United States Department of Agriculture
Natural Resources Conservation Service
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100 Matsonford Road
Radnor, PA 19087-4585

Subject: Archaeology -- Geophysical Assistance **Date:** 29 December 1998

To: Mark W. Berkland
State Conservationist
USDA - NRCS
1835 Assembly Street, Room 950
Columbia, South Carolina 292

Purpose:
The purpose of this investigation was to provide geophysical field assistance to the South Carolina State Park Service.

Participating Agencies:
South Carolina State Park Service
USDA-Natural Resources Conservation Service

Principal Participants:
Donnie Barker, Chief Archaeologist, SC State Park Service, Columbia, SC
Jim Doolittle, Research Soil Scientist, USDA-NRCS, Radnor, PA
Jim Errante, Archaeologist, USDA-NRCS, Columbia, SC
Kurt Johnston, Superintendent, Rose Hill Plantation, SC State Park Service, Union, SC
Charles Harrison, Director, SC State Park Service, Columbia, SC
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Activities:
All field activities were completed during the period of 14 to 17 December 1998.

Equipment:
The electromagnetic induction meter used at Croft State Park is the EM31 manufactured by Geonics Limited.[1] This meter is portable and requires only one person to operate. McNeill (1980) has described principles of operation. No ground contact is required with this meter. This meter provides limited vertical resolution and depth information. Lateral resolution is approximately equal to the intercoil spacing. The EM31 meter operates at a frequency of 9,800 Hz and has theoretical observation depths of about 3 and 6 m in the horizontal and vertical dipole orientations, respectively (McNeill, 1980). Two components of the induced magnetic field are measured by EMI: quadrature phase and inphase components. Although measurements were made of both components, the quadrature phase produced the most readily interpretable results and is included in this report (see appendix). Apparent conductivity is determined from the quadrature phase component and is expressed in milliSiemens per meter (mS/m).

The ground-penetrating radar (GPR) unit used at Rose Hill Plantation State Historic Site was the Subsurface Interface Radar (SIR) System-2, manufactured by Geophysical Survey Systems, Inc.[1.] The SIR System-2 consists of a digital control unit (DC-2) with keypad, VGA video screen, and connector panel. A 12-volt battery powered the system. Morey (1974), Doolittle (1987), and Daniels and others (1988) have discussed the use and operation of GPR. The antenna used was the model 5103 (400 mHz).

[1] Trade names are used to provide specific information. Their use does not constitute endorsement by USDA-NRCS.

At Croft State Park, the position of each observation point was obtained with a Rockwell Precision Lightweight GPS Receiver (PLGR) [1.] The receiver was operated in the continuous mode using an external power source (portable 9-volt battery). The Universal Transverse Mercator (UTM) coordinate system was used.

To help summarize the results of this study, the SURFER for Windows software program developed by Golden Software, Inc., was used to construct two-dimensional simulations.[2] Grids were created using kriging methods. In the enclosed plots, shading and filled contour lines have been used. These options were selected to help emphasize spatial patterns. Other than showing trends and patterns in apparent conductivity (i.e., zones of higher or lower electrical conductivity), no significance should be attached to the shades themselves.

Discussion:

Croft State Park

Croft State Park is located on grounds which were formerly part of a World War II Army training camp known as Camp Croft. From March 1941 to July 1945, nearly 200,000 men received training at Camp Croft in all phases of infantry combat. Following the end of the war, the 19,000-acre camp fell into disuse and was declared surplus property by the Federal Government. In 1949, the State of South Carolina purchased 7,088 acres of the former camp for development as a state park. The South Carolina Department of Parks, Recreation and Tourism has acquired unconfirmed information concerning the locations of buried military materials. These features are believed to be buried along a former roadway. Depth of burial has been reported to be less than 12 feet. The South Carolina Department of Parks, Recreation and Tourism requested an electromagnetic induction survey to help verify the information concerning this suspected site.

Electromagnetic induction (EMI) has been used to locate and define archaeological features (Bevan, 1983; Frohlich and Lancaster, 1986; and Dalan, 1991). These studies have demonstrated the utility of EMI for locating, identifying, and determining the boundaries of various types of cultural features such as buried structures, tombs, filled fortification ditches, and earthen mounds. Advantages of EMI methods include speed of operation and moderate resolution of subsurface features. Results of EMI surveys are interpretable in the field. This technique can provide in a relatively short time the large number of observations needed for site characterization and assessments. Maps prepared from correctly interpreted apparent conductivity data provide a basis for assessing site conditions and for planning further investigations.

