the Establishment of Pine Plantations in the Southeast, November 28, 1995. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, Washington, DC.
- Gregory, J. D. 2005. Forested wetland types of North Carolina where mechanical site preparation for planting pines requires a 404 permit. Unpublished report. Department of Forestry & Environmental Resources, North Carolina State University, Raleigh, NC.
- Rheinhardt, M. C. and R. D. Rheinhardt. 2000. Canopy and woody subcanopy composition of wet hardwood flats in eastern North Carolina and southeastern Virginia. *Journal of the Torrey Botanical Society* 127(1): 33-43.
- Schafale, M. P. 2008. Nonriverine wet hardwood forests in North Carolina, status and trends. Unpublished report, January 2008. North Carolina Natural Heritage Program, Raleigh, NC.
- Schafale, M. P. Undated. Site Survey Report Form. NC Natural Heritage Program. Site Name: Bonnerton Road Wet Hardwood Forest and Seep. Dates Visited: April 15, 2005 and January 26, 2005.
- Schafale, M. P. and A. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Natural Heritage Program, N.C. Department of Environment, Health, and Natural Resources, Raleigh, NC.

EXHIBIT A

Non-Riverine Wet Hardwood Forest



Significant Natural Heritage Area (Avoided by Alt. L)
Significant Natural Heritage Area (Within Alt. L)

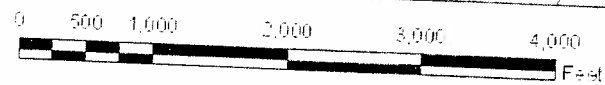
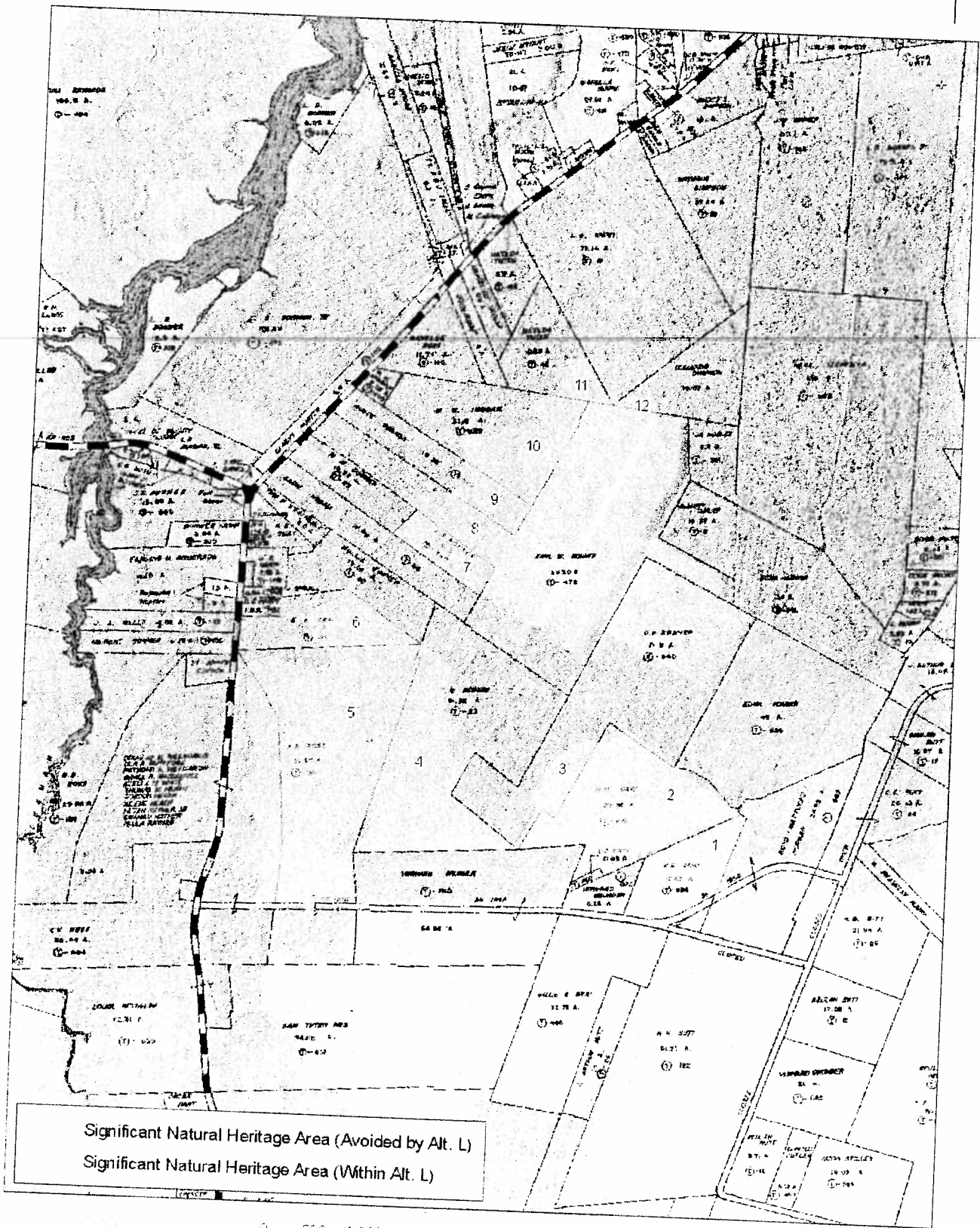
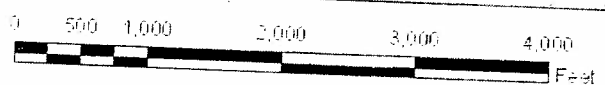


