SITE ASSESSMENT REPORT

Proposed Natural Gas Combined-Cycle Electric Generating Unit
Kentucky Utilities Company
Green River Generating Station
811 Power Plant Road
Central City, Muhlenberg County, Kentucky 42330

Prepared for
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ADT	Average daily traffic
AMSL	Above mean sea level
BLM	US Bureau of Land Management
CCR	Coal combustion residues
CTG	Combustion turbine generator
dB	Decibels
dBA	A-weighted decibels
FEMA	Federal Emergency Management Agency
HRSG	Heat recovery steam generator
Hz	Hertz
KOP	Key observation points
KPDES	Kentucky Pollution Discharge Elimination System
KRS	Kentucky Revised Statutes
KU	Kentucky Utilities
KYTC	Kentucky Transportation Cabinet
L_{10}	Sound level exceeded 10 percent of sampling period (often referred to as intrusive sound level)
L_{50}	the sound level exceeded 50 percent of sampling period
L_{90}	the sound level exceeded 90 percent of sampling period (often referred to as residual or background sound level)
L_{eq}	The average sound level for a specific time period
L_{dn}	Day-Night sound level
L_w	Sound power level
MW	Megawatts

NGCC	Natural gas combined-cycle electric generating unit
NRCS	Natural Resources Conservation Service
Owner	Louisville Gas & Electric and Kentucky Utilities
PVA	Property Valuation Administrator (Muhlenberg and Ohio Counties)
SAR	Site Assessment Report
STG	Steam turbine generator
TGT	Texas Gas Transmission, LLC
USDA	U.S. Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VRM	Visual Resource Management

EXECUTIVE SUMMARY

Presented below is a summary of key information and findings contained within this Site Assessment Report.

This Site Assessment Report (SAR) has been prepared to provide evaluation, documentation, and reporting pursuant to requirements in Kentucky Revised Statues (KRS) 278.708 for a new Natural Gas Combined-Cycle Electric Generation Unit (NGCC) proposed to replace existing Coal-Fired Electric Generating Units at Kentucky Utilities (KU) Green River Generating Station in Muhlenberg County, Kentucky.

Operation of existing Coal-Fired Electric Generating Units at the KU Green River Generating Station is scheduled for termination in 2015, prior to initiation of construction for the proposed NGCC Unit. Construction of the NGCC and related infrastructure is estimated to require a period of roughly three years for completion, with May 2018 as a target date for commercialization of the NGCC Unit.

KU will acquire a portion of an adjacent parcel to the southwest of its property to comply with setback requirements of KRS 278.704(2), (3), or (5).

No significant impacts associated with the proposed NGCC on air, land, or water resources have been identified in the analyses contained within this SAR. Furthermore, no significant impacts or complications on surrounding infrastructure or nearby residents (including viewshed impairments, property value effects, excessive noise, and transportation impacts) have been identified.

Replacement of the existing Coal-Fired Electric Generating Units will result in the following benefits:

- Generation and addition of coal combustion residues to site management/ control structures will cease
- Water withdrawal rates from the Green River for process water will be significantly reduced
- Effluent discharge rates from the facility to the Green River will be reduced
- Shipments of coal to the site will be discontinued

- The NGCC will have a smaller footprint and overall lower profile

Analysis indicates that nearly all infrastructure necessary for the NGCC is already in place at the site, requiring only minor additions, modifications, and/or connections. The only significant new service required is an underground natural gas pipeline which will be connected to an existing pipeline in the area and constructed entirely, or almost entirely, on existing easements owned by KU and/or the selected pipeline company.

An assessment of the scenic compatibility of the proposed NGCC conducted in accordance with Bureau of Land Management protocols indicates that the proposed facility will not have an impact on surrounding scenic value and no related mitigative measures are necessary.

Evaluation of potential impact of the proposed NGCC on surrounding property values resulted in a determination that there would be no negative effects associated with the proposed facility. Furthermore, location of the proposed NGCC on the site of the existing Green River Generating Station ensures its compatibility with existing land use.

Completion of an ambient background noise assessment and evaluation of potential impacts for noise emissions from the proposed NGCC resulted in a determination that no significant noise impacts would result from the proposed action, and no related mitigation is indicated.

Consideration of highway, railroad, and barge transport modes was included in a transportation analysis addressing potential impacts associated with construction and operation of the proposed NGCC. Based on this analysis, no significant impacts on transportation were identified.

Potential concerns associated with generation of fugitive dust during construction were identified and determined to be manageable using readily available best management practices which will also be incorporated into the facility's existing Kentucky Pollution Discharge Elimination System (KPDES) permit.

1.0 PURPOSE AND SCOPE

The purpose of this SAR is to provide evaluation, documentation, and reporting pursuant to requirements in KRS 278.708 for a new NGCC Unit proposed to replace existing Coal-Fired Electric Generating Units at the KU Green River Generating Station in Muhlenberg County, Kentucky.

Requirements for completion of the SAR are contained in KRS 278.706 as excerpted below:

> ***"Any person seeking to obtain a construction certificate from the board to construct a merchant electric generating facility shall file an application at the office of the Public Service Commission." [KRS 278.706(1)]"*** and

…such application shall contain:

> ***"A site assessment report as specified in KRS 278.708. The applicant may submit and the board may accept documentation of compliance with the National Environmental Policy Act (NEPA) rather than a site assessment report." [KRS 278.706(2)(l)]"***

The scope of the SAR is defined pursuant to the statutory requirements outlined in KRS 278.708 Site Assessment Report -- Consultant -- Mitigation Measures, as excerpted below:

> ***(1) Any person proposing to construct a merchant electric generating facility shall file a site assessment report with the board as required under KRS 278.706(2)(l).***
>
> ***(2) A site assessment report shall be prepared by the applicant or its designee.***
>
> ***(3) A completed site assessment report shall include:***
>
> > ***(a) A description of the proposed facility that shall include a proposed site development plan that describes:***
> >
> > 1. ***Surrounding land uses for residential, commercial, agricultural, and recreational purposes;***
> >
> > 2. ***The legal boundaries of the proposed site;***

3. ***Proposed access control to the site;***

4. ***The location of facility buildings, transmission lines, and other structures;***

5. ***Location and use of access ways, internal roads, and railways;***

6. ***Existing or proposed utilities to service the facility;***

7. ***Compliance with applicable setback requirements as provided under KRS 278.704(2), (3), or (5); and***

8. ***Evaluation of the noise levels expected to be produced by the facility;***

(b) An evaluation of the compatibility of the facility with scenic surroundings;

(c) The potential changes in property values resulting from the siting, construction, and operation of the proposed facility for property owners adjacent to the facility;

(d) Evaluation of anticipated peak and average noise levels associated with the facility's construction and operation at the property boundary; and

(e) The impact of the facility's operation on road and rail traffic to and within the facility, including anticipated levels of fugitive dust created by the traffic and any anticipated degradation of roads and lands in the vicinity of the facility.

(4) The site assessment report shall also suggest any mitigating measures to be implemented by the applicant including planting trees, changing outside lighting, erecting noise barriers, and suppressing fugitive dust.

Effective: April 24, 2002

This SAR for the proposed KU NGCC located at 811 Power Plant Road, Central City, Muhlenberg County, Kentucky 42330 has been prepared to meet the requirements of KRS 278.

2.0 INTRODUCTION

The project is proposed for development, construction, and operation of a nominal 700 MW NGCC at the KU Green River Generating Station. The Green River Generating Station currently utilizes two coal-fired electric generating units to produce 180 MW.

Construction of the proposed NGCC will commence in 2015. NGCC construction is scheduled to be completed over a three year period, with commercialization of the unit anticipated in 2018.

2.1 Location

As shown in Figure 1, Muhlenberg County Map, KU's Green River Generating Station is located in the far northeast area of Muhlenberg County, Kentucky between US 431 and the Green River, near River Mile 82. The site lies mostly within the extreme northwest corner of the United States Geological Survey (USGS) 7.5 Minute Topographic Quadrangle Map for the Central City East, KY Quadrangle, with portions lying in the extreme northeast corner of the USGS 7.5 Minute Quadrangle Map for the Central City West, KY Quadrangle.

The Kentucky Geologic Map Information Service, found on the Internet at URL http://kgs.uky.edu/kgsmap/KGSGeoServer/, was used to develop Figure 2, Topographic Vicinity Map, combining portions of the USGS 7.5 Minute Topographic Quadrangle Maps for Central City East, KY and Central City West, KY. The proposed NGCC facility occurs at approximate geographic coordinates of 37^0 21' 50" North latitude and 87^0 07' 27" West longitude, corresponding to Universal Transverse Mercator (UTM) coordinates of 489,018 meters Easting, 4,135,252 meters Northing, in Zone 16S, based on the horizontal datum for the World Geodetic System of 1984 (WGS84). The site lies at an elevation of approximately 419 feet above Mean Sea Level (AMSL) relative to the National Geodetic Vertical Datum of 1929 (NGVD29).

Figure 3, Proposed NGCC Site Layout, shows the layout of the proposed NGCC site within the 416 acre property currently owned by KU that contains the existing KU Coal-Fired Electric Generating facilities. In order to meet setback requirements contained in Kentucky Revised Statutes (KRS) 278.704, the proposed project requires acquisition of part of an adjacent parcel of land to the south-southwest of the existing property owned by KU (Ray C. Dunlap - Deed Book 481, Page 380) as identified in Figure 4, Surrounding Properties Map.

3.0 PROJECT DESCRIPTION

The proposed project includes development, construction, and operation of a nominal 700 MW NGCC. The proposed NGCC will replace two existing Coal-Fired Steam Electric Generating Units at KU's Green River Generating Station that currently generate a combined 180 MW. As noted, the proposed facility will be constructed within the boundaries of an approximately 416 acre parcel owned by KU currently containing the existing Coal-Fired Steam Electric Generating Units. More specifically, it will be located immediately to the northwest of the existing Green River Coal-Fired Steam Electric Generating Units and related facilities. As such, considerable required infrastructure is already present or immediately adjacent to the proposed facility.

The proposed NGCC will include the following structures / facilities as shown on Figure 3:

- Combustion Turbines
- Heat Recovery Steam Generator
- Steam Turbine Building
- Administration / Control Building
- Gas Yard
- Gas Compressor Building
- Circulating Water Pumps
- Emergency Generator
- Demineralized Water Storage Tank
- Plant Parking
- Generator Step-Up Transformer
- Switchyard
- Cooling Tower
- Warehouse/Maintenance Shop
- Water Treatment Building
- Water Pretreatment Area
- Unit Auxiliary Transformers
- Service / Fire Water Storage Tank
- Fire Protection Pump House
- Continuous Emissions Monitoring Shelter Enclosure
- Waste Water Tank
- Circulating Water Chemical Feed Building
- Auxiliary Boiler Building

- Existing Switchyard
- Boiler Feed Pump / Electrical Building
- Demineralized Water Forwarding Pumps
- Waste Water Pump Skid
- Backwash Collection Basin
- Service Water Pump Skid
- Ammonia Unloading / Storage / Forwarding
- Combustion Turbine Crane Maintenance Area
- $C0_2$ Bulk Storage Tank
- Nitrogen Storage Tank

During construction of the NGCC, the following temporary infrastructure will be required (also depicted on Figure 3):

- Laydown and Construction Parking Area (Approximately 30 Acres)
- Construction Road
- Main Gate

Once commercialized, the proposed NGCC electric generating unit will be served by the following infrastructure:

- Access Road (the existing Power Plant Road extending from US 431 to the facility will be used to access the proposed site with new driveways to be constructed surrounding the proposed facility)
- Potable Water Supply Line (connection to existing potable water supply line)
- Sanitary Wastewater Discharge Collection System (new connection to new on-site package sewage treatment plant)
- Process Wastewater Discharge Collection and Treatment (new processes and connection to existing facilities for ultimate discharge to Green River via currently permitted outfalls)
- Stormwater Collection / Retention System (connection to existing system)
- Natural Gas Supply Line. A natural gas pipeline will be extended to the site from an existing supply line in the area. As shown in Figure 3, the pipeline will enter the site along an existing KU electric transmission right-of-way.

At the time of this report, four candidate routes for extending the required natural gas supply via underground pipeline to the facility are under consideration, as shown in Figure 5 – Pipeline Route Candidates. These include the following connections:

- 11 miles southwest of Central City connect to Texas Gas Transmissions (TGT) pipeline at mile point 15+4870;
- 11 miles southwest of Central City connect to TGT pipeline at mile point 17+1700;
- 19 miles northwest of Central City connect to TGT pipeline near KY-370 at Ashbyburg Road; or
- 23 miles northwest of Central City connect to ANR Transmission (ANR) pipeline near KY-370 at Gravel Pit Road.

The natural gas transmission pipeline is specified to be 16 to 24 inches in diameter. It will be extended entirely or nearly entirely along existing utility right-of-way belonging to TGT, ANR, and / or KU from an existing valve station to a new meter and pressure regulating station at the proposed facility. Delivery pressure for the natural gas pipeline will be 500 to 700 psig at the Green River Station boundary. Depending upon the ultimate model of gas combustion turbine selected for the proposed NGCC, additional on-site gas compression may be required.

3.1 Site Setting

3.1.1 Physiographic Setting

As shown to the right in Exhibit 3.1, Physiographic Setting, the Green River Station site lies in the northeastern portion of Muhlenberg County, Kentucky, near the center of Western Kentucky Coal Field physiographic region.

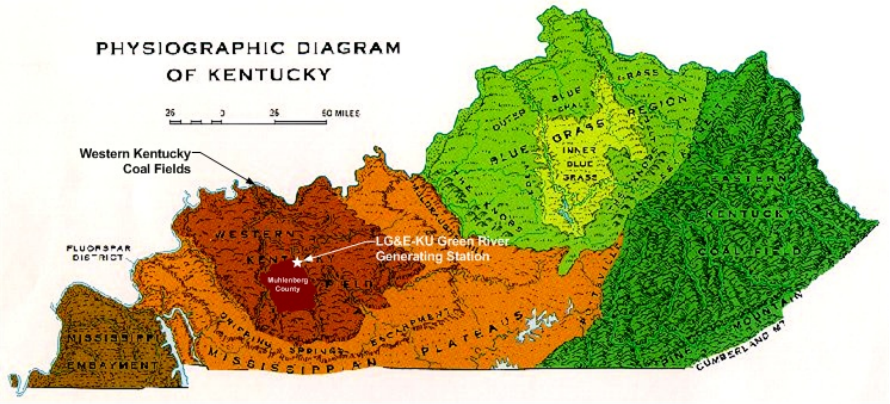


Exhibit 3.1- Physiographic Setting

The Western Kentucky Coal Field region is characterized by dissected uplands with "V"-shaped valleys in the south, east and west marginal areas and gently rolling hills and wide flat bottomlands in the north and interior portions of the region. The Western Kentucky Coal Field region represents the southern edge of a larger geologic feature called the Illinois or Eastern Interior Basin. The Western Kentucky Coal Field region features rich soils, sandstone and shale outcroppings and is drained by the Green River and the Tradewater River, both of which empty into the Ohio River. The portion of the

Western Kentucky Coal Field Region containing the proposed NGCC site is drained by the 384 mile long Green River which discharges into the Ohio River at River Mile 784.2. The Green River is fed by tributaries including Rough, Barren, Nolin, and Pond Rivers. The proposed NGCC site drains directly into the Green River around River Mile 82.5.

3.1.2 Topographic Setting

As noted previously, the Green River Electric Generating Station lies mostly within the extreme northwest corner of the USGS 7.5 minute topographic quadrangle map for the Central City East, KY Quadrangle, with portions lying in the extreme northeast corner of the USGS 7.5 minute quadrangle map for the Central City West, KY Quadrangle. Figure 2, Topographic Vicinity Map, depicts the topography for the site and surrounding area.

This area corresponds to northeastern Muhlenberg County and is characterized by gently rolling hills with flat bottomlands along the Green River. Topographic relief in the area is on the order of 190 feet from elevations that range from approximately 550 feet AMSL at topographical highpoints along ridgelines north, northwest, and west of the existing Coal-Fired Electric Generating Station, to the area's the topographic low point at the normal pool elevation of the Green River at 363.0 feet AMSL The Green River's normal pool elevation adjacent to the site is controlled by Dam No. 2 on the Green River at River Mile 63.1 near Calhoun, Kentucky, operated by the Unites States Army Corps of Engineers.

The property owned by KU is gently rolling with some steep grades. Elevations near the northwest corner of the property approach 500 feet AMSL while the lower portions of the site near the Green River are approximately 370 feet AMSL. Elevations in the vicinity of the proposed NGCC range from roughly 435 feet AMSL to 450 feet AMSL and average around 80 feet above the normal pool elevation of the adjacent Green River.

3.1.3 Geologic Setting

Again, the KU Green River Generating Station is located in the northwest and northeast corners of the USGS 7.5 minute quadrangle maps for the Central City East, KY Quadrangle Central City West, KY Quadrangle, respectively. Geology mapped for these quadrangles by the Kentucky Geological Survey (KGS) is depicted on Geologic Quadrangle Maps GQ-1031 and GQ-831, respectively.

The Kentucky Geologic Map Information Service, found on the Internet at URL http://kgs.uky.edu/kgsmap/KGSGeoServer/, was used to develop Figure 6, Geologic Vicinity Map. As shown in Figure 6, the uppermost geologic unit in the area surrounding the proposed NGCC unit is the Patoka Formation (map symbol –Pp) of Middle to Upper Pennsylvanian age. This unit is referred to as the Lisman Formation in prior versions of the GQs. As described in the stratigraphic column for the Central City East, KY Geologic Quadrangle, the Patoka Formation is comprised of sequences of sandstone, siltstone, shale, limestone, coal, and underclay described as follows:

"Sandstone, bright orange-brown, locally medium gray, generally dark red to dark gray where weathered; fine grained, grains commonly angular to subrounded, poorly sorted; micaceous, partly shaly, generally soft and friable, partly limonitic; very thin to thick bedded, partly irregularly bedded and crossbedded; outcrop areas commonly covered with loose sand. Sandstone above No. 15 coal locally contains thin beds of clay-ironstone pebble conglomerate and thin irregular lenses of carbonaceous material, and grades laterally into siltstone and shale. Siltstone, medium gray; orange brown where weathered; partly shaly and sandy, micaceous, limonitic; limonite concretions abundant on weathered outcrops. Shale, in part clay shale, medium brown to medium gray; light gray to orange where weathered; partly silty, sandy, and limonitic, hard; locally contains scattered carbonaceous streaks and lenses. Shale overlying No. 15 coal bed, black, carbonaceous. Limestone, dark gray, dense, silty; occurs locally as nodules in clay shale. No. 15 coal bed, thin, present only in northwestern part of quadrangle. Underclay, dark gray; light gray where weathered; partly silty, moderately hard; locally contains thin sulfurous streaks."