Electromagnetic induction uses electromagnetic energy to measure the apparent conductivity of earthen materials. Apparent conductivity is a weighted average conductivity measurement for a column of earthen materials to a theoretical observation depth. Variations in apparent conductivity are produced by changes in the electrical conductivity of earthen materials. The electrical conductivity is influenced by the volumetric water content, the type and concentration of ions in solution, the temperature and phase of the soil water, and the amount and type of clays in the soil matrix (McNeill, 1980). In soils, apparent conductivity increases with increases in the amount of soluble salts, water, and/or clays. Typically, areas of soil disturbances or buried metallic objects produce measurements that contrast with the background levels of apparent conductivity. These anomalous values help to identify areas of disturbance, cut and fill operations, and buried objects.

Values of apparent conductivity are seldom diagnostic in themselves, but variations in these measurements have used to infer the locations of buried cultural features. Interpretations of EMI data are based on the identification of spatial patterns within data sets. The location, orientation, size, and shape of patterns revealed on two-dimensional plots often provide clues as to the cultural features producing them.

The detection of buried cultural features is affected by the electromagnetic gradient existing between the buried cultural feature and the soil. The greater or more abrupt the difference in electrical properties between the buried cultural feature and the surrounding soil matrix, the more likely the artifact will be detected. Buried cultural features with electrical properties similar to the surrounding soil matrix are often difficult to discern.

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[2] Trade names are used to provide specific information. Their use does not constitute endorsement by USDA-NRCS.

Field Procedures:
The suspected portion of the former roadway, though discernible in the field, is partially hidden by trees and litter. A traverse line was established near the centerline of this former roadway. Survey flags were inserted in the ground at a 20-foot interval along this line and served as observation points. Two additional lines were established on each side of the former road. Apparent conductivity was measured at 20-foot intervals along the centerline and at varying intervals along each of the four nearby traverse lines. This process produced 165 observation points. The coordinates of each observation point were obtained with a Rockwell Precision Lightweight GPS receiver. The five traverses formed a crude grid across the study area. At each observation point, measurements were obtained with the EM31 meter in the horizontal and vertical dipole orientations. For each measurement, the meter was placed on the ground surface.

Results:
Table 1 summarizes apparent conductivity measurements along the former road and for the remainder (background) of the survey area. Along the former road, the apparent conductivity of the upper 3 meters (measured with the EM31 meter in the horizontal dipole orientation) averaged 47.71 mS/m with a range of 1.8 to 127.6 mS/m. One-half of the observations had values of apparent conductivity between 3.2 and 82.8 mS/m. The apparent conductivity of the upper 6 meters (measured with the EM31 meter in the vertical dipole orientation) averaged 11.74 mS/m with a range of –18.4 to 39.6 mS/m. One-half of the observations had values of apparent conductivity between 2.4 and 22.2 mS/m. This vertical trend (decreasing conductivity with increasing soil depth) suggests the probable occurrence of anomalous and highly conductive materials near the surface of the former roadway.

In background areas away from the former road, the apparent conductivity of the upper 3 meters (measured with the EM31 meter in the horizontal dipole orientation) averaged 2.74 mS/m with a range of 0.0 to 13.8 mS/m. One-half of the observations had values of apparent conductivity between 2.4 and 4.8 mS/m. The apparent conductivity of the upper 6 meters (measured with the EM31 meter in the vertical dipole orientation) averaged 5.04 mS/m with a range of –23.2 to 18.8 mS/m. One-half of the observations had values of apparent conductivity between 2.6 and 7.2 mS/m. In background areas away from the former road, apparent conductivity was low and increased slightly with depth. This vertical trend (increasing conductivity with increasing soil depth) was attributed principally to increased clay and moisture contents with increasing soil depth.