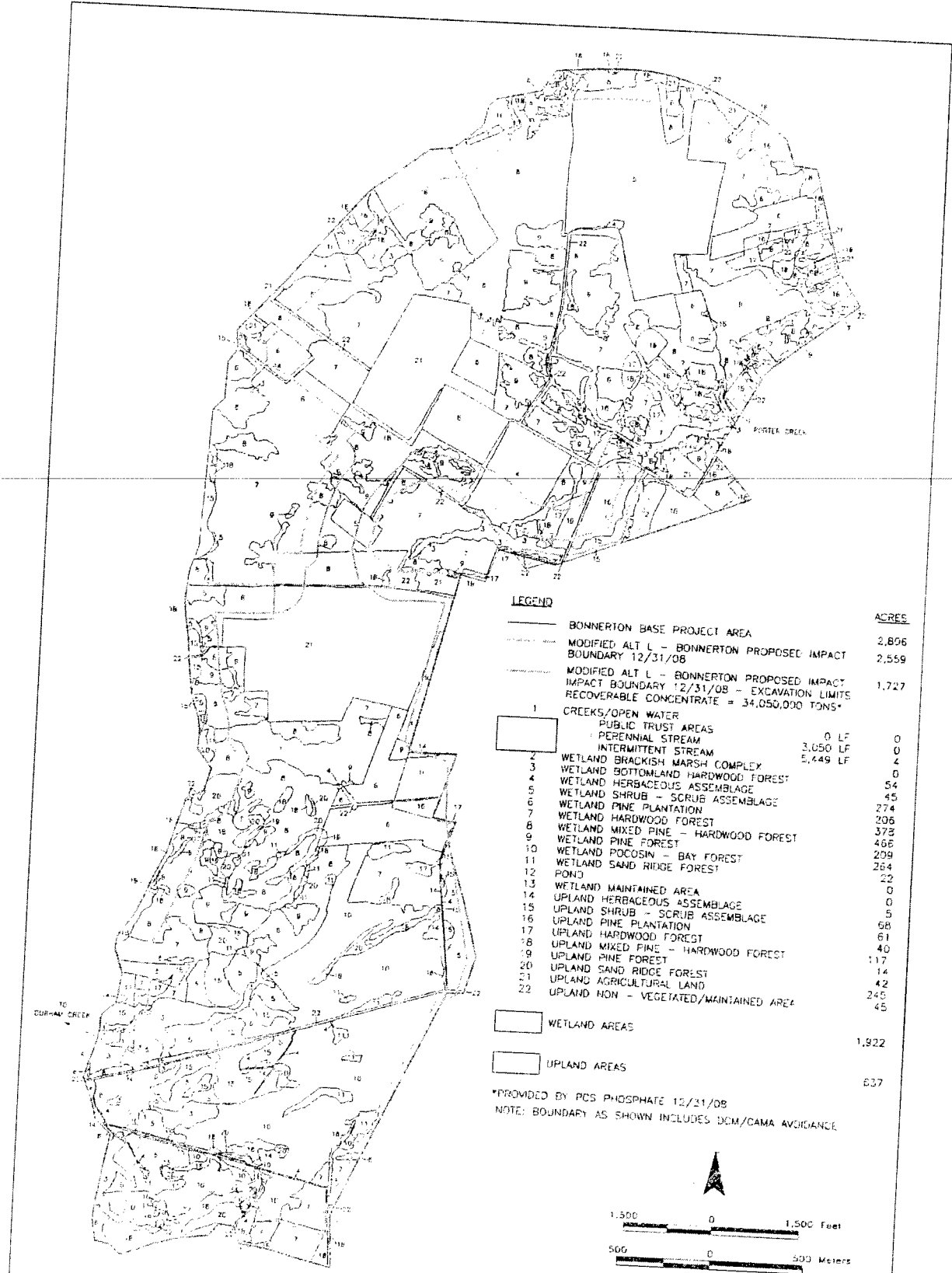
EXHIBIT A

Non-Riverine Wet Hardwood Forest



Significant Natural Heritage Area (Avoided by Alt. L)
Significant Natural Heritage Area (Within Alt. L)

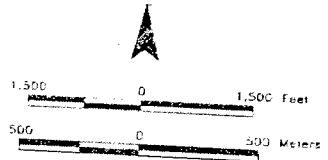




LEGEND

	ACRES
— BONNERTON BASE PROJECT AREA	2,806
--- MODIFIED ALT L - BONNERTON PROPOSED IMPACT BOUNDARY 12/31/08	2,559
--- MODIFIED ALT L - BONNERTON PROPOSED IMPACT BOUNDARY 12/31/08 - EXCAVATION LIMITS RECOVERABLE CONCENTRATE = 34,050,000 TONS*	1,727
1 CREEKS/OPEN WATER	
PUBLIC TRUST AREAS	0 LF
PERENNIAL STREAM	3,050 LF
INTERMITTENT STREAM	5,449 LF
2 WETLAND BRACKISH MARSH COMPLEX	0
3 WETLAND BOTTOMLAND HARDWOOD FOREST	4
4 WETLAND HERBACEOUS ASSEMBLAGE	54
5 WETLAND SHRUB - SCRUB ASSEMBLAGE	45
6 WETLAND PINE PLANTATION	274
7 WETLAND HARDWOOD FOREST	206