The area immediately south/southeast of the proposed site (vicinity of the existing Coal-Fired Generating Units) along the Green River is identified as Alluvium (map symbol –Qal) of Quaternary age. The Alluvium reportedly contains silt, clay, sand, and gravel described as follows:

"Generally light brown to reddish-brown, poorly sorted. Well-developed natural levees adjacent to Green River are composed mostly of silt and fine sand. Alluvium

thicknesses of as much as 100 feet are indicated by drift-hole data in vicinity of Green River north of Gibralter mine, and as much as 60 feet on the Pond Creek flood plain north of Drake No. 1 mine. Elsewhere on the Green River and Pond Creek flood plains alluvium thicknesses of more than 50 feet are common. Slackwater deposits were not recognized in the quadrangle, but may be present in valley of Pond Creek. Contact with underlying strata approximately located."

Structural contours drawn on the base of the No. 9 Coal Bed in the vicinity of the proposed NGCC site indicate strata dipping to the west-northwest at a gradient of roughly 0.35 percent. There has been faulting noted in Muhlenberg County; however, none has been mapped within a radius of about five miles from the site including Ohio County.

3.1.4 Soils

A Custom Soil Resource Report was developed for the proposed NGCC site using the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey tool at URL http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

Figure 7, Soils Map, was developed from the Web Soil Survey and is included in the Custom Soil Resource Report for the site that is provided in Appendix A. As shown in Figure 7, the following soils are present at the site:

Map Unit Symbol	Map Unit Name	Acres In AOI	Percent of AOI
Du	Dumps	13.4	13.0%
FlE	Frondorf-Lenberg complex, 20 to 30 percent slopes	8.4	8.1%
LoC	Loring silt loam, 6 to 12 percent slopes	3.8	3.7%
LoC3	Loring silt loam, 6 to 12 percent slopes, severely eroded	10.1	9.7%
Nh	Nolin silt loam	3.0	2.9%
OtB	Otwell silt loam, 2 to 6 percent slopes	14.5	14.0%
W	Water	17.5	16.9%
WlC3	Wellston silt loam, 6 to 12 percent slopes, severely eroded	15.5	15.0%
WlD	Wellston silt loam, 12 to 20 percent slopes	17.1	16.5%
Totals for Area of Interest (AOI)…….		103.2	100.0%

Further descriptions of these soil mapping units are included in the USDA-NRCS Custom Soil Resource Report provided in Appendix A.

3.1.5 Water Resources

3.1.5.1 Surface Water

The most prominent surface water feature in the area is the Green River which lies approximately 750 feet southeast of the proposed NGCC site. The Green River is approximately 500 feet wide in the vicinity of the site. According to data developed by the USGS, flow rates in the Green River near Central City range from around 4,500 cubic feet per second during periods of low-flow to approximately 12,500 cubic feet per second during high-flow.

The Green River is the only surface stream of significance in the vicinity of the proposed NGCC. Drainage from the site flows south/southeast into the Green River. The site is located downstream on the north side of an oxbow bend in the Green River; river flow is from southwest to northeast as it passes by the site, although overall flow direction for the Green River is from southeast to northwest, toward the Ohio River. As noted, the Green River Basin is one of Kentucky's 12 major drainage basins. With headwaters in Lincoln County, the 384 mile long Green River drains an area of over 8,800 square miles in western Kentucky before discharging into the Ohio River near Henderson at River Mile 784.2.

The existing KU Green River Power Station withdraws water from the Green River for steam generation and once through cooling. An estimated 185 MGD are withdrawn from a location identified as Outfall 006 according to the facility's Water Balance Diagram and the facility's KPDES permit. Projections for the proposed NGCC indicate a significantly diminished withdrawal rate of 7.5 MGD.

The current KU Green River Power Plant discharges treated effluent to the Green River pursuant to KPDES Permit No. KY0002011 issued by the Kentucky Department for Environmental Protection - Division of Water. Two outfalls (001 and 002) discharging into the Green River are identified in the permit, at River Mile Points 81.3 and 81.6, respectively. Outfalls 003 and 004 are internally routed to Outfall 001. The Green River Generating Station's water withdrawal from the Green River is identified as Outfall 006.

Primarily two types of by-product ash are generated at the existing Coal-Fired Steam Electric Generating plant from combustion of coal – bottom ash and fly ash. Under current operations the Green River Generating Station manages coal pile runoff and coal combustion ash using two Ash Treatment Basins (ATBs) and a Coal Pile Runoff

Basin. Figure 8, Site Impoundments, is taken from an aerial photograph and identifies the current facility's impoundment structures. General descriptions of these structures as excerpted from ***Draft Report of Geotechnical Investigation Dam Safety Assessment of Coal Combustion Surface Impoundments, Kentucky Utilities, Green River Station, Central City, KY*** **(September 2010)** prepared by AMEC Earth & Environmental, Inc., are provided below:

> ***"Ash Treatment Basin #1***
>
> ***"The Ash Treatment Basin #1 (Main Ash Pond) has an inside surface area of approximately 32 acres and receives process flows from plant operations and rainfall runoff flows. The basin discharges from a rectangular reinforced concrete decant structure that has stop-logs to control the pond water level. A floating skimmer upstream of the decant structure prevents potential discharge of floating solids or oil sheens. The discharge flow is conveyed to Ash Treatment Basin #2 through an open channel.***
>
> ***"Ash Treatment Basin #2***
>
> ***"The Ash Treatment Basin #2 has an inside surface area of approximately 23 acres and receives flows from the Ash Treatment Basin #1, coal pile runoff pond, and rainfall runoff. Depending on seasonal rainfall, accumulated rainfall waters are also pumped from the Scrubber Pond to the Ash Treatment Basin #2. The discharge of this pond flows through a rectangular reinforced concrete decant structure consisting of stop-logs to control the pond water level. A floating skimmer upstream of the decant structure prevents potential discharge of floating solids or oil sheens. Flow is directed to the KPDES monitoring and sampling point. This monitoring/sampling point consists of a concrete structure with a rectangular concrete weir. Flow from the monitoring / sampling point structure discharges to a rip-rap lined open channel which directs flow to the Green River downstream of the plant buildings. Plant operations staff manages the pool elevation by adjusting stop log elevations as necessary to maintain freeboard.***

"Scrubber Pond

"The Scrubber Pond has an inside surface area of approximately ten acres and has not received process water since 2003 due to retirement of Units 1 and 2 and their FGD systems. The pond remains available for possible future FGD material storage if necessary for Units 3 and 4. Previously the pond received FGD slurry material by pipelines.

The solids settled, and the water was recycled for use in the FGD system. Currently, the pond accumulates rainfall. Plant operations staff manages the pool elevation by pumping to the Ash Treatment Basin #2.

"Coal Pile Runoff Pond

"The coal pile runoff basin has an inside surface area of approximately six acres and drains into the Ash Treatment Basin #2. In addition to the coal pile runoff, the pond receives plant sump/process flows from the oil-water separator and sewage treatment plant."

Coal combustion ash, coal mill rejects, and pyrites are conveyed by sluicing to ATB No. 1. The following materials are directed to the Coal Pile Runoff Pond:

- boiler blowdown
- water demineralizer regeneration
- reverse osmosis system reject flows
- miscellaneous filter backwash and floor drain flows (from plant sumps)
- sewage treatment plant effluent.

Both ATB 1 and the Coal Pile Runoff Pond discharge into ATB 2. Generation of all coal combustion by-products will cease with termination of operations for the existing Coal-Fired Electric Generating Units. Wastewater generated by the NGCC will be processed through the Coal Pile Runoff Pond to ATB 2, discharging to Outfall 001.

Wastewater flows from the proposed NGCC include:

- boiler blowdown
- water demineralizer regeneration
- reverse osmosis system reject flows
- miscellaneous filter backwash and floor drain flows (from plant sumps)
- sewage treatment plant effluent
- cooling tower blowdown
- miscellaneous cooling water discharges

The existing KPDES Permit No. KY0002011 for the Green River Generating Station will be revised to address all of these flows.

The nearest downstream municipal water withdrawal point is Intake # 0092 for Livermore Water Works located on the Green River at River Mile 71.28, roughly ten miles downstream from KU's Green River Generating Station. A susceptibility analysis of Livermore's water supply to contamination was conducted by the Green River Area Development District. The analysis yielded a rating of generally moderate risk. Areas identified as potential sources of contaminants of concern included 4 bridges, 2 ports, 1 railroad, 2 areas of sewer lines, and row crops. None of these are located in the vicinity of the KU Green River site and are unrelated to the proposed project.

Discharges from the KU Green River Generating Station were not identified as concerns.

3.1.5.2 Floodplain

Figure 9, FEMA Firmette Map, was obtained from the Federal Emergency Management Agency (FEMA) website at:

https://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1

Figure 9 [developed from Flood Insurance Rate Map (FIRM) No. 21177C0135C, Panels 135 and 155 of 400], depicts the site and surrounding floodplain information. As shown, the majority of KU's property, including the existing Coal-Fired Electric Generating Units lies within an area designated as Zone X, indicating that it is outside the 100-year and 500-year floodplains. A small area on the eastern margin of the property along the Green River is within an area designated as Zone AE, indicating a 1 percent annual chance of flooding. None of the current or proposed operating structures at the Green River Generating Station lie within Zone AE.

3.1.5.3 Wetlands

Figure 10, Wetlands Map, was obtained from the United States Fish and Wildlife Services (USFWS) web-site using the "Wetlands Mapper" tool at:

www.fws.gov/wetlands/Data/Mapper.html.

As shown, this map does not identify potential wetlands in the location of the proposed project site. The facility's current surface water impoundments are labeled as a "lake", "ponds" or "other potential wetland". A potential Freshwater Emergent Wetland area

was depicted on an adjacent property along the eastern boundary of the Green River Generating Station property. No wetlands are identified in the vicinity of the existing Coal-Fired Generating Units or the proposed NGCC.

Note that the appearance of an apparent wetlands area on the National Wetlands Inventory Map is not necessarily definitive. While no wetlands or jurisdictional waters were identified on the NWI maps, a field determination will be completed for the site.

3.1.5.4 Groundwater

As previously noted, the site lies adjacent to the alluvial flood plain and terrace deposits in glacial outwash along the Green River. According to Carey, Daniel I., and John F. Stickney, Groundwater Resources of Muhlenberg County, KY, County Report 89, Series XII, ISSN 0075-5567, Kentucky Geologic Survey (2004), these sediments yield as much as 100 gallons per minute from sands and gravel along the Green and Pond Rivers. The alluvium is expected to yield sufficient water for domestic water supply (more than 500 gallons per day) to wells in valleys of the Green and Pond Rivers and their larger tributaries. These deposits are not expected to yield sufficient water in wells in small valleys. Water is hard or very hard, and may contain high concentrations of iron.

Review of the Kentucky Groundwater Data Repository - Water Well and Spring Location Map at URL http://kgs.uky.edu/kgsmap/KGSWater/, indicates that there are no domestic use, industrial, municipal, monitoring, agricultural, public, or mining wells installed within a one-mile radius of the Green River Generating Station on the west side of the Green River (there are wells installed across the Green River at the Equality Boot Mine site, but the Green River Generating Station site has no influence on ground water quality at this location). The nearest groundwater features identified by KGS are two springs, located roughly 1.31 miles northeast and 1.26 miles southwest of the existing Green River Power Station.

3.2 Surrounding Land Use

The KU Green River Generating Station is located along the Green River in the northern part of Muhlenberg County. The site is located 6.3 miles northeast of the largest city in the county, Central City, and roughly 12.9 miles northeast of Greenville. The surrounding area is composed of family farms, private residences, undeveloped land, and a mining operation located across the river in Ohio County.

Muhlenberg County does not designate property zoning. The site is located in an area of mixed property uses including undeveloped wooded acreage, agricultural land, mining land, residential and commercial development. The closest residential structure

is approximately 0.32 miles southwest of the proposed NGCC site. The next five closest residential structures are located northwest of the proposed NGCC site at distances greater than one-half mile, with additional scattered residences located along US 431 at greater distances. Although individual houses are present, there are no residential neighborhoods within 2,000 feet of the proposed unit pursuant to definitions at KRS 278.700.

The Green River lies approximately 750 feet south/southeast of the proposed NGCC. Land use in Ohio County across the Green River to the south / southeast consists of agricultural land and mining land. No residential properties exist within the Green River oxbow south-southeast of the site.

The proposed NGCC will be constructed on an existing Coal-Fired Electric Generating Station site. Based on the surrounding land use and the historical use of the property for power generation, it is clear that the site property is compatible with the proposed NGCC unit operations.

As noted previously, construction of a natural gas pipeline is proposed to supply the NGCC electric generating unit. At the time of this report, four candidate routes for extending the required natural gas supply via underground pipeline to the facility are under consideration, as shown in Figure 5 – Pipeline Route Candidates.

The natural gas transmission pipeline will be extended entirely or nearly entirely along existing utility right-of-way belonging to TGT, ANR, and / or KU. Additional easements will be obtained as necessary for areas of the proposed pipeline construction which are outside existing utility right-of-way corridors. The completed pipeline will be below ground surface.

3.3 Legal Boundaries

As shown in Figure 11, Parcel Map, the proposed project site is located within a parcel of land currently owned by KU. According to information obtained from the Muhlenberg County Property Valuation Administrator's (PVA) Office, Parcel ID No. 138-00-00-002.000F, upon which KU coal-fired steam electric generating station is located, is 416 acres in size. Muhlenberg County does not designate zoning for parcels.

According to the legal description, the KU parcel was acquired in 1947; the 416 acre parcel is a conglomeration of several parcels purchased simultaneously in 1947 from private owners. The purchases of the various parcels that make up the site are described in the following Deed Books and Pages:

Parcel ID No. 138-00-00-002.00 – Deed Book 162, Page 522; Deed Book 162, Page 479; Deed Book 162, Page 482; Deed Book 165, Page 99; Deed Book 294, Page 257

A complete legal description for the KU Green River Station property and the adjacent property, some or all of which it will acquire to meet setback requirements (Ray C. Dunlap Parcel) is provided in Appendix B.

3.4 Access Control

Access to the site is currently controlled with perimeter security fencing around the land boundary limits of the Generating Station, the Green River, and a manned security gate controlling entry into the site along Power Plant Road. The existing access control facilities will be modified and extended as necessary to control access to this site during construction and operation of the proposed NGCC unit.

3.5 Location of Buildings

The proposed site layout, including existing structures, is shown in Figure 3 and depicts the relative locations of buildings, power transmission lines, and related structures at the site.

3.6 Transportation Infrastructure

As shown on Figure 12, Transportation Infrastructure Map, the existing Coal-Fired Generating Station and proposed NGCC facilities are served by roads for vehicular access. There is an existing barge mooring located immediately south of the coal-fired plant on the north bank of the Green River; however, facility personnel report that this mooring is no longer in use and that no deliveries to or shipments from the facility are currently made via barge.

There is no direct railroad access to the site and none is planned for the proposed NGCC project. The nearest railroad is a CSX line located roughly one mile west of the site on the other side of US 431. There is an abandoned rail spur which formerly served the Green River Station.

Direct vehicular access to the proposed NGCC will be provided via Power Plant Road. Power Plant Road is a two-lane, undivided local road that intersects with US 431 between KY 81 and KY 175 and meanders east towards the Green River and into the existing Electric Generating Station.

The following main highways near the proposed NGCC are expected to accommodate travel through Muhlenberg County to the plant.

US Highway 431 – two-lane undivided rural principal arterial

KY 81 – rural two-lane undivided major collector

KY 175 – rural two-lane undivided minor collector

As noted previously, vehicular access to the existing coal-fired power plant is controlled by fencing and a manned security gate.

Wendell H. Ford Parkway is the main east / west highway that traverses west central Kentucky, extending east from Elizabethtown to Madisonville, Paducah and beyond to the west. The site is located centrally between two north / south highways of significant size – Bluegrass Parkway is located approximately 15 miles to the east and Pennyrile Parkway is located approximately 18 miles west. Additionally, the site is located approximately 78 miles west of Interstate 65.

According to the Kentucky Transportation Cabinet's Department (KYTC) of Highways count database, existing annual average daily traffic (AADT) volume on U.S. 431 is 4,476 vehicles per day south of the site and 4,430 vehicles per day north of the site. The AADT volume on KY 81 is 2,640. The AADT volume on KY 175 is 636. The AADT on U.S. 431 south of KY 81 is 6,904. Hourly peak hour volume was not available, therefore, based on the American Association of State Highway and Transportation Officials: A Policy on Geometric Design of Highways and Streets (2004), a typical factor of 15 percent of the average daily traffic was used for this assessment. Based on the Transportation Research Board Highway Capacity Manual (2010), the capacity of a two-lane roadway is 3,200 vehicles per hour or 1,700 vehicles per hour in one direction.

During the peak construction period for the proposed NGCC, there will be an estimated 818 construction related trips entering and exiting the site on a daily basis. During the peak hour (either AM or PM), there will be 409 construction related trips. It is expected that half of the construction traffic will come from the north on U.S. 431 and the other half from the south on U.S. 431. Based on existing travel patterns, it is expected that 10 percent will travel on KY 175 and 15 percent on KY 81. To determine the total peak-hour, peak-direction volume, a typical 60 / 40 directional split was applied to the existing traffic and a 90 / 10 directional split was applied to the construction traffic. Based on the peak hour, peak direction total volume on the study roadways, existing roads will adequately accommodate both construction and plant traffic without adverse impact.

Following completion of construction and attainment of commercialization for the NGCC unit, traffic volumes will diminish to levels below those associated with the current coal-

fired facility. Additional analysis of traffic conditions is provided in Section 7 of this document.