Table 1-Basic Statistics
EMI Survey Croft State Park
Spartanburg County, South Carolina
(All values are in mS/m)

Former Road (N = 40)

				Quartiles			
Meter	Orientation	Minimum	Maximum	1st	Median	3rd	Average
EM31	Horizontal	1.8	127.6	3.2	44.4	82.8	47.71
EM31	Vertical	-18.4	39.6	2.4	7.8	22.2	11.74

Away from Road (N = 125)

				Quartiles			
Meter	Orientation	Minimum	Maximum	1st	Median	3rd	Average
EM31	Horizontal	0.0	13.8	2.4	3.2	4.8	2.74
EM31	Vertical	-23.2	18.8	2.6	4.8	7.2	5.04

Values of apparent conductivity were highly variable along the road but were low and invariable across the remainder of the survey area. In the background areas away from the former road, a majority of EMI measurements were between 2.0 and 7.5 mS/m. The high variability of apparent conductivity along the road suggests disturbance and the likely burial of cultural features. For the purpose of this investigation, areas having

apparent conductivity less than 0 mS/m or greater than 10mS/m are considered anomalous. Both negative and positive values of apparent conductivity were obtained. Negative or high positive values of apparent conductivity are often attributed to the presence of metallic objects within the electromagnetic fields of the meter.

Figure 1 contains two-dimensional plots of apparent conductivity. The left-hand plot represents data collected with the EM31 meter in the horizontal dipole orientation. The right-hand plot represents data collected with the EM31 meter in the vertical dipole orientation. The locations of the former road, a cemetery, and a paved road have been shown in each plot. In each of these plots, the isoline interval is 10 mS/m.

In both plots, spatial patterns indicate that anomalous features underlie the southern 560 feet of the former road. In this portion of the roadway, values of apparent conductivity are highly variable and distinct from adjoining areas. Along the northern 240 feet of the former road, values of apparent conductivity were low, invariable, and indistinct from adjoining areas. Table 2 summarizes the disparity of apparent conductivity between the two portions of the former road.

Table 2 Basic Statistics for the Former Road
(All values are in mS/m)

Southern 560 Feet
(N = 28)

				Quartiles			
Meter	Orientation	Minimum	Maximum	1st	Median	3rd	Average
EM31	Horizontal	3.9	127.6	43.3	67.3	86.2	69.19
EM31	Vertical	-18.4	39.6	4.8	16.5	27.6	15.87

Northern 240 Feet
(N = 12)

				Quartiles			
Meter	Orientation	Minimum	Maximum	1st	Median	3rd	Average
EM31	Horizontal	2.2	6.2	2.2	2.8	3.2	3.22
EM31	Vertical	1.0	7.8	2.4	2.8	3.02	3.27

Conclusions:
An electromagnetic induction survey revealed an anomalous area along a 560-foot portion of a former roadway within Croft State Park. This area is characterized by exceptionally high and variable apparent conductivity. The pattern of these values suggests the likely burial of cultural objects beneath this portion of the former road. Along this portion of the former road, values of apparent conductivity decreased with increasing depth of observation (measurements made in the horizontal dipole orientation were typically higher than those made in the vertical dipole orientation). This relationship suggests that the anomalous features are buried close to the surface and within the upper 3 meters of the soil profile.

Rose Hill Plantation
Rose Hill Plantation State Historic Site is located near the town of Union, South Carolina. The 44-acre park contains the former home of South Carolina's "Secession Governor" William H. Gist. This Federal style house was completed in 1832. The grounds contained several outbuildings and gardens. In 1860, Gist managed a 5,000-acre cotton plantation and owned 179 slaves. The slaves lived in twenty slave cabins dispersed about Rose Hill. The purpose of this investigation was to locate archaeological remains of former buildings.

Field Procedures:

Seven grids were established across several areas near the Gist's house. The grid interval was typically 10 feet, but ranged to 25 feet. Survey flags were inserted in the ground at each grid intersection and served as reference points. Pulling the 400 mHz antenna along the grid lines completed radar traverses.

Discussion:

In the search for buried cultural features with GPR, success is never guaranteed. Even under ideal site and soil conditions, some buried cultural features will be missed with GPR. The usefulness of GPR depends on the amount of uncertainty or omission that is acceptable to archaeologists.