8 WETLAND MIXED PINE - HARDWOOD FOREST	373
9 WETLAND PINE FOREST	486
10 WETLAND POCOSIN - BAY FOREST	209
11 WETLAND SAND RIDGE FOREST	264
12 POND	22
13 WETLAND MAINTAINED AREA	0
14 UPLAND HERBACEOUS ASSEMBLAGE	0
15 UPLAND SHRUB - SCRUB ASSEMBLAGE	5
16 UPLAND PINE PLANTATION	58
17 UPLAND HARDWOOD FOREST	61
18 UPLAND MIXED PINE - HARDWOOD FOREST	40
19 UPLAND PINE FOREST	117
20 UPLAND SAND RIDGE FOREST	14
21 UPLAND AGRICULTURAL LAND	42
22 UPLAND NON - VEGETATED/MAINTAINED AREA	246
WETLAND AREAS	1,922
UPLAND AREAS	837

*PROVIDED BY PCS PHOSPHATE 12/31/08
NOTE: BOUNDARY AS SHOWN INCLUDES DCM/CAMA AVOIDANCE



Modified Alt L - Bonnerton Proposed Impact Boundary 12/31/08 - Biotic Communities Impacts	
PCS PHOSPHATE MINE CONTINUATION	
Scale: As shown	Drawn by: BFG
Date: 1/06/09	File: 1/06/09
Approved by:	