3.7 Utilities

To the extent practicable, the proposed project will utilize existing infrastructure for its operations. With the exception of minor rerouting and establishment of new connections, the following existing utilities will be utilized by the proposed NGCC unit:

- Electric Power Transmission Lines (connection to existing overhead electric power transmission lines)
- Telephone via existing AT&T service
- Potable Water Supply Line (connection to existing potable water supply line from Muhlenberg County Water District #3)
- Raw process water supply from Green River via existing intake structure at Outfall 006 (screen house)
- Sanitary Wastewater Discharge Collection System (new connection to new on-site package sewage treatment plant)
- Process Wastewater Discharge Collection and Treatment (new processes and connection to existing facilities for ultimate discharge to Green River via currently permitted outfalls)
- Stormwater Collection / Retention System (connection to existing system)

As discussed above, the only new utility service anticipated for the proposed NGCC is a natural gas supply line. A natural gas pipeline will be extended to the site from an existing supply line in the area. There are currently four candidate natural gas pipeline routes as depicted on Figure 5. As shown in Figure 3, the pipeline will enter the site along an existing right-of-way.

3.8 Compliance with Setback Requirements

The proposed facility will utilize two 180 feet high stacks for Heat Recovery Steam Generator (HRSG) and one 40 foot high stack for the Auxiliary Boiler exhaust emissions. Prior to initiation of construction of the proposed NGCC, KU will acquire at least the portion of the adjacent Ray C. Dunlap (Deed Book 481, Page 380) parcel located to south-southwest necessary to comply with the setback requirement. As shown in Figure 13, Setback Radii Map, with this acquisition the proposed NGCC will comply with setback requirements described in KRS 278.704. Both stacks are located more than 1,000 feet from the nearest property boundary and more than 2,000 feet from

the nearest residential neighborhood property boundary [pursuant to KRS 278.700 – Definitions for KRS 278.700 to 278.716, (6) "Residential neighborhood" means a populated area of five (5) or more acres containing at least one (1) residential structure per acre].

No additional setback requirements are identified for the project.

4.0 SCENIC COMPATIBILITY ANALYSIS

4.1 Introduction

The following scenic compatibility analysis has been prepared consistent with the requirements under Kentucky Revised Statute 278.702(2)(1) for the expansion of any new or existing power plant. This purpose of this analysis is to evaluate the compatibility of the proposed NGCC project at the Green River Generating Station with the quality and characteristic of the surrounding scenic environment. This assessment provides an overview of the proposed facility developments, describes the existing scenic environment, and assesses the compatibility of the proposed facility changes against the existing characteristics and quality of the existing scenic environment.

4.2 Project Description

KU proposes to retire its existing Green River Coal-Fired Electric Generating Station and construct an NGCC Electric Generating Unit. The facility location will remain at 811 Power Plant Road in Central City, Kentucky as shown in Figure 2, Topographic Vicinity Map.

The existing Green River Coal-Fired Electric Generating Station is located adjacent to the Green River. The new NGCC will be located on the existing property site adjacent to the current facility. It is proposed to be located west of the existing Coal-Fired Electric Generating Units as shown in Figure 3, Site Layout.

4.3 Existing Structures

The existing coal-fired plant uses approximately 20 acres of the site adjacent to the Green River. The tallest and most visually dominant existing structure on the plant site is the stacks with total heights of 198 feet and 247 feet above ground elevations, or 610 feet and 659 feet AMSL, respectively (see photographs to right and below). The height of the supporting power plant buildings on site ranges between 120 and 170 feet (corresponding to elevations of 532 feet and 582 feet AMSL). In addition to the existing power plant and stacks the site includes electric power transmission towers and lines, fly ash material storage, access roads, parking, administration

buildings, equipment buildings, and storage ponds.

The existing Coal-Fired Electric Generating Units burn approximately 400,000 tons of coal per year. The coal combustion residues produced as by-product to power production are disposed of in ash ponds located adjacent to the northeast of the existing coal-fired power plant. The ash ponds will cease accepting coal combustion residues upon termination.

4.4 Proposed Modifications to Project Site

4.4.1 Proposed NGCC Development

The proposed NGCC unit would be located adjacent to and northwest of the existing Coal-Fired Electric Generating Station site. The conceptual site plan (see Figure 3 – Site Layout) for the NGCC shows the proposed plant in relation to the existing facilities. The tallest features as part of the proposed NGCC are the two HRSG stacks that will be approximately 180 feet tall at an elevation of 620 feet AMSL. The top of the new HRSG stacks will be at an elevation approximately 10 feet above and 39 feet below the existing stacks for Coal Fired Unit No.'s 3 (at 610 feet AMSL) and 4 (at 659 feet AMSL), respectively. The following NGCC major facilities are taken into account for the visual assessment because of their dominant visual nature and potential to be seen from a distance:

Combustion turbines

- HRSG 1 exhaust stack – 180 feet tall (620 feet AMSL)
- HRSG 2 exhaust stack – 180 feet tall (620 feet AMSL)
- 10 cooling tower cells – 64 feet tall (504 feet AMSL)
- Auxiliary boiler stack – 42 feet tall (482 feet AMSL)

Other developments that will be constructed as part of the NGCC include the following facilities. These facilities would be lower in height and less visible from a distance:

- Heat recovery steam generator
- Steam turbine building
- Administration/control building

- Gas compressor building
- Emergency generator
- Water storage tank
- Switchyard
- Warehouse/maintenance shop
- Water treatment building
- Fire protection pump house
- Auxiliary boiler building

An underground natural gas pipeline will also be constructed to provide fuel to the NGCC. The origin of the pipeline would be in one of four candidate locations, as follows:

1) 11 miles southwest of Central City;
2) 11 miles southwest of Central City;
3) 19 miles northwest of Central City; or
4) 23 miles northwest of Central City.

Regardless of the route selected, the pipeline will be constructed underground and entirely or nearly entirely within existing right-of-way for existing pipeline and / or KU transmission lines. The potential visual effects from the proposed pipeline are minimal considering it will be buried beneath the surface and not visible to the public.

4.4.2 Abandonment of Existing Facilities

The existing stacks will not be in use after the proposed NGCC unit is in production but will remain in place. The existing transmission lines will remain in place to provide transmission from the proposed NGCC. The existing coal-fired power plant will be decommissioned and left in place.

4.4.3 Existing Environment & Technical Approach

The terrain surrounding the Green River power plant is rolling hills with the site immediately surrounded by thick deciduous forest and agricultural land. Presently there is a minimum half mile buffer of dense forest surrounding the western, northern, and eastern sides of the plant. In general, north of the project site is heavily forested and used for agricultural lands; while land across the Green River is used for agricultural and mining. Highway US 431 runs north-south along the western edge of the property line, connecting Moorman and South Carrollton.

View from US 431 looking south

View from US 431 looking north

View from Moorman Cemetery Road

View from Moorman Cemetery Road

4.4.4 Visual Assessment Methodology

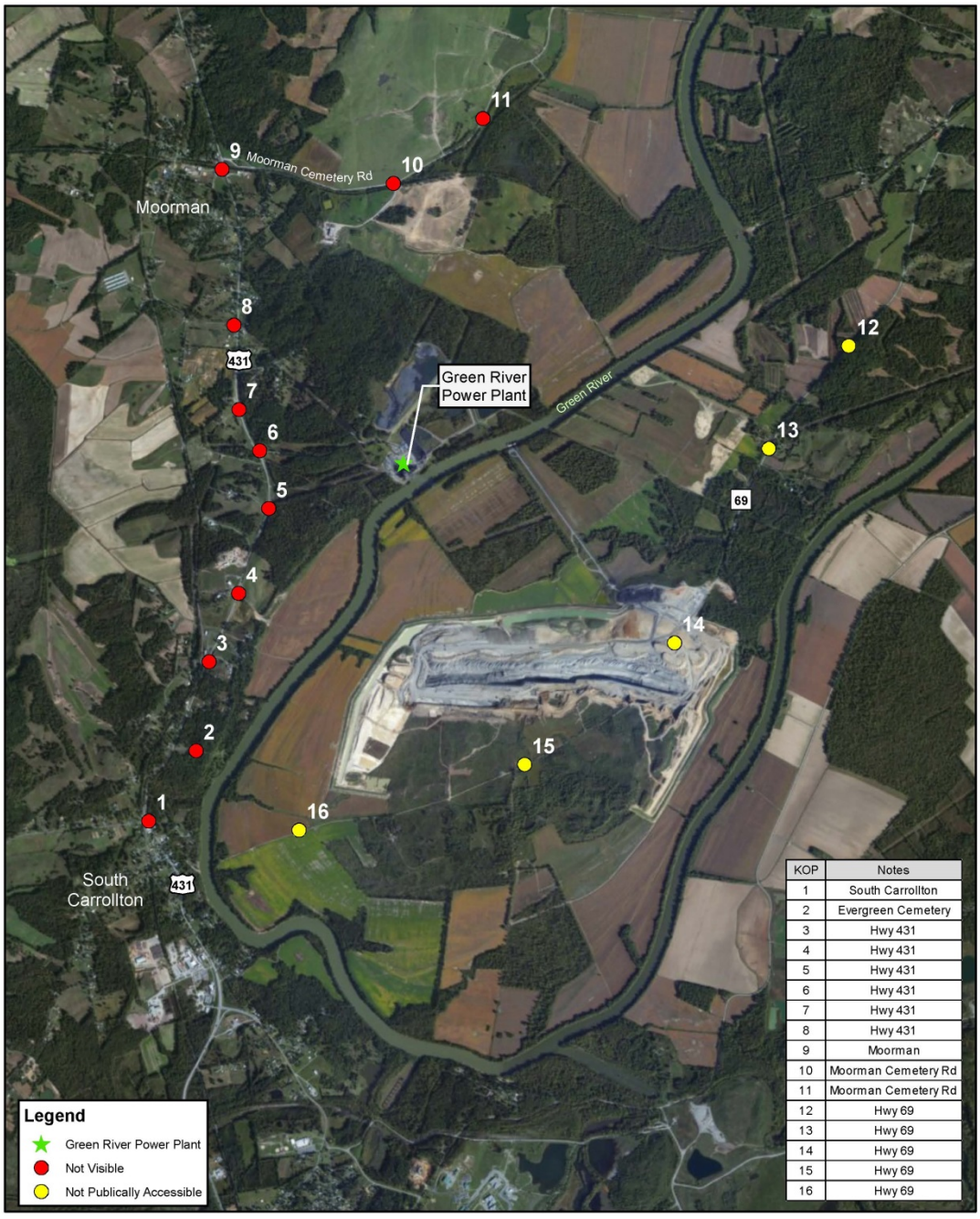
This assessment uses the established methods provided in the Bureau of Land Management (BLM) Visual Resource Management protocol (BLM Handbook H-8410-1). In the absence of a specific methodology provided in the Kentucky Revised Statues, the BLM methodology is widely considered the standard methodology for assessing visual and scenic effects. The process used to assess the visual impacts incorporated a desktop and field analysis component scaled to the complexity of the project site. Data collection and analytical methods included:

- Desktop review of surrounding terrain
- Selection of key observation points
- Line of sight/viewshed analysis
- Field data collection included photographs and visual impact assessment
- Selection of Key Observation Points

Based on the desktop review of the surrounding topography and terrain, Key Observation Points (KOPs) were identified to develop viewshed and line-of-sight perspectives. KOPs are selected to be representative of critical locations (i.e. public locales) and from which the proposed action (i.e., closing of an existing coal-fired electric generating unit and installing an NGCC electric generating unit) would be seen. A review of baseline data was conducted to gain familiarity with the existing landscape, viewer sensitivity, and the characteristics of the project site. The selection of 16 initial KOPs was generally based on the following criteria:

- KOP's proximity to populated and public areas;
- KOP's location provides representative views of the landscape along a specific transportation route segment (e.g., US 431) or in a general region of interest; and / or
- KOP's viewpoint effectively captures the presence or absence of a potentially adverse Proposed Action impact in that location.

The 16 KOPs in relation to the project site are provided in Exhibit 4.1– KOP Locations. A visual resources inventory was conducted over a two day period in mid-December, 2013. KOP viewpoints were visited and evaluated for visual assessment.



KOP	Notes
1	South Carrollton
2	Evergreen Cemetery
3	Hwy 431
4	Hwy 431
5	Hwy 431
6	Hwy 431
7	Hwy 431
8	Hwy 431
9	Moorman
10	Moorman Cemetery Rd
11	Moorman Cemetery Rd
12	Hwy 69
13	Hwy 69
14	Hwy 69
15	Hwy 69
16	Hwy 69

KU Green River Power Plant

Exhibit 4.1 | KOP Locations

4.4.5 Line of Sight Profiles

A digital elevation model (DEM) was downloaded from USGS National Elevation Dataset. The raster file dataset was a 30 meter resolution and is representative of bare earth elevation/terrain changes. Vegetation is not accounted for in the DEM and therefore used for preliminary screening of KOP prior to field data collection. Line-of-sight profiles were generated from various potential KOP locations utilizing the DEM surface. A line-of-sight is a straight line tool enabled within GIS that calculates intervisibility between the first and last point (first point being the viewer and the last point being the proposed NGCC plant). Any obstruction of the line-of-sight would show lack of visibility and visual impact. The elevation of the proposed HRSG exhaust stacks (620 feet AMSL) was used for the line-of-sight profiles from a person standing 6 feet tall at a KOP location. Exhibit 4.2 – Line-of-Site Profiles, illustrates the use of the line-of-sight tools in determining possible visibility of the site.

4.4.6 Visual Impact Assessment Methodology

The principle measure for assessing project construction and operation effects to visual resources lies in the BLM's use of a "contrast rating." A visual contrast rating entails comparing project features with the major features in the existing landscape using the basic design elements of form, line, color, and texture. The steps in the contrast rating process used in this assessment follow the procedures provided in the BLM Manual H-8431 (Visual Resources).

To evaluate the potential visual effects, contrast ratings were assigned to each KOP by considering the following factors: distance, angle of observation, length of time the project site was in view, relativity to size or scale, season of use, light conditions, recovery time, spatial relationship, and atmospheric conditions. Contrast ratings were noted as being none, weak, moderate, and strong, depending upon the degree of change. Contrast created by the project was rated by the criteria provided below in Table 4.1.

Table 4.1 Degree of Contrast Criteria

Degree of Contrast	Criteria
None -	The element contrast is not visible or perceived.
Weak -	The element contrast can be seen but does not attract attention.
Moderate -	The element contrast begins to attract attention and begins to dominate the characteristic landscape.
Strong -	The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

Source: BLM VRM 2007

The 16 KOPs offer different perspectives on the proposed developments and therefore differ in their evaluation of the contrast rating and whether they are compatible with the surrounding environment. In this evaluation, each KOP is assessed for its contrast with the existing setting, with a discussion of whether the design would conflict with the surrounding scenery and warrant mitigation measures.

Many factors go into making a degree of contrast determination. Four elements (form, line, color, and texture) of the proposed developments are compared to the existing landscape. Each of these elements is further examined by looking at other factors including distance, perspective, spatial relationships, and length of time in view.

4.4.7 Assumptions

Assumptions regarding the proposed facilities for analysis purposes included:

1. Proposed HRGS exhaust stacks and cooling towers will be shorter than the tallest existing plant stack (Unit No. 4)

2. Lighting for the NGCC would be consistent with current plant lighting

3. Possible steam plume from NGCC operations would be highly influenced by atmospheric and meteorological conditions

4. Proposed NGCC will resemble the generally existing coal-fired power plant in color and form

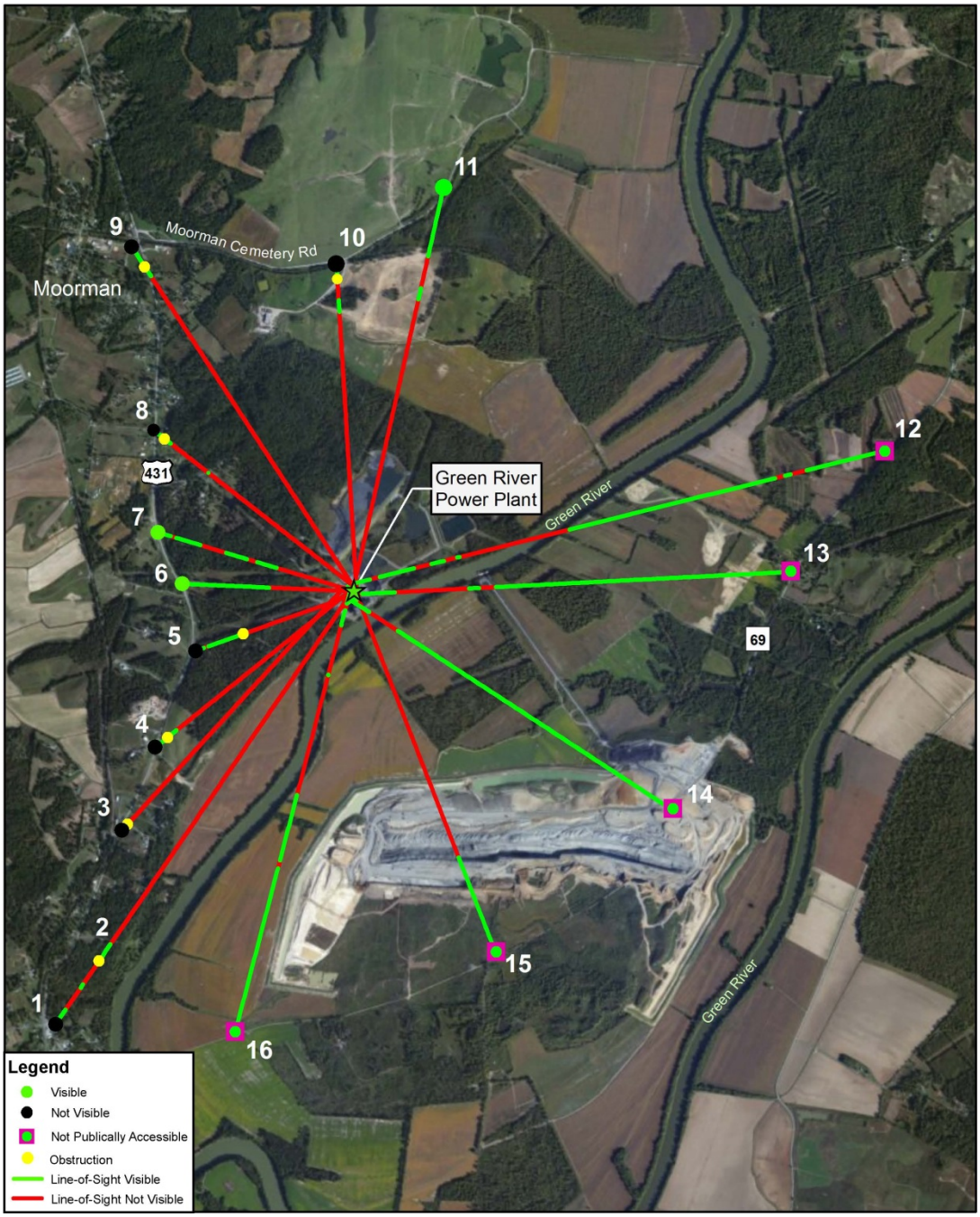
4.4.8 Visual Effects Analysis

The visibility and degree of contrast for the proposed NGCC developments was assessed for each KOP. The findings for each KOP are discussed below and summarized below in Table 4.2. KOPs 12-16 are located along Old Highway 69 and are not publically accessible; therefore, these KOPs are not carried forward for further analysis because the public will not be able to access nor see the NGCC from these KOPs. KOPs 1 through 9 are located along portions of Highway 431. Please refer to Exhibit 4.2 for reference on the specific location of these KOPs along Highway 431.