The detection of buried cultural features with GPR is affected by the electromagnetic gradient existing between the buried cultural feature and the soil; the size, shape, and orientation of the buried cultural feature; and the presence of scattering bodies within the soil (Vickers et al., 1976). The amount of energy reflected back to an antenna by an interface is a function of the dielectric gradient existing between the buried cultural feature and the soil. The greater and more abrupt the difference in electromagnetic properties, the greater the amount of energy reflected back to the antenna, and the more intense will be the amplitude of the recorded image. At Rose Hill Plantation State Historic Site, buried bricks were difficult to detect with GPR. It is believed that the bricks have electromagnetic properties similar to the surrounding soil matrix, are poor reflectors of electromagnetic energy, and are difficult to detect on radar profiles

The size, orientation, and depth to a buried cultural feature affect detection. Large, electrically contrasting features reflect more energy and are easier to detect than small, less contrasting features. Small, shallowly buried features will be missed, unless located directly beneath the aperture of the radar's antenna. With GPR surveys covering extensive areas and using large grid intervals, the detection of small cultural features is considered fortuitous. No large cultural feature (e.g. cellar, privy, and vault) was detected at Rose Hill Plantation State Historic Site. Several pillars that supported outbuildings or slave cabins may have been detected in several grids (grid #3, #5, and #6).

Cultural features are difficult to distinguish in soils having numerous rock fragments, roots, animal burrows, modern cultural features, and debris or fill layers. These scattering bodies produce undesired subsurface reflections that complicate radar imagery and can mask reflections from buried cultural features. Frequently, "desired" cultural features are indistinguishable from background clutter. In soils having numerous scattering bodies, GPR surveys often provide little meaningful information to supplement traditional sampling methods. Scattering bodies in survey grids #1 and #2 complicated the identification of buried cultural features.

Figures 3 to 8 summarize the results of the radar survey. In each plot, the locations of trees and buried point anomalies have been shown. In some plots, conspicuous subsurface point anomalies have been identified. For grids #4, #5, and #7, these conspicuous point anomalies are believed to represent the remains of former pillars to outbuildings or slave cabins. The direction and file number of each radar traverse has also been identified in each figure.

Figure 3 is a simulation summarizing radar interpretations from Grid #1. This grid was located along a former roadway located to the south and leading to the Gist's house. Numerous point anomalies were detected within this survey area. Many of these reflectors are believed to represent rock fragments or tree roots. These reflectors appear to be more numerous and concentrated in the northeast portion of the survey area. This portion of the grid is the lowest lying area within the grid. As a consequence, this portion of the survey area is considered the most unsuitable site for an outbuilding or slave cabin. Although many of the anomalies are believed to represent rock fragments, the identity of some of these point reflectors should be verified. The concentration of these anomalies within the northeast corner of the study area may be of some significance to archaeologists.

Figure 4 is a simulation summarizing the radar interpretations from Grid #2. This grid was located to the southwest of the Gist's house. Several subsurface point anomalies were detected with GPR on lower slope positions located in the southern portion of the grid. This area is the most distant from the Gist house. Three conspicuous subsurface anomalies were detected within this grid.

Figure 5 is a simulation summarizing the radar interpretations from Grid #3. This grid was located to the immediate west of the Gist's house. An entry way to the gardens and Gist's house is located midway along the eastern border of the grid. Few point anomalies were detected within this grid.

Figure 6 is a simulation summarizing the radar interpretations from Grid #4. This grid was located in front of the carriage shed. Although few point anomalies were detected within this grid, a buried pillar is believed to be the "conspicuous anomaly" seen in Figure 6.

Figure 7 is a simulation summarizing the radar interpretations from Grid #5. This grid was located on the north side of the existing slave cabin. Three buried pillars ("conspicuous anomaly") may have been detected within the survey area.

Figure 8 is a simulation summarizing the radar interpretations from Grid #7. This grid was located between the carriage shed and the slave cabin. Several point anomalies and three buried pillars ("conspicuous anomaly") may have been detected within the survey area.

Results:

1. An electromagnetic induction survey revealed a 560-footlong anomalous area along a former roadway within Croft State Park. This area is characterized by exceptionally high and variable apparent conductivity. Spatial patterns suggest the likely burial of cultural objects beneath this portion of the former road. Along this portion of the former road, values of apparent conductivity decreased with increasing depth of observation (measurements made in the horizontal dipole orientation were typically higher than those made in the vertical dipole orientation). This relationship suggests that the anomalous features are buried close to the surface and within the upper 3 meters of the soil profile.

2. At Rose Hill Plantation State Historic Site and with a ten-foot (grid) search strategy, no major subsurface structures were identified with GPR. Point anomalies were more numerous in grids located to the south and southwest of the Gist's House. Several conspicuous subsurface point anomalies were detected to the east of the Gist's House. These features may represent the remnants of former pillars used to support outbuildings and slave cabins.