Table 4.2 KOP Analysis Summary

KOP	Distance to NGCC Site (miles)	NGCC Site Visible	Notes	Contrast Rating
1	2.0	No	Viewpoint from South Carrollton	None
2	1.6	No	View along Hwy 431, heavily forest view towards project site	None
3	1.3	No	View along Hwy 431, rolling terrain with intermittent trees.	None
4	1.0	No	View along Hwy 431, rolling terrain with ag lands in foreground and forest in background buffering the plant	None
5	0.7	No	View along Hwy 431, rolling terrain with thick forest buffering the plant to the edge of property. Large overhead power line visible crossing the highway	Weak
6	0.7	No	Plant entrance off of Hwy 431, forest dominates side of roadway blocking views	None
7	0.8	No	View along Hwy 431, rolling terrain with thick forest buffering the plant to the edge of property.	None
8	1.0	No	Views along Hwy 431 at Ladshaw Road. Rolling hills with view towards site heavily forested.	Weak

KOP	Distance to NGCC Site (miles)	NGCC Site Visible	Notes	Contrast Rating
9	1.6	No	View near Moorman in a more developed area toward project site. Rolling terrain blocks views in foreground	None
10	1.2	No	Views from Moorman Cemetery Road. Most agricultural area with rolling terrain blocks views	None
11	1.6	No	Views from Moorman Cemetery Road. Most agricultural area with rolling terrain blocks views	None
12	2.0	No	Old Hwy 69 (Bluff Road) no longer publically accessible	Possibility of contrast but no longer accessible
13	1.6	No	Old Hwy 69 (Bluff Road) no longer publically accessible	Possibility of contrast but no longer accessible
14	1.4	No	Old Hwy 69 (Bluff Road) no longer publically accessible	Possibility of contrast but no longer accessible
15	1.5	No	Old Hwy 69 (Bluff Road) no longer publically accessible	Possibility of contrast but no longer accessible
16	1.8	No	Old Hwy 69 (Bluff Road) no longer publically accessible	Possibility of contrast but no longer accessible



Photographs taken from KOPs 1 through 11 are provided on the following pages.

KOP 1: South Carrollton (edge of town)
This area is heavily forested in the foreground with a small cemetery blocking the viewshed of the project site. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 2: Highway 431
This area is heavily forested in the foreground, blocking all views towards project site. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 3: Highway 431
This area is rolling terrain with residences scattered along Highway 431. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 4: Highway 431
This area is rolling terrain with agricultural use in the foreground and forest in background. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 5: Highway 431
This area is rolling terrain thick with forest in the foreground, blocking views toward the project site. The proposed developments will not be visible from this KOP. However, a transmission line running from the existing coal-fired power plant is visible from and runs perpendicular to Highway 431. This transmission line would be used for the proposed NGCC and while it is already constructed, does represent a weak contrast with the surrounding scenery.

KOP 6: Highway 431
This view represents the entrance to the existing KU coal-fired power plant. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 7: Highway 431
This area is heavily forested in the foreground, blocking all views towards project site. The property perimeter fence is visible from this KOP. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 8: Highway 431 near Ladshaw Road
This view shows residences in the foreground and heavy forest in the background. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 9: Highway 431 near Moorman
This view shows residences in the foreground and heavy forest in the background. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

KOP 10: Moorman Cemetery Road
This area is rolling terrain with agricultural use in the foreground and light forest in background. The proposed developments will not be visible from this KOP and, therefore, there is no contrast rating assigned to this KOP.

4.5 Summary of Results

The existing coal-fired power plant and associated facilities are an accepted part of the landscape and the addition of the proposed NGCC would not represent a significant visual effect. The tallest and most visible part of the existing coal-fired power plant, the stacks (at elevations of 610 feet and 659 feet AMSL), were not visible from any of the KOPs sampled in this analysis. Considering that the proposed stacks for the NGCC are shorter (620 feet AMSL) than the stack for existing Unit No. 4, it is highly likely that the proposed NGCC will not be visible to the public. The only KOPs (12-16) that the proposed NGCC would be visible from are off-limits to the public.

The only project-related facilities that would be visible to the public are the existing transmission lines running from the coal-fired power plant. These transmission lines are in weak contrast with the immediate scenery and are considered part of an existing built environment.

4.6 Mitigation

Existing transmission lines represent the only project-related features visible from the KOPs. These are existing facilities that are in weak contrast with the surrounding environment. No mitigation measures are required for the proposed project.

5.0 PROPERTY VALUE ASSESSMENT

Pursuant to KRS 278.708(3)(c), this section of the SAR provides an evaluation of the potential changes in property values resulting from the siting, construction, and operation of the proposed NGCC electric generating plant for property owners adjacent to the facility. This evaluation includes an overview of land use compatibility, a description of the surrounding property characteristics, and an analysis of the potential impact to adjacent property values.

5.1 Land Use Compatibility

The site is located along the Green River in the northern part of Muhlenberg County. The largest city in the county, Central City, is 6 miles from the site. The surrounding area is composed of family farms, private residences, undeveloped land, and a surface mining operation located across the river in Ohio County. The mine, Equality Boot Mine, is owned and operated by Armstrong Energy. According to the Armstrong Energy website (http://www.armstrongcoal.com/equality-boot-mine.html), Equality Boot Mine has been producing coal since the fall of 2010.

The proposed NGCC plant will be constructed on an existing electric power generating site. As such and based on the surrounding land use and the historical use of the property for power generation, it is clear that the site property is compatible with the proposed NGCC unit operations.

5.2 Property Valuation

This section evaluates the potential for changes in adjacent property values from the construction and operation of the NGCC electric generating plant. The evaluation approach used is based on readily available data from the Muhlenberg and Ohio County PVA offices, American Community Survey (ACS), and an online real estate database operated by Zillow (http://www.zillow.com/corp/About.html). The data is summarized in Table 5.1.

Table 5.1 Available Data and Sources

Source	Description	Data of Interest	Geographic Level Used	Time Period Used
American Community Survey (ACS)	An annual survey of US households	Estimates of owner-occupied house value	Summarized by Census Tract	2008-2012
Muhlenberg and Ohio County Property Value Administrator Offices (PVA)	Maintains a database of all county property parcels for the purpose of tax assessment	Type of property, general description, acreage, and assessment value	Adjacent properties	2013
Zillow	Online database of US home sales	Recent home sales price and date	Central City, KY	2011-2013

Table 5.2 outlines the geographic areas defined for the NGCC site and for nearby areas. When available, the analysis uses household level data. If household level data is unavailable, the analysis uses data aggregated at the Census Tract level. The site is located within Muhlenberg County, Kentucky on the border with Ohio County. Muhlenberg County is divided into nine tracts. ACS data is available at the tract level. Individual home sales and adjacent property data are available from Zillow and the PVA.

Table 5.2 Geographic Regions within Study Area

Geographic Size	Type	Name	Surrounding Areas
Largest	County	Muhlenberg County	Ohio County
	Town	Central City	Bremen, Centertown, Rockport, Beaver Dam, Island, Sacramento
	Zip Code	42330	42372, 42325, 42350, 42328, 42354, 42369
Smallest	Census Tract	9602	9601, 9603-9609
	Specific Properties	Adjacent properties	Other properties in Central City

5.3 Description of Area Housing Prices

Table 5.3 shows the number of owner-occupied housing units and the median value for the nine Muhlenberg County Census Tracts. The housing value is derived from the ACS survey respondents' estimates of how much their house and lot would sell for if it were for sale. The median is the middle value of the distribution.

The NGCC site is in Census Tract 9602 (highlighted in Table 5.3). This tract has the highest number of owner-occupied housing units and ranks 4th in owner-reported median value.

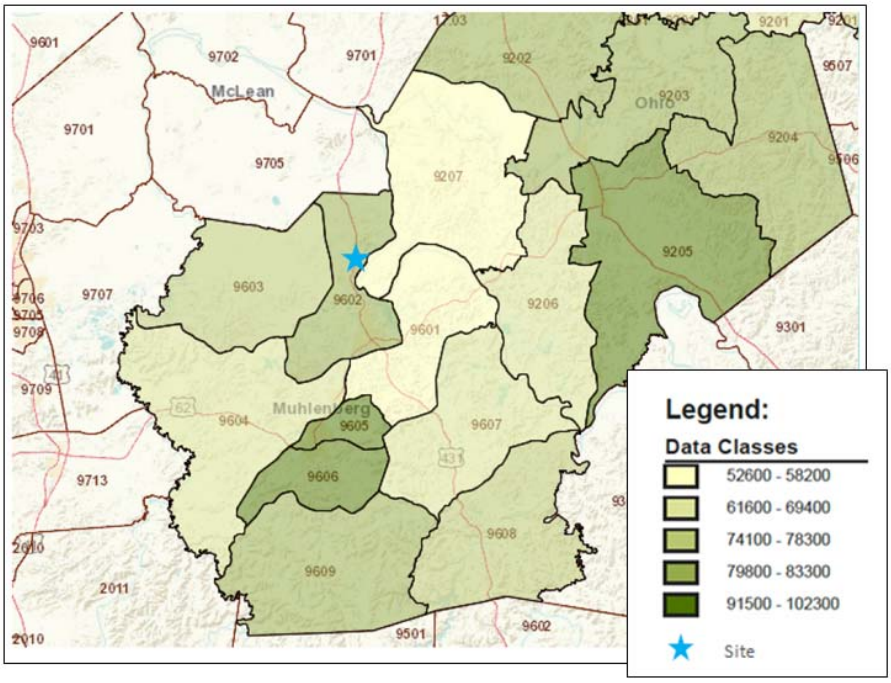
Table 5.3 - Number and median value of owner-occupied housing units in Muhlenberg County, KY

Town	Muhlenberg County Census Tract Number	# Owner-occupied units[1]	Median Value[1] ($)	Margin of Error[2]
Greenville	9605	1052	102,300	+/- 21,301
Greenville	9606	984	100,500	+/ - 14,233
Rosewood	9609	470	83,300	+/ - 20,342
Central City	9602	1787	79,800	+/ - 6,830
Penrod	9608	660	78,300	+/ - 12,580
Bremen	9603	1403	74,100	+/ - 8,021
Drakesboro	9607	1254	69,400	+/ - 9,448
Greenville	9604	1694	63,200	+/ - 6,691
Central City	9601	351	52,600	+/ - 17,752

1. Source: U.S. Census Bureau, 2008-2012 American Community Survey, 5-year estimates
2. The margin of error roughly provides a 90 percent probability that the interval contains the true value. For Census Tract 9605, there is a 90 percent probability that the true median value is between $80,999 and $123,601.

Exhibit 5.1 is a map of Muhlenberg and Ohio Counties, broken out by Census Tract. Tracts with higher median home values are darker shades of green than those with lower median home values. The proposed NGCC site is located within Muhlenberg Tract number 9602 and is indicated with a blue star. All of the adjacent residential and farm properties are in Tract 9602, which has a median home value of $79,800. The median home value in tract 9602 is higher than the median home value in the surrounding area. For example, Tract 9601 and Tract 9207 have a median home value of $52,600 to $58,200 compared to $79,800 in Tract 9602.

Exhibit 5.1 – Map of Muhlenberg and Ohio Counties: Median home value by Census Tract



5.4 Description of Adjacent Property Values

If property values had been affected by the existing nearby facility, one might expect to see lower sales prices for adjacent properties compared to surrounding regions. However, there have not been any home sales within a mile of the proposed NGCC site in the last three years. While ownership of some of the adjacent properties has changed in recent years, these appear to be private sales or gifts between family members. The following paragraphs describe the types of properties immediately surrounding the facility and their potential marketplace value using tax assessment data.

There are 16 properties adjacent to the proposed NGCC site. Two of these properties are in Ohio County and are jointly owned by Western Land Co LLC, Western Mineral Development LLC, and Armstrong Conveyance LLC. Together, they operate a strip mining company. The combined acreage of the two Ohio County properties is 338 acres. The other 14 adjacent properties are located in Muhlenberg County.

Property assessment data for adjacent properties within Muhlenberg County was collected from the Muhlenberg County PVA office. The Muhlenberg County properties include 11 properties classified as farms and three classified as residential. A list of the adjacent farms is shown in Table 5.4. The farms range in size from 16 to 2,369 acres. Excluding the largest (2,369 acres), the average farm size is approximately 41 acres. The combined farm acreage is about 2,700 acres. The PVA assesses these properties at their fair cash value. The total fair cash value for adjacent farms ranges from $39,000 to $2.37 million. The value per acre ranges from $1,000 to $12,919 with an average of approximately $3,800.

Table 5.4 – Adjacent Farms, Muhlenberg County

Primary Parcel Number	Total Farm Acres	Total Fair Cash Value ($)	Total Fair Cash Value per acre ($)
120-00-00-036.000	16	39,000	2,438
120-00-00-031.000	18	89,000	4,944
120-00-00-034.000	18	168,000	9,333
120-00-00-008.001	24	310,000	12,917
138-00-00-004.000	30	60,000	2,000
120-00-00-019.000	35	89,000	2,543
120-00-00-032.000	47	113,000	2,404
138-00-00-005.000	49	50,000	1,020
120-00-00-008.002	50	94,000	1,880
138-00-00-003.000	123	272,000	2,211
137-00-00-002.000	2369	2,369,000	1,000

A list of the adjacent residences is shown in Table 5.5. There are three non-farm properties, two of which include a mobile home. The PVA assigns a separate parcel number for mobile homes. The properties range in size from 1 to 7 acres.

Table 5.5 – Adjacent Residences, Muhlenberg County

Number	Parcel Numbers	Description	Acres	Class	Total Taxable Value ($)
1	138-00-00-004.000M	Mobile home only	0	Mobile Home	16,000
	120-00-00-034.001	House & lot	7	Residential	109,000
2	120-00-00-035.000M	Mobile home only	0	Mobile Home	23,200
	120-00-00-035.000	Lot only	0.9	Residential	8,000
3	138-00-00-004.001	House & lot	1.033	Residential	160,000

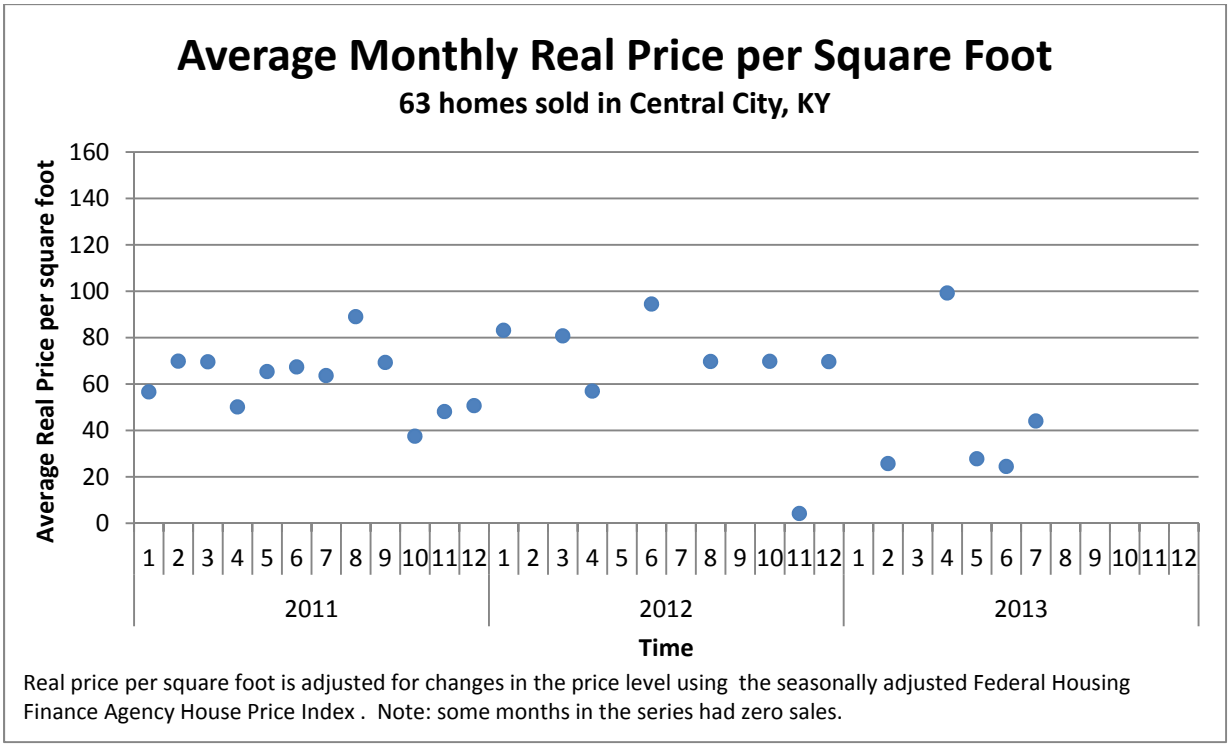
5.5 Description of Recent Home Sale Prices

A database of home sales was constructed using an online real estate database operated by Zillow. According to the website, 106 properties were sold in Central City in the past three years (Appendix C). Records typically report the address, date sold, and purchase price. A portion of the records also include other characteristics such as number of bedrooms, number of bathrooms, square footage, and lot size. The data was used to estimate distance from each house to the KU Green River facility. A statistical model shows there is no significant relationship between price and distance from the facility.

5.6 Price per Square Foot Analysis

Total sales price is affected by the square footage of the home among other factors. To account for this, home values were analyzed using the price per square foot. The database included 63 records with home square footage. The closest property to the facility is a mobile home sold in 2011 that is almost 2 miles from the site, but square footage is not available. The closest property to the site that includes square footage is a home sold in 2011 that is 4.1 miles from the site. Chart 5.1 shows the recent trend in home prices over the last three years, adjusted for inflation. The data indicate that there has been a slight decrease in purchase price per square foot in the last year, but this result is not statistically significant.

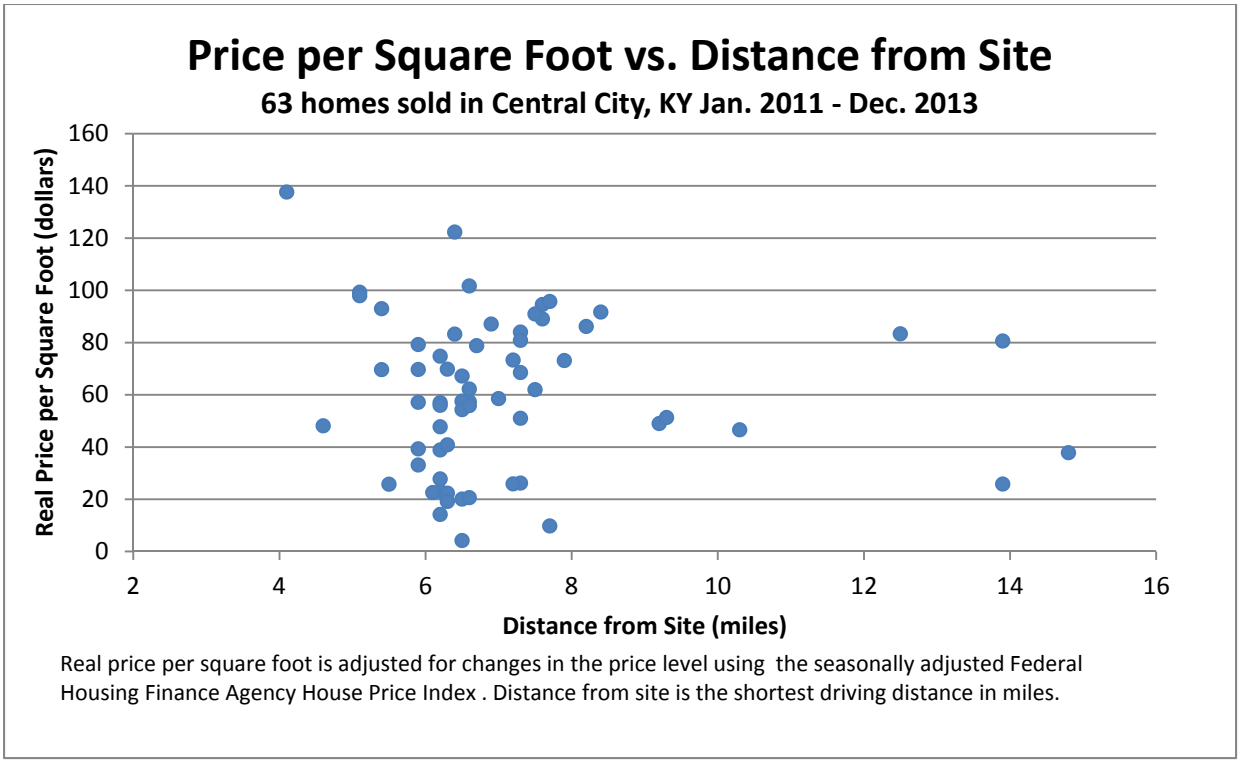
Chart 5.1 – Recent Trend in Home Prices, Average Monthly Price per Square Foot



Real price per square foot is adjusted for changes in the price level using the seasonally adjusted Federal Housing Finance Agency House Price Index . Note: some months in the series had zero sales.

Chart 5.2 plots the price per square foot against distance from the NGCC site. The plot shows sale prices decline slightly as distance from the site increases. However, a statistical model (i.e., a linear regression analysis) shows the decline is not significant. Therefore, there is no correlation between proximity to the NGCC site and sales price.

Chart 5.2 – Price per Square Foot vs. Distance from the NGCC Site



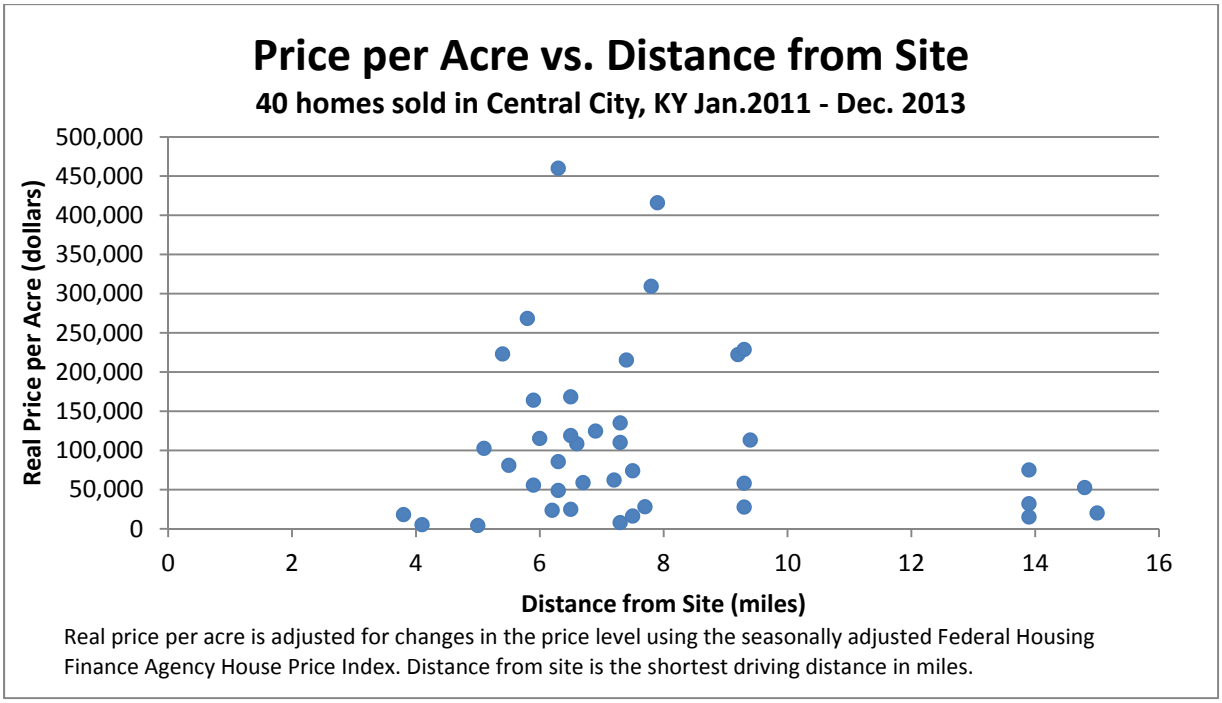
Real price per square foot is adjusted for changes in the price level using the seasonally adjusted Federal Housing Finance Agency House Price Index . Distance from site is the shortest driving distance in miles.

5.7 Price per Acre Analysis

For this section, price per acre was analyzed. The database included 40 records with data on acreage. The acreage ranges from less than 1 to 33 acres. In the last three years, there have been just two properties sold in Central City that are more than 5 acres. Of these, the closest is 4.1 miles from the NGCC site and 33 acres in size. It has an inflation-adjusted price per acre of about $5,100. The second is 7.3 miles away and is about 7 acres. The inflation-adjusted price per acre is $7,800.

Chart 5.3 plots the price per acre against distance from the NGCC site. The data shows a slight decrease in price as distance from the site increases, but this result is not statistically significant. Based on a linear regression analysis (Appendix D), there is no correlation between proximity to the site and sales price per acre. (Note this result is not affected by the inclusion of outliers in the data. Whether or not extreme high or extreme low values of price or distance are included or excluded, there does not appear to be any correlation between proximity to the site and price per acre. The analysis was conducted by excluding the 1%, 5%, and 10% tails of the distribution of price and distance.)

Chart 5.3 – Price per Acre vs. Distance from the NGCC Site



Real price per acre is adjusted for changes in the price level using the seasonally adjusted Federal Housing Finance Agency House Price Index. Distance from site is the shortest driving distance in miles.

5.8 Conclusion

Since the proposed NGCC facility will be located on an existing power plant site, the site property is compatible with the proposed operations. The U.S. Census divides Muhlenberg County into nine areas, called tracts. Of these, the NGCC site is located in the tract with the most owner-occupied housing units. Owner-reported home values in the tract around the site are higher than other surrounding area Census Tracts. Also, an analysis of property values indicates that there is no correlation between price per square foot or price per acre and proximity to the site. Taken together, this indicates that there has not been a negative impact on property values associated with proximity to the site. Furthermore, there will be no new scenic disruptions that could affect property values (see Section 3.0). The proposed stacks for the NGCC will be shorter than the stack for existing Unit No. 4, and the transmissions lines, while visible, are already part of the existing scenery. Other significant improvements over the existing facility include reduction in air emissions, elimination of coal shipments to the site via highway, cessation of landfill operations, and a smaller footprint and lower profile for the proposed NGCC power station.

Considering these improvements and that the existing coal-fired electric-generating station has not negatively affected area property values, it is reasonable to conclude that the proposed NGCC facility will not have a negative impact on local property values.

6.0 NOISE ASSESSMENT

This section provides an assessment of potential impacts due to noise emissions from the proposed NGCC facility at KU's Green River Generating Station. The section contains a brief overview of acoustics, a description of the existing acoustical environment based on monitoring, an estimate of proposed NGCC facility noise emissions during construction and operation, an assessment of potential impact, and discussion of mitigative measures.

KU commissioned an ambient background noise monitoring study encompassing the existing KU Green River electric generating station and surrounding area as a component of this Noise Assessment. This study was conducted by Cardno ATC and incorporated into the SAR.

6.1 Acoustical Terminology

Environmental noise level assessments quantify noise levels utilizing a variety of parameters and metrics. This section introduces general concepts and terminology related to environmental noise measurements and assessments.

6.1.1 Sound Energy Characteristics

Sound energy is physically characterized by amplitude and frequency. Sound amplitude is measured in decibels (dB) which is the logarithmic ratio of a sound pressure to the typical threshold of human hearing (20 micro Pascals, abbreviated µPa). Generally, the average listener considers a 3 dB change in a constant broadband noise "just barely perceptible". Similarly, a 5 dB change is generally considered "clearly noticeable" and a 10 dB change is generally considered a doubling (or halving) of the apparent loudness. Frequency is measured in hertz (Hz), which is the number of cycles per second. The typical human ear can hear frequencies ranging from approximately 20 Hz to 20,000 Hz and is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz). To duplicate this sensitivity, sound energy measurements are weighted by frequency to simulate the frequency response of the human ear to sounds at typical environmental levels. This weighted scale is referred to as the "A weighting" and is denoted as dBA. The A-weighting scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. For reference, the A-weighted sound pressure levels associated with some common noise sources are shown in Table 6.1.

Table 6.1 – Typical Sound Pressure Levels Associated with Common Noise Sources

Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 ft.	
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 ft.	
120	Threshold of feeling	Elevated Train	Hard rock band
110		Jet flyover at 1000 ft.	Inside propeller plane
100	Very Loud	Power mower, motorcycle at 25 ft., auto horn at 10 ft., crowd noise at football game	
90		Propeller plane flyover at 1000 ft., noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately Loud	Diesel truck (40 mph) at 50 ft.	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner, electric typewriter
60	Moderate	Air-conditioner condenser at 15 ft., near highway traffic	General office
50	Quiet		Private office
40		Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very Quiet	Quiet residential neighborhood	Bedroom, average residence (without TV and stereo)
20		Rustling leaves	Quiet theater, whisper
10	Just Audible		Human breathing
0	Threshold of hearing		

Source: Adapted from Architectural Acoustics, M. David Egan, 1988 and Architectural Graphic Standards, Ramsey and Sleeper, 1994

6.1.2 Environmental Noise Metrics

Noise in the environment is constantly fluctuating, such as when a car drives by or a plane passes overhead. Several noise metrics have been developed to quantify fluctuating noise levels. These metrics include the equivalent-continuous sound level and the exceedance sound level.

The equivalent-continuous sound level, L_{eq} or L_{avg} is the level of a hypothetical steady sound that has the equivalent sound energy as the actual fluctuating sound over a given time duration. For example, L_{avg} (24 hour) is the equivalent-continuous sound level measured over a 24 hour period and provides an indication of the average sound energy over the 24 hour period.

The exceedance sound level, L_x, is the sound level exceeded "x" percent of the sampling period and is referred to as a statistical sound level. The most common L_x values are L_{90}, L_{50}, and L_{10}. L_{90} is the sound level exceeded 90 percent of the sampling period. L_{90} is often referred to as the residual sound level because it measures the background sound level without the influence of loud, transient noise sources. L_{50} is the sound level exceeded 50 percent of the sampling period or the median sound level. L_{10} is the sound level exceeded 10 percent of the sampling period. L_{10} is often referred to as the intrusive sound level because it measures the occasional louder noises. The variation between the L_{90}, L_{50}, and L_{10} sound levels can provide an indication of the variability and distribution of the noise environment. If the noise environment were perfectly steady, all values would be identical. A large variation between the values would indicate a large range of sound levels within the environment. For instance, measurements near a roadway with frequent passing vehicles would cause a large variation in the statistical sound levels.

6.2 Human Response to Noise

Human response to noise is highly individualized and influenced by a variety of acoustic and non-acoustic factors. Acoustic factors generally include the sound's amplitude, duration, spectral content, and fluctuations. Non-acoustic factors typically include the listener's ability to become used to the noise, the listener's attitude towards the noise and the noise source, the listener's view of the necessity of the noise, and the predictability of the noise.

6.3 Applicable Noise Regulations

6.3.1 Local Regulations

No local regulations were identified.

6.3.2 Commonwealth of Kentucky Regulations

The Commonwealth of Kentucky Revised Statutes 224.30-050 contains a qualitative noise law; however, the current statute does not have any enforceable, numerical limits. Therefore, there are no identifiable or enforceable Commonwealth of Kentucky sound level limits that would be applicable to the KU Green River electric generating station.

6.3.3 Federal Regulations

The U.S. Environmental Protection Agency (USEPA) has identified yearly day-night average sound levels, L_{dn}, sufficient to protect public health and welfare from the effects of environmental noise [***EPA Pub. No. 550/9-79-100, 1978***]. The day-night sound level, L_{dn}, is the 24-hour average sound level with a 10 dB penalty applied to the nighttime sound levels (10:00 p.m. to 7:00 a.m.) to account for increased sensitivity to noise during night time hours. According to the USEPA, yearly outdoor levels below an L_{dn} of 55 dBA are sufficient to protect public health and welfare in sensitive areas such as residences, schools, and hospitals. Generally, an L_{dn} of 55 dBA equates to a constant sound level (L_{avg}) of 55 dBA during daytime hours and 45 dBA during nighttime hours.

The USEPA emphasizes that since the protective sound levels were derived without concern for technical or economic feasibility, and contain a margin of safety to ensure their protective value, they must not be viewed as standards, criteria, regulations, or goals. Rather, they should be viewed as levels below which there are no reasons to suspect that the general population will be at risk from any of the identified effects of noise. As guidance documents USEPA recommended levels are not enforceable.

6.4 Existing Acoustical Environment

In order to characterize the existing acoustical environment at the KU Green River Generating Station (project site and surrounding area), an ambient sound level survey was conducted. This section describes the results of the survey and the nature of the existing acoustical environment surrounding the project site.

6.4.1 General Community Noise

The existing acoustical environment around the project site is typical of a predominantly rural area. The primary sources of noise include natural sounds and occasional traffic. Areas immediately surrounding the existing station experience noise associated with the operation of the existing generation unit which ranges from a L_{avg} (24 hour) of 47.0 dBA to 64.6 dBA.

6.4.2 Survey Procedure and Conditions

The ambient sound level survey was conducted between December 16 and 18, 2013 to characterize the existing acoustical environment. The survey was conducted during normal operation of the existing facility with both Coal-Fired Units No. 3 and No. 4 running, utilizing survey procedures based on general industry test standards including ANSI S12.9 and ANSI S1.13.

In order to effectively quantify and qualify the existing ambient noise level, readings were collected from ten locations at the KU Green River electric generating station. Nine of the data collection points were located at various points on the facility perimeter and one sample point was located at the approximate center of the facility for reference. These locations were selected to capture acoustical environments representative of the nearby noise-sensitive receptors (i.e., residences) and to capture the existing sound levels at various points near the facility perimeter. Each measurement location is identified in Figure 14 and described below in Table 6.2.

Table 6.2 Data Collection Point Locations and Descriptions

Location	Description	Latitude (D-M-S)	Longitude (D-M-S)	Unit #	L_{avg} (dBA) 12/16/13	L_{avg} (dBA) 12/17/13
1	Nearest to Facility	37.21.7547	87.07.3111	00970	62.5	64.6
2	SW of facility, prop line	37.21.7588	87.07.5114	004000	Device Failure	
3	NE of facility along river, coal loading across river	37.21.9711	87.06.8365	R7014	61.5	60.8
4	Near main road, center of property	37.21.9321	87.07.4128	R4631	59.0	58.4
5	NE prop line	37.22.3437	87.07.0554	004518	54.7	49.4
6	Northernmost location, prop line	37.22.4859	87.07.2155	R3375	48.3	47.0
7	North central, prop line	37.22.3723	87.07.3757	R3471	47.2	49.1
8	NW of facility, prop line	37.22.0844	87.07.7390	R3407	63.9	62.1
9	NW corner of prop. Near 431	37.22.0969	87.08.1206	00866	Device Failure	
10	Near entrance	37.21.8691	87.08.0352	R3259	61.1	60.6

6.4.3 Continuous Monitoring

Continuous noise monitoring was conducted for approximately 48 hours and data was successfully collected and recorded over this period for eight of the ten locations. The data collection units at locations 2 and 9 failed to collect data during the second 24 hour period and have been excluded from this assessment. The results of the continuous monitoring provide an indication of the daily trends in the ambient sound level for this 48-hour monitoring period, during which the existing Green River Generating Station was operating under normal conditions (that is, operation of Units 3 and 4). The measurements included the L_{avg}, L_1, L_{10}, L_{50}, and L_{90} sound pressure levels.