3. All radar records of the Rose Hill Plantation State Historic Site have been returned to Donnie Barker under a separate cover letter. These records document our work and may serve as a guide for future archaeological activities at Rose Hill Plantation State Historic Site.

It was my and the National Soil Survey Center pleasure to be of assistance to you and the South Carolina State Park Service.

With kind regards,

James A. Doolittle

Research Soil Scientist

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References

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EMI DATA FROM CROFT STATE PARK

Waypoint	Easting	Northing	EM31H	EM31V
WP001	420088	3860742	3.9	20.2
WP002	420083	3860747	10.0	28.8
WP003	420081	3860763	39.2	16.6
WP004	420077	3860764	42.4	16.2
WP005	420071	3860779	84.2	-11.4
WP006	420068	3860777	112.6	31.4
WP007	420066	3860790	78.4	-18.4
WP008	420068	3860793	127.6	13.8
WP009	420064	3860790	99.4	-3.0
WP010	420062	3860790	51.6	-14.2
WP011	420064	3860814	44.4	29.0
WP012	420061	3860814	43.6	22.6
WP013	420055	3860823	110.2	-0.2
WP014	420053	3860819	53.4	36.6
WP015	420049	3860826	38.0	39.6
WP016	420059	3860840	62.0	38.6
WP017	420053	3860848	51.2	16.2
WP018	420049	3860843	69.4	26.6
WP019	420051	3860855	120.4	1.2
WP020	420050	3860864	86.0	6.0
WP021	420049	3860871	70.6	27.6
WP022	420045	3860879	82.8	22.2
WP023	420041	3860893	84.6	14.2
WP024	420046	3860887	86.8	14.4
WP025	420041	3860898	116.0	7.6
WP026	420045	3860900	65.2	18.6
WP027	420038	3860904	34.2	27.6
WP028	420039	3860912	5.4	5.8
WP029	420037	3860916	3.4	7.8
WP030	420037	3860920	3.0	3.4
WP031	420036	3860926	6.2	1.0
WP032	420032	3860927	3.2	2.8
WP033	420031	3860936	3.0	2.8
WP034	420031	3860940	2.8	3.0
WP035	420032	3860944	2.6	2.8
WP036	420030	3860950	2.2	2.4
WP037	420028	3860954	2.4	2.4
WP038	420020	3860953	2.2	2.4
WP039	420023	3860982	2.2	2.6
WP040	420030	3860977	1.8	2.2
WP041	420027	3860989	1.6	2.6
WP042	420025	3860968	0.8	3.0
WP043	420025	3860987	1.8	3.2
WP044	420028	3860979	2.0	3.0
WP045	420030	3860964	1.8	2.4
WP046	420036	3860952	2.4	2.6
WP047	420033	3860952	2.4	2.6
WP048	420034	3860935	2.6	4.0
WP049	420035	3860935	2.6	3.0
WP050	420037	3860930	2.4	3.8
WP051	420038	3860930	2.4	3.8
WP052	420040	3860922	2.4	7.8
WP053	420039	3860917	2.6	7.0
WP054	420045	3860911	2.8	8.6
WP055	420044	3860914	2.8	8.4
WP056	420046	3860904	2.8	7.8
WP057	420046	3860896	3.2	6.8
WP058	420050	3860897	3.0	7.0
WP059	420051	3860873	3.8	7.8