As previously discussed, the L_{avg} (24 hour) sound level is the hypothetical equivalent sound over each 24 hour period. L_{90} sound level is generally considered representative of the residual or background sound level (i.e., without discrete noise events such as traffic, aircraft, dogs, etc.), the L_{50} sound level is considered the median sound level, and the L_{10} sound level is generally considered the intrusive sound level (i.e., with occasional discrete events such as traffic, aircraft, etc.).

The continuous noise monitoring L_{avg} (24 hour) results are detailed in Table 6.3 for each 24 hour period. Appendix F contains printouts for the noise monitoring data collected during this study.

Table 6.3 Background Noise Data KU Green River Noise Assessment December 16-18, 2013

Location	Description	Latitude (D-M-S)	Longitude (D-M-S)	Unit #	L_{avq} dBA 12/16/13	L_{avq} dBA 12/17/13
1	Nearest to Facility	37.21.7547	87.07.3111	00970	62.5	64.6
2	SW of facility, prop line	37.21.7588	87.07.5114	004000	Device Failure	
3	NE of facility along river, coal loading across river	37.21.9711	87.06.8365	R7014	61.5	60.8
4	Near main road, center of property	37.21.9321	87.07.4128	R4631	59.0	58.4
5	NE prop line	37.22.3437	87.07.0554	004518	54.7	49.4
6	Northernmost location, prop line	37.22.4859	87.07.2155	R3375	48.3	47.0
7	North central, prop line	37.22.3723	87.07.3757	R3471	47.2	49.1
8	NW of facility, prop line	37.22.0844	87.07.7390	R3407	63.9	62.1
9	NW corner of prop. Near 431	37.22.0969	87.08.1206	00866	Device Failure	
10	Near entrance	37.22.2511	87.08.1141	R3259	61.1	60.6

The exceedence data including the L_{10}, L_{50}, and L_{90} levels during the 48-hour period for each data collection point is presented below in Charts 6.1 through 6.8.

Charts 6.1 through 6.8 Exceedences and Statistics per Location

Chart 6.1a Exceedence Chart Location 1

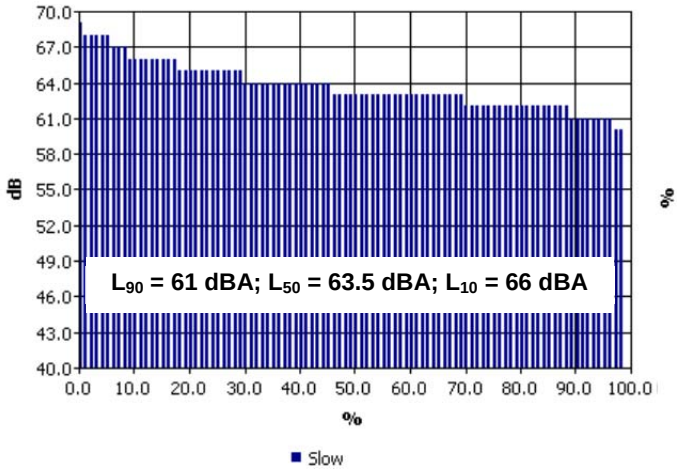


Chart 6.1b Statistics Chart Location 1

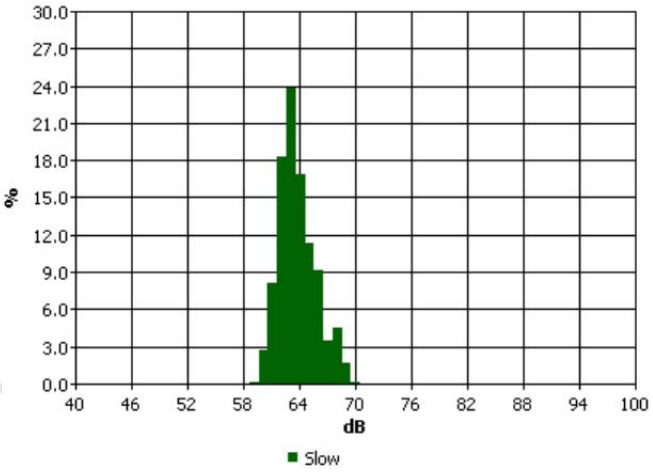


Chart 6.2a Exceedence Chart Location 3

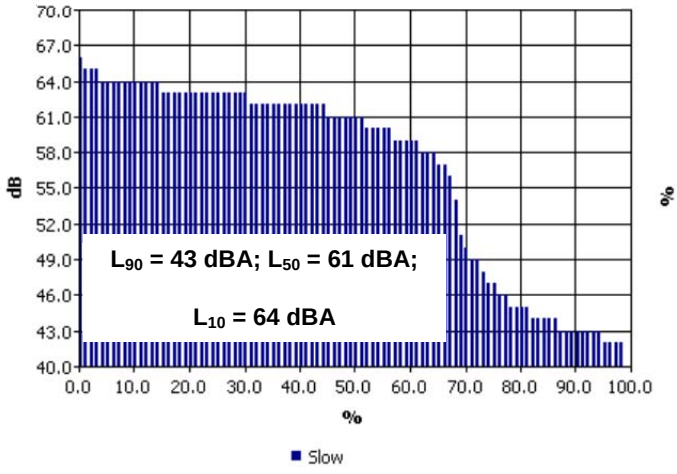


Chart 6.2b Statistics Chart Location 3

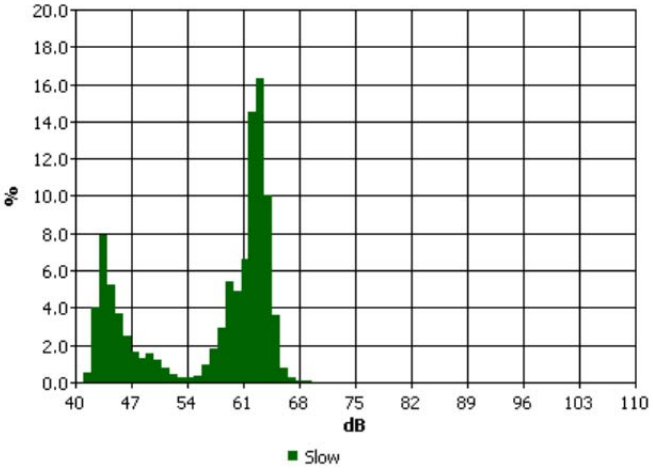


Chart 6.3a Exceedence Chart Location 4

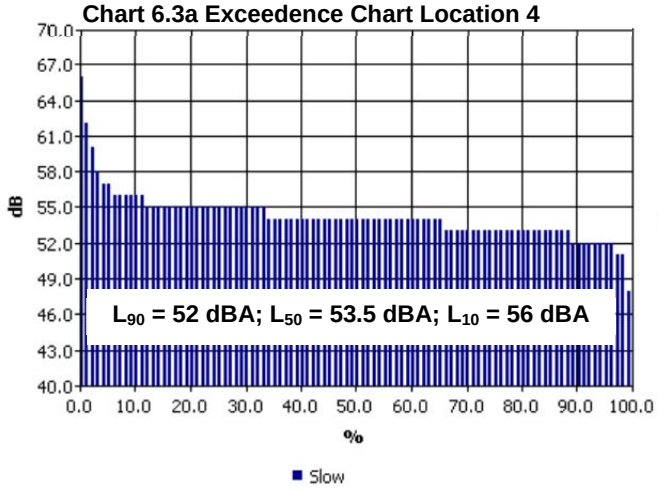


Chart 6.3b Statistics Chart Location 4

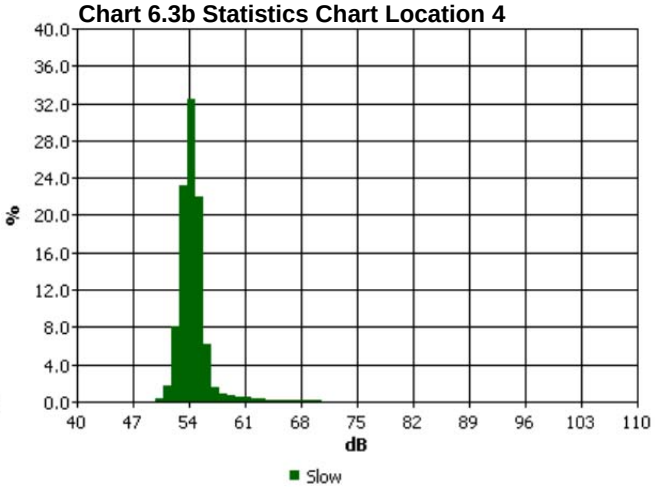


Chart 6.4a Exceedence Chart Location 5

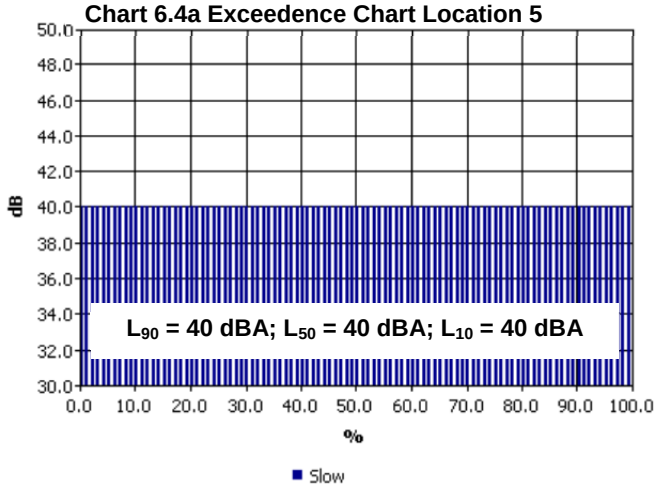


Chart 6.4b Statistics Chart Location 5

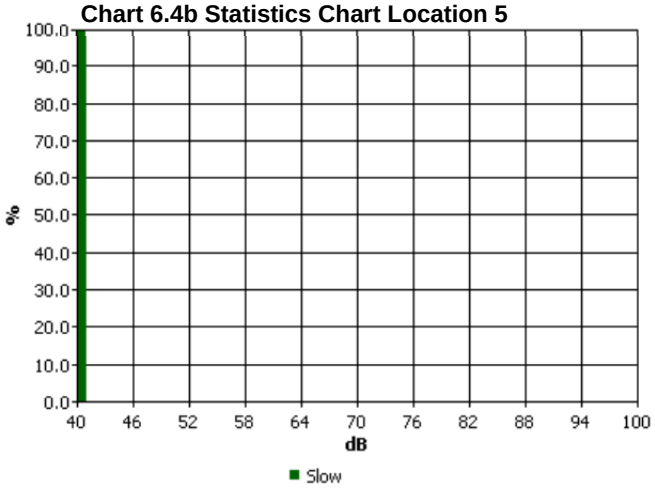


Chart 6.5a Exceedence Chart Location 6

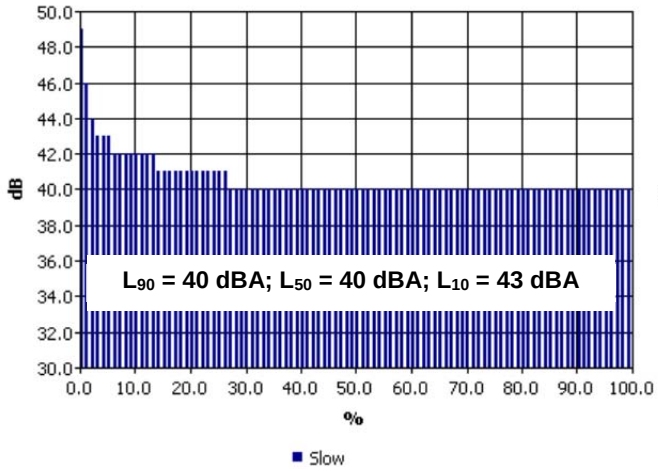


Chart 6.5b Statistics Chart Location 6

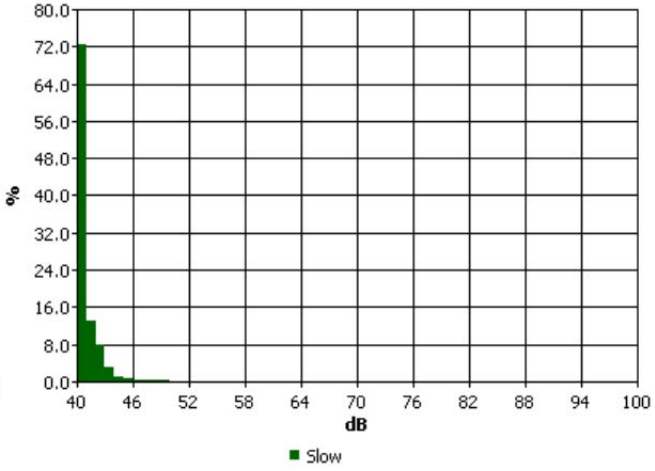


Chart 6.6a Exceedence Chart Location 7

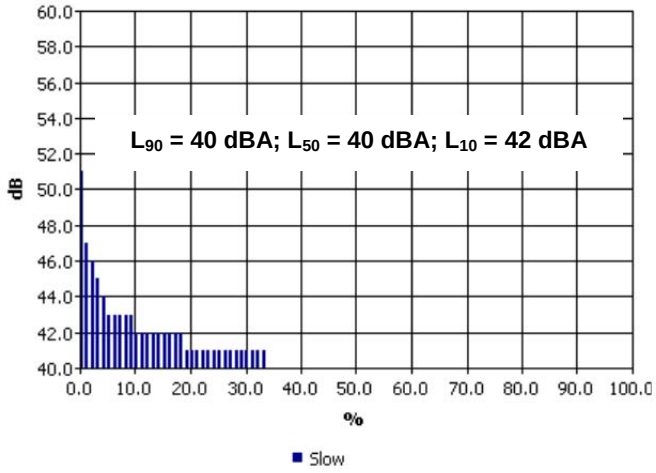


Chart 6.6b Statistics Chart Location 7

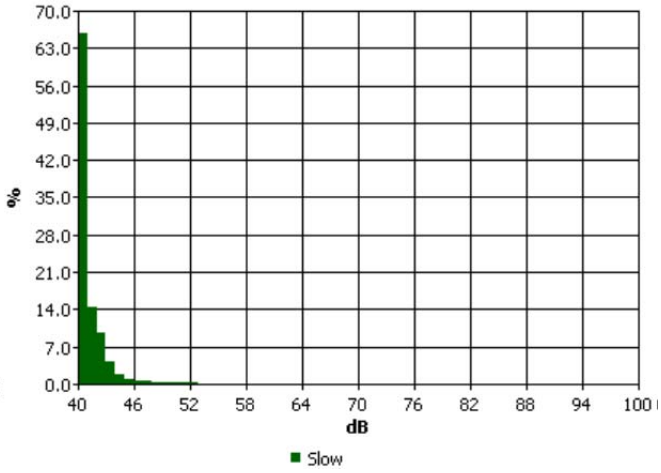


Chart 6.7a Exceedence Chart Location 8

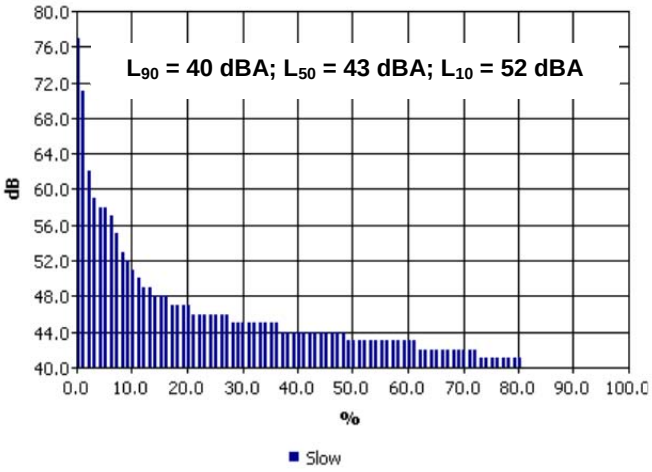


Chart 6.7b Statistics Chart Location 8

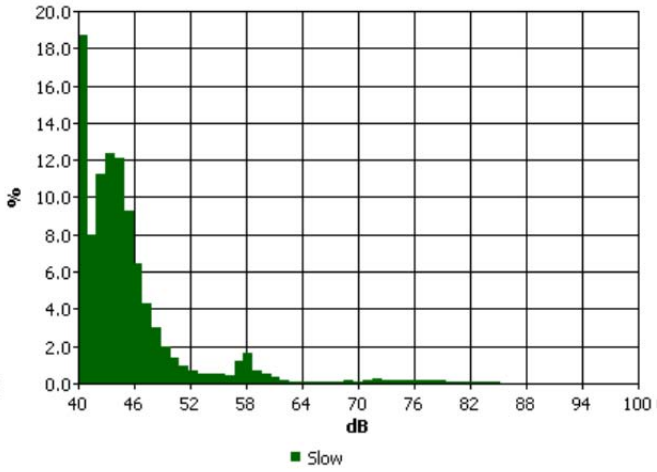


Chart 6.8a Exceedence Chart Location 10

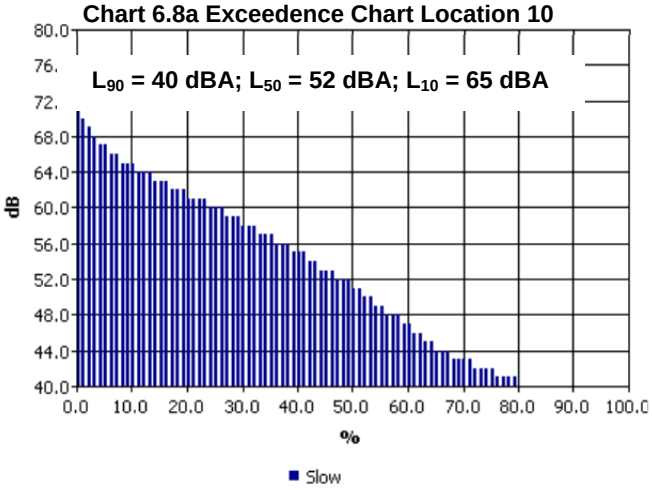
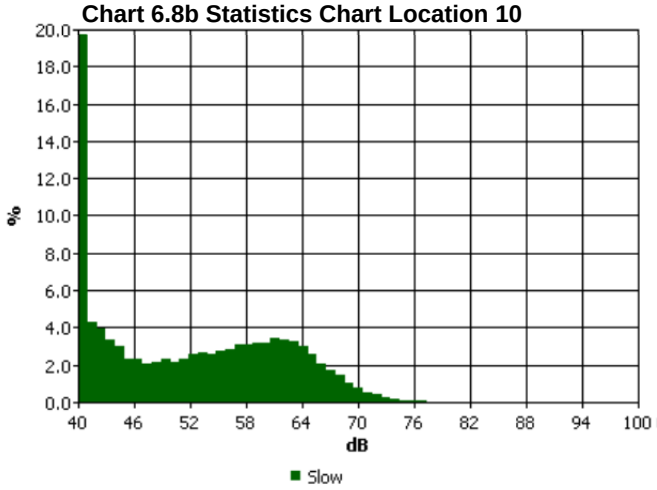


Chart 6.8b Statistics Chart Location 10



6.5 Environmental Noise Emissions

6.5.1 Equipment Noise Sources

KU intends to build a 2 x 1 G/H Class NGCC turbine, nominally rated at about 720 MW at summer design conditions.

Although the combustion turbine technologies and net electrical output differ, each NGCC arrangement has been held to the following thermal design constraints:

- Natural gas fuel
- Triple pressure HRSG with low temperature economizer (LTE)
- 1,050 °F/1,050 °F main steam and reheat steam temperature
- 2,400 psig steam turbine throttle with sliding pressure as steam load decreases
- A minimum stack exit of 180 °F
- Evaporative cooling of gas turbine inlet air
- Gas compression as necessary

6.5.2 Facility Noise Emissions

According to the aforementioned feasibility study, the equipment to be installed will be designed to a near-field noise standard of 85 dBA at 3 feet. Design criteria for far-field noise emissions are expected to be approximately 55 dBA at the property line. In order to evaluate potential noise impacts on surrounding noise sensitive receptors, the design far-field noise emissions were compared to the measured ambient sound levels.

The design far-field noise emissions of 55 dBA at the property line will exceed the L_{90} or residual sound levels measured during the ambient noise survey at all seven parameter data collection points. However, designed far-field noise emissions of 55 dBA will only exceed the ambient L_{10} or intrusive sound levels and ambient L_{avg} (24 hour) sound levels at only data collection points 5, 6, and 7. Locations 5, 6, and 7 (along the northern edge of the property) are the farthest points from the existing facility and are located in heavily wooded areas of the property. Both the distance from existing (and proposed) noise sources and the heavy ground cover in these areas are significant noise attenuation factors with influence on both the ambient noise survey and the expected noise impact of the proposed NGCC facility. Since the proposed footprint of the additional facility does not significantly change the distance of the noise sources from the northern property line nor impact of the heavy wooded ground cover along the northern property, it is unlikely the proposed NGCC facility will have an unacceptable impact above ambient acoustical L_{10} or L_{avg} (24 hour) conditions.

Environmental factors and natural conditions (e.g., wind direction and speed), may allow noise emissions from the proposed NGCC facility to be audible at the nearest receptors at certain times. However, the proposed NGCC facility's overall impact to background sound levels at the nearest receptors is generally anticipated to be insignificant.

In addition, design criteria for far-field noise emission limits of 55 dBA at property lines has been predicated on setback criteria of 1,000 feet from adjoining property owners. In other words, the design basis is 55 dBA at a distance of 1,000 feet. As noted previously, KU will acquire the adjacent property to the south-southwest to meet setback requirements. Once this acquisition is completed, the nearest property boundary will be nearly 2,000 feet from the proposed NGCC. The nearest residential structures are over one-half mile from the proposed NGCC.

It is important to note that, the Existing Coal-Fired Generating Units and the proposed NGCC unit will never operate simultaneously since operation of the existing units will be terminated prior to the commercialization of the proposed NGCC, thus only one source of noise emissions from power production will be in operation at any given time.

6.6 Construction Noise Emissions

Construction activities are anticipated to include mobilization/site preparation, foundation construction, equipment installation, building structure erection, and site cleanup/demobilization. Some blasting is anticipated and will comply with all applicable regulations. Noise emissions, due to construction, will vary with each phase of construction depending on the construction activity and the associated equipment. Construction activities should be scheduled during daytime and evening periods (7:00 a.m. to 10:00 p.m.) to the fullest extent possible. Any nighttime construction should be limited to low noise activities to the extent practicable.

6.7 Mitigation

Since no significant impacts are expected to result from the construction or operation of the proposed NGCC facility: no significant mitigation is anticipated to be required. However, construction activities planned along the northern boundary should avoid disturbance to the heavily wooded areas along KU's northern property boundary. In addition, construction noise should be limited by use of properly maintained equipment with engine mufflers and limiting construction activity to daytime and evening periods, as practicable (7:00 AM to 10:00 PM).

7.0 TRAFFIC ASSESSMENT

This section describes the local roadways within the project vicinity and the potential impacts that could result from the construction and operation of the proposed NGCC. The majority of the assessment is focused on the traffic impacts to the surrounding roadway system; however, due to the project's proximity to the Green River potential impacts to the barge system are also discussed.

As part of this project, the existing Coal-Fired Electric Generating Units will be shut down prior to commercialization of the proposed NGCC. Shutdown of the Coal-Fired Electric Generating Units is approximately scheduled for 2015. The construction period for the proposed NGCC is estimated to be three years. The proposed NGCC is projected to be commercialized and on line in 2018.

7.1 Local Roadways

The NGCC Electric Generating Plant is proposed to be located within the boundaries of the existing Coal-Fired Electric Generating Station. Access to the NGCC Electric Generation Plant will be provided via Power Plant Road. As shown in Figure 3, Site Layout, two additional entrances from Power Plant Road to U.S. 431 will be installed south of the existing intersection during construction. One of these will remain open after completion of construction to serve the proposed NGCC, with the other one gated but remaining available for potential future use. Power Plant Road is a two-lane, undivided private road owned by KU that intersects with U.S. 431 between KY 81 and KY 175 and meanders east towards the Green River into the existing Electric Generating Station.

The traffic assessment was undertaken for the main highways near the project that are expected to accommodate travel through Muhlenberg County to the plant. The study roadways include U.S. Highway 431, KY 81, and KY 175. U.S. 431 is two-lane undivided rural principle arterial. KY 81 is a rural two-lane undivided major collector. KY 175 is a rural two-lane undivided minor collector

The study roadways are illustrated in Exhibit 7.1.

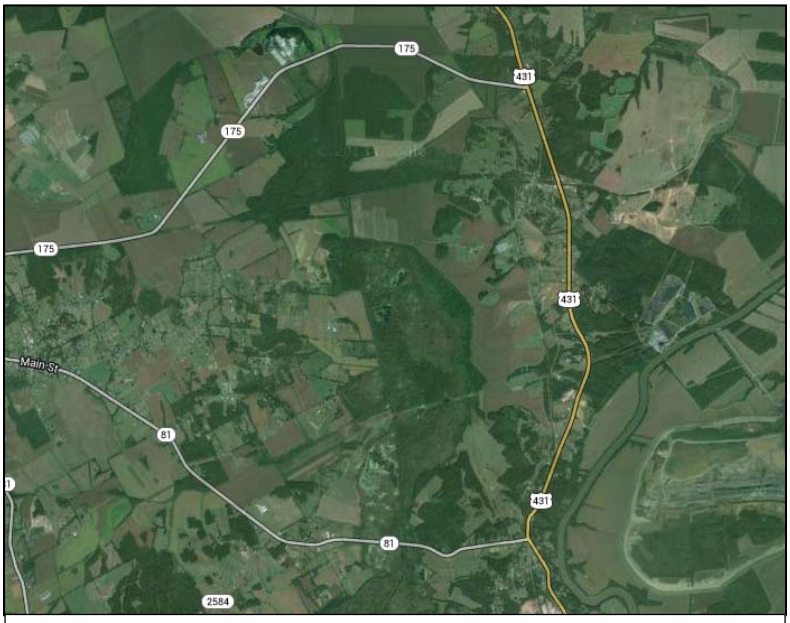


Exhibit 7.1 – Traffic Assessment Study Area

According to the KYTC count database, existing AADT volume on U.S. 431 is 4,476 vehicles per day south of the site and 4,430 vehicles per day north of the site. The AADT volume on KY 81 is 2,640. The AADT volume on KY 175 is 636. The AADT on U.S. 431 south of KY 81 is 6,904. Hourly peak hour volume was not available, therefore, based on the American Association of State Highway and Transportation Officials: A Policy on Geometric Design of Highways and Streets (2004), a typical factor of 15 percent of the average daily traffic was used for this assessment. Based on the Transportation Research Board Highway Capacity Manual (2010), the capacity of a two-lane roadway is 3,200 vehicles per hour or 1,700 vehicles per hour in one direction.

7.1.1 Potential Impacts from Construction Activities

For construction of the proposed NGCC Electric Generating Plant, site labor is estimated to peak in Month 16 (September 2016) of the project, with 505 construction personnel actively working. It is assumed that 70 percent of the construction personnel will drive their vehicle to the site and the remaining 30 percent will carpool and be contained within the 70 percent. The resulting volume is approximately 354 vehicles (i.e., 505 x 0.70 = 354) entering and leaving the site on a daily basis. With each vehicle making two trips (entering and leaving), the daily trip generation from construction personnel is expected to be 708 trips on a daily basis during the peak month. The standard work week will include five 10-hour days and the site-generated traffic will most likely occur from 6:00 a.m. to 6:00 p.m. on weekdays. Therefore, the majority of construction related traffic will travel the roads before and after the typical morning (7-9 a.m.) and evening (4-6 p.m.) workday peak periods. Construction personnel will access onsite parking from Power Plant Road.

In addition to construction personnel trips, after the start of construction, daily truck deliveries will occur on site. The daily deliveries will vary from 0 to 80 truck deliveries with the peak months expected in Month 15 and 16 of the project at 80 trucks, or 160

daily trips (80 x 2 = 160). These deliveries will include typical construction materials such as mechanical and electrical equipment, construction supplies, concrete and steel. The possibility of barge deliveries for transporting heavy equipment components to the site is being explored. The plan is to have several heavy construction equipment pieces remain on site during various phases of construction or for the duration of the construction period.

Various auxiliary service and support vendors will also be accessing the site during construction. These services include portable restrooms, communications and other support services. It is expected that the vendors will generate 30 site visits or 60 daily trips (30 x 2 = 60) during the peak construction month.

During the peak construction period, there will be an estimated 928 construction related trips (708 personnel + 160 truck deliveries + 60 vendor visits) entering and exiting the site on a daily basis. During the peak hour (either AM or PM), there will be 464 construction related trips. It is expected that half of the construction traffic will come from the north on U.S. 431 and the other half from the south on U.S. 431. Based on existing travel patterns, it is expected that 10 percent will travel on KY 175 and 15 percent on KY 81. To determine the total peak- hour, peak-direction volume, a typical 60 / 40 directional split was applied to the existing traffic and a 90 / 10 directional split was applied to the construction traffic. Based on the peak hour, peak direction total volume on the study roadways, the construction traffic is not expected to adversely affect the roadway capacity. The results are summarized in Table 7.1.

Table 7.1

Impacts to Roadway Capacity from Construction

Roadway	No. of Lanes	Existing Volume			Construction Trips		Total Volume Peak-Hour Peak-Direction	Roadway Capacity (v/hr)	Meets Capacity (Y/N)
		AADT	Peak Hour Volume	Peak Hour Peak Direction	Distribution	Peak-Hour Peak Direction			
U.S. Highway 431 (North of KY 175)	2LU	3,622	544	327	40%	168	495	1,700	Y
U.S. Highway 431 (North of Power Plant Road)	2LU	4,430	665	399	50%	209	608	1,700	Y
U.S. Highway 431 (South of Power Plant Road)	2LU	4,476	672	404	50%	209	613	1,700	Y
U.S. Highway 431 (South of KY 81)	2LU	6,904	1036	622	35%	147	769	1,700	Y
KY 81	2LU	2,640	396	238	15%	63	301	1,700	Y
KY 175	2LU	636	96	58	10%	42	100	1,700	Y

7.1.2 Fugitive Dust

Fugitive dust emissions will be of most concern during construction activities. During construction, dust will be associated with ground excavation, cut-and-fill operations, on-site transport of materials and equipment, operation of heavy equipment and other activities. The amount and expanse of potential dust will vary from day to day, depending on the level of activity and the weather.

Strategies such as best management practices will be employed during construction to limit fugitive dust emissions. Several measures may include watering of traffic ways, limiting the area of open excavation/grading areas, and providing temporary cover for soil stockpiles.

Access throughout the plant site will be by use of existing paved roads along with new paved roads and temporary internal unpaved roadways installed during construction. These roads provide direct access to locations of construction activities and therefore fugitive dust emissions should be minimized from onsite traffic.

7.1.3 Road Degradation

The highest traffic volume is anticipated to occur during construction of the NGCC. As previously noted, the anticipated construction traffic volume is within the capacity of the local roadways. As such, road degradation is not expected to occur from overuse of the local roadways as a result of construction activities.

If heavy equipment such as turbines, generators, and larger sections of the heat recovery steam generator are delivered via barge, then the loading on the local roadways will be reduced. By using barge to transport heavy equipment, oversized truck loads on surrounding roadways may be greatly reduced. For those oversized truck loads travelling on the roadways, they will conform to weight capacity limitations on the roadways traversed, and necessary permits will be obtained from the KYTC for all such shipments. KY-175 and US 431 have weight limit classes of 44,000 lbs. and 80,000 lbs., respectively.

7.2 Potential Impacts from Facility Operation

As addressed above, there may be overlapping periods of operations for the existing Coal-Fired Electric Generation Units with construction activities. However, since the Coal-Fired Electric Generating Units will be shut down prior to commercialization of the proposed NGCC, there are no overlapping periods where both the existing and proposed facilities are in operation. Therefore, only the permanent period of operation, beginning once the NCGG unit attains commercialization requires evaluation, as follows.

The proposed NGCC electric generating plant will employ essentially the same number of personnel and operate at the same hours as the existing plant facility. As noted, the Coal-Fired Electric Generating Units will be shut down prior to commercialization of the proposed NGCC, and all traffic volume associated with the Coal-Fired Electric Generating Units will be eliminated. Permanent operation of the NGCC unit is

anticipated to require 42 personnel, one contractor, and 5 deliveries per day, yielding a total peak hour traffic volume of 48 vehicles per hour on the study roadways.

No new trips are generated after the commercialization of the NGCC unit, so no significant impacts to roadway capacity are anticipated on the adjacent study roadways.

7.3 Rail and Barge Traffic

There is no direct railroad access to the site and none is planned for the proposed NGCC project. The nearest railroad is a CSX line located roughly one mile west of the site on the other side of US 431. As shown on Figure 12 a potential route for deliveries by rail is being evaluated for the proposed project. If utilized, this route would require restoration of an abandoned section of the CSX line located north of the site near Moorman and extension of a rail spur southward to the proposed NGCC site for construction deliveries. At the time of this SAR the ultimate feasibility of option this is has not been determined.

Currently no materials are delivered to the existing site by barge and are primarily delivered by trucks. Due to the site's proximity to the Green River, the river provides for convenient access to the site by barge. The potential transport of heavy equipment components to the site by barge during construction and after commercialization of the NGCC unit is being explored. The types of heavy equipment that may be delivered during construction include heavy construction equipment or large equipment items such as the turbine, generator, and larger sections of the heat recovery steam generator, as well as large commodity orders that are not prefabrication such as gas pipe. This increase is considered minimal compared to the existing barge traffic along the Green River. Therefore, transport to and from the NGCC is not expected to result in any adverse impacts to the barge traffic on the Green River.

7.4 Mitigation

7.4.1 Roadways

The most significant increase in traffic volume will occur during construction of the proposed NGCC unit. During the peak month of construction, traffic volumes are expected to increase by 818 vehicles per day or 409 vehicles in the peak hour. After the NGCC unit attains commercialization and the coal-fired units are shut down, the trips are expected to be 94 daily trips and 47 peak hour trips due to the elimination of the coal related deliveries. The assessment analyzed the traffic impacts of the construction and operation of the proposed NGCC to U.S. Highway 431, KY 81 and KY 175 in the vicinity of the site.

Based on the analysis, U.S. Highway 431, KY 81 and KY 175 in the vicinity of the site have sufficient roadway capacity to handle the traffic generated by the construction and operation of the proposed NGCC unit. No significant impacts to roadway capacity are anticipated due to the traffic generated by the construction and operation of the proposed NGCC unit. Once commercialization of the NGCC unit is attained, traffic volumes will decrease in comparison to current operations.

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FIGURES

DATE: January 7, 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

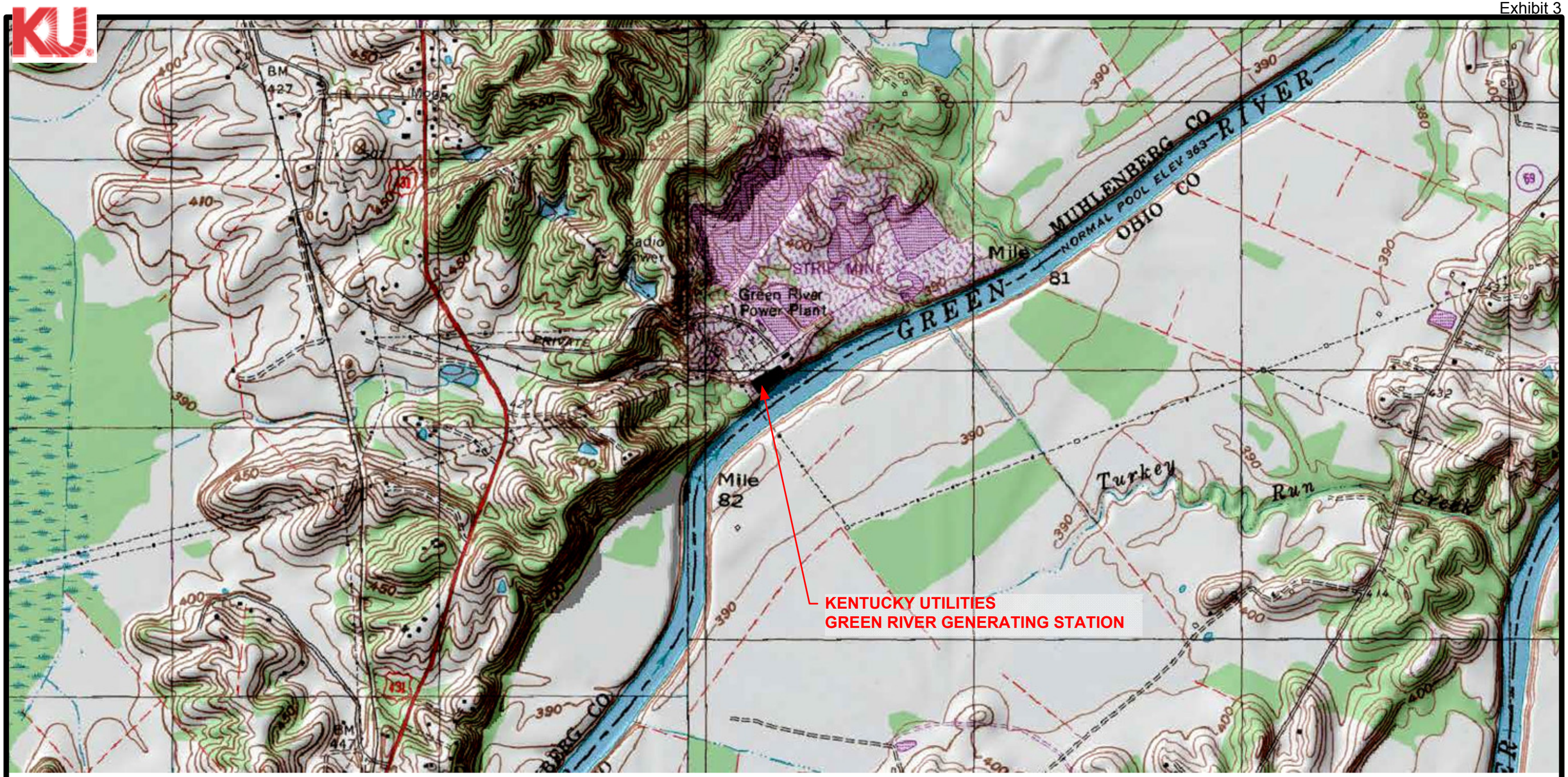
APPROXIMATE SCALE: 1 inch = 4 miles

FIGURE 1

MUHLENBERG COUNTY MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC
11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299



SOURCE: KENTUCKY GEOLOGIC SURVEY AND USGS 7.5' TOPOGRAPIC QUADRANGLE MAPS FOR CENTRAL CITY - WEST, KY AND CENTRAL CITY - EAST, KY

0 1,500 3,000

Approximate Graphic Scale (Feet)

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 1,500 feet

N

FIGURE 2

TOPOGRAPHIC VICINITY MAP

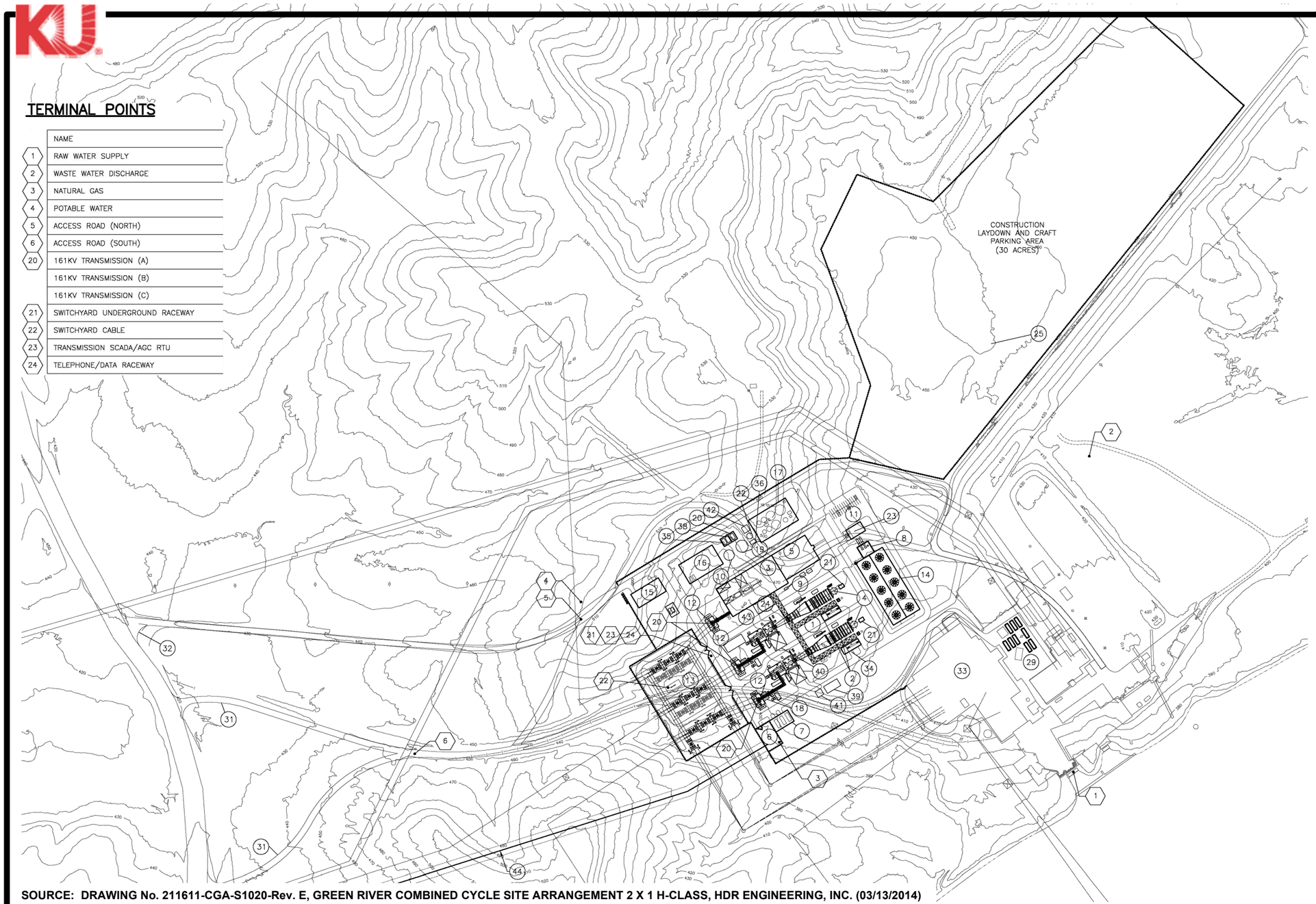
KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

TERMINAL POINTS

	NAME
1	RAW WATER SUPPLY
2	WASTE WATER DISCHARGE
3	NATURAL GAS
4	POTABLE WATER
5	ACCESS ROAD (NORTH)
6	ACCESS ROAD (SOUTH)
20	161KV TRANSMISSION (A)
	161KV TRANSMISSION (B)
	161KV TRANSMISSION (C)
21	SWITCHYARD UNDERGROUND RACEWAY
22	SWITCHYARD CABLE
23	TRANSMISSION SCADA/AGC RTU
24	TELEPHONE/DATA RACEWAY



1. COMBUSTION TURBINE
2. HEAT RECOVERY STEAM GENERATOR
3. STEAM TURBINE BUILDING
4. STACK *
5. ADMINISTRATION/CONTROL BUILDING
6. GAS YARD
7. GAS COMPRESSOR BUILDING
8. CIRC WATER PUMPS
9. EMERGENCY GENERATOR *
10. DEMIN WATER STORAGE TANK
11. PLANT PARKING
12. GSU TRANSFORMER
13. SWITCHYARD RESERVED SPACE
14. COOLING TOWER
15. WAREHOUSE/MAINTENANCE SHOP
16. WATER TREATMENT BUILDING
17. WATER PRETREATMENT AREA
18. UNIT AUX TRANSFORMERS
19. SERVICE/FIRE WATER STORAGE TANK
20. FIRE PROTECTION PUMP HOUSE *
21. CEMS SHELTER
22. WASTE WATER TANK
23. CIRC. WATER CHEMICAL FEED BUILDING
24. AUXILIARY BOILER BUILDING *
25. LAYDOWN AND CONSTRUCTION PARKING AREA
26. NOT USED
27. NOT USED
28. NOT USED
29. CONSTRUCTION TRAILERS
30. CRAFT PARKING
31. CONSTRUCTION ROAD
32. MAIN GATE
33. EXISTING SWITCHYARD
34. BOILER FEED PUMP/ELECTRICAL BLDG.
35. DEMIN. FORWARDING PUMPS
36. WASTE WATER PUMP SKID
37. BACKWASH COLLECTION BASIN
38. SERVICE WATER PUMP SKID
39. AMMONIA UNLOADING/STORAGE/FORWARDING
40. CT CRANE MAINTENANCE AREA
41. CO_2 BULK STORAGE TANK
42. NITROGEN STORAGE TANK (TEMPORARY)
43. HYDROGEN TUBE TRAILER
44. GAS PIPELINE W/40' WIDE ACCESS AREA

* INDICATES AIR PERMIT EMISSION SOURCE

0 400 800

Approximate Graphic Scale (Feet)

SOURCE: DRAWING No. 211611-CGA-S1020-Rev. E, GREEN RIVER COMBINED CYCLE SITE ARRANGEMENT 2 X 1 H-CLASS, HDR ENGINEERING, INC. (03/13/2014)

DATE: 13 March 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 400 feet

N

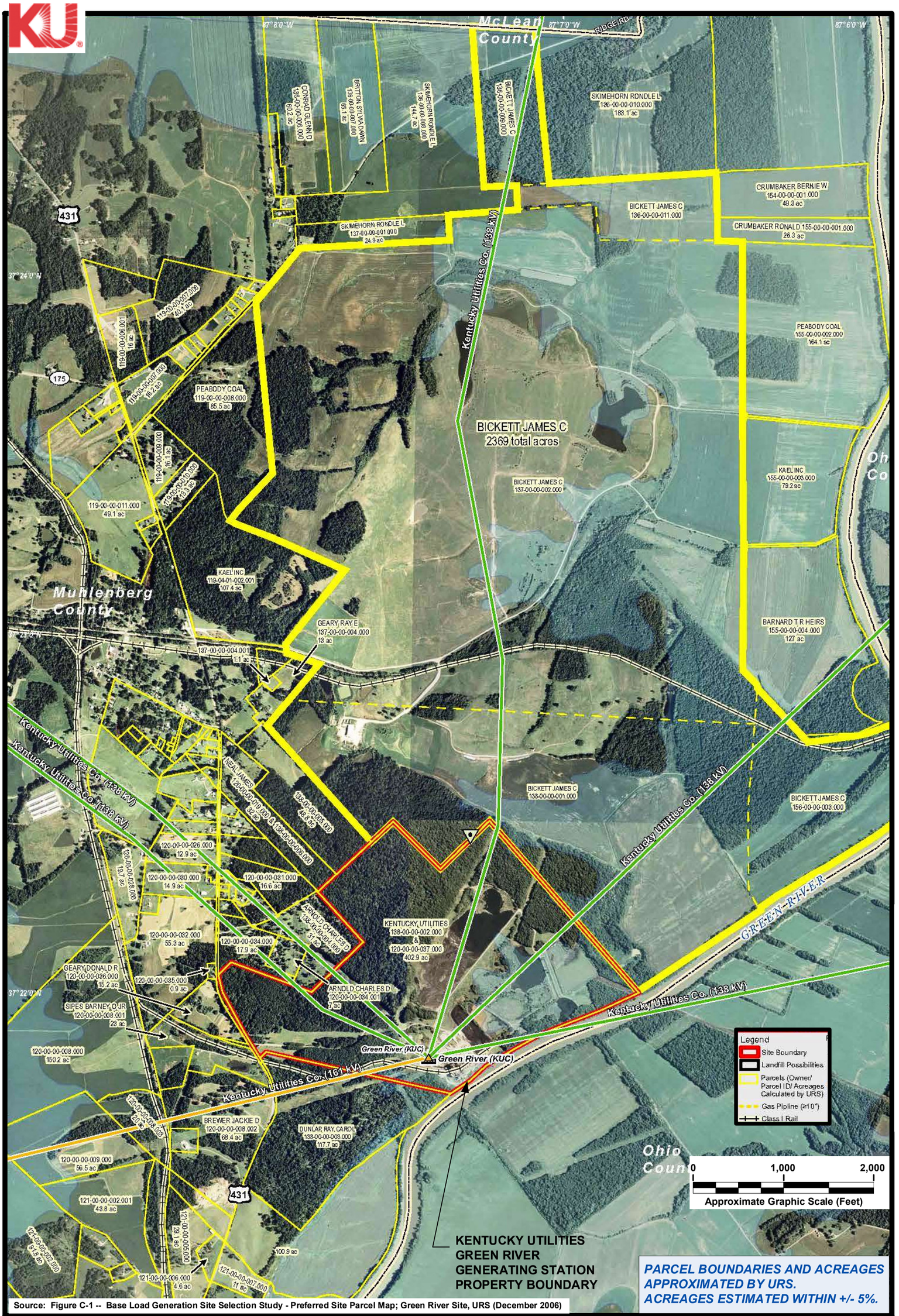
FIGURE 3

PROPOSED NGCC SITE LAYOUT

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299



Source: Figure C-1 -- Base Load Generation Site Selection Study - Preferred Site Parcel Map; Green River Site, URS (December 2006)

DATE

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 1,000 feet

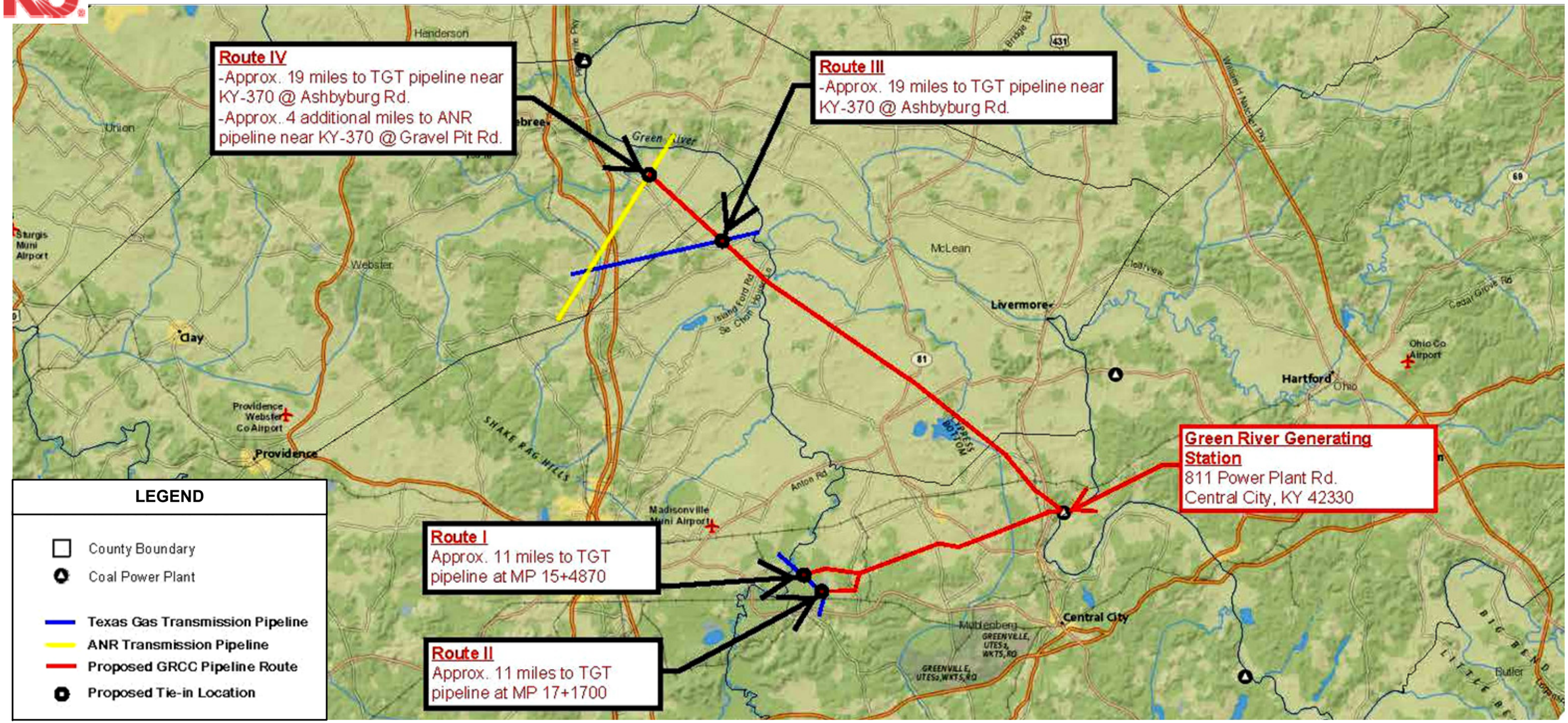
FIGURE 4

SURROUNDING PROPERTIES MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC
11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

Exhibit 3



Existing and proposed routes and distances are estimated from satellite imagery. They are not exact. Distances do not account for changes in elevation.

SOURCES: National Geographic:