Waypoint	Easting	Northing	EM31H	EM31V
WP060	420048	3860875	2.6	8.6
WP061	420052	3860868	2.6	9.4
WP062	420054	3860858	2.8	9.4
WP063	420055	3860850	2.6	7.2
WP064	420058	3860847	2.4	6.4
WP065	420057	3860844	2.6	6.8
WP066	420059	3860832	2.8	8.2
WP067	420072	3860824	2.6	8.8
WP068	420061	3860819	2.6	8.8
WP069	420071	3860828	2.8	9.6
WP070	420067	3860808	2.8	9.0
WP071	420066	3860812	3.0	10.6
WP072	420069	3860803	3.0	10.4
WP073	420072	3860790	3.0	9.6
WP074	420073	3860791	2.6	8.0
WP075	420072	3860780	2.4	7.0
WP076	420083	3860780	2.2	7.4
WP077	420083	3860777	2.4	7.6
WP078	420083	3860774	1.8	7.8
WP079	420083	3860774	3.0	9.2
WP080	420079	3860793	4.0	7.6
WP081	420078	3860780	3.2	6.2
WP082	420070	3860809	2.8	5.6
WP083	420071	3860822	2.8	5.4
WP084	420067	3860839	2.6	5.0
WP085	420064	3860832	2.6	5.2
WP086	420063	3860850	2.8	4.6
WP087	420057	3860857	3.0	4.8
WP088	420057	3860874	2.6	4.4
WP089	420056	3860891	3.0	4.6
WP090	420058	3860893	2.8	4.2
WP091	420056	3860901	2.6	4.2
WP092	420051	3860913	2.6	6.6
WP093	420055	3860921	13.8	-23.2
WP094	420049	3860919	3.0	5.8
WP095	420047	3860935	3.0	3.8
WP096	420041	3860937	2.8	3.2
WP097	420038	3860954	0.0	4.6
WP098	420038	3860957	2.8	2.4
WP099	420037	3860973	2.6	2.6
WP100	420035	3860984	2.2	2.4
WP101	420015	3860986	2.2	2.8
WP102	420010	3860966	2.2	2.8
WP103	420014	3860959	2.4	2.8
WP104	420019	3860959	2.4	2.6
WP105	420021	3860957	2.4	2.4
WP106	420025	3860950	2.4	2.8
WP107	420016	3860953	2.6	3.2
WP108	420020	3860939	1.8	4.8
WP109	420029	3860931	3.4	4.6
WP110	420024	3860924	2.4	4.8
WP111	420031	3860926	2.2	4.8
WP112	420030	3860915	3.6	18.8
WP113	420034	3860917	3.6	-17.6
WP114	420036	3860903	2.4	12.8
WP115	420035	3860897	2.0	8.8
WP116	420035	3860897	2.6	7.6
WP117	420033	3860888	2.4	7.6
WP118	420040	3860882	2.4	10.0
WP119	420040	3860875	3.0	10.6

WP120	420039	3860873	3.0	7.8

Waypoint	Easting	Northing	EM31H	EM31V
WP121	420043	3860870	2.0	5.6
WP122	420037	3860853	2.2	5.4
WP123	420043	3860854	2.6	5.2
WP124	420037	3860834	2.8	6.6
WP125	420048	3860843	2.6	6.0
WP126	420039	3860846	2.6	5.2
WP127	420044	3860829	3.0	5.4
WP128	420051	3860815	2.6	5.2
WP129	420053	3860815	2.8	5.4
WP130	420058	3860812	3.2	5.4
WP131	420063	3860798	2.6	5.6
WP132	420051	3860796	3.0	5.0
WP133	420055	3860790	3.2	4.6
WP134	420056	3860781	3.0	4.2
WP135	420062	3860783	2.4	4.6
WP136	420070	3860779	2.4	3.6
WP137	420066	3860770	2.2	4.2
WP138	420070	3860753	2.2	4.0
WP139	420070	3860750	2.6	4.8
WP140	420082	3860752	2.6	4.6
WP141	420074	3860741	3.2	3.6
WP142	420065	3860748	2.8	2.4
WP143	420059	3860758	2.3	2.7
WP144	420054	3860770	2.9	3.7
WP145	420045	3860786	2.6	2.8
WP146	420041	3860796	2.7	3.2
WP147	420031	3860805	2.7	3.2
WP148	420037	3860825	2.8	3.2
WP149	420032	3860849	2.6	3.4
WP150	420028	3860841	2.6	3.5
WP151	420033	3860863	2.9	3.5
WP152	420036	3860889	2.6	3.6
WP153	420025	3860898	2.6	3.8
WP154	420018	3860908	4.5	-7.0
WP155	420020	3860920	2.6	5.3
WP156	420020	3860930	3.1	3.4
WP157	420017	3860944	2.6	2.8
WP158	420016	3860953	2.3	3.1
WP159	420012	3860971	2.7	2.6
WP160	420073	3860934	4.2	5.8
WP161	420071	3860917	5.0	5.5
WP162	420080	3860885	2.5	4.6
WP163	420087	3860825	2.6	6.9
WP164	420086	3860776	2.7	7.4
WP165	420097	3860742	2.7	6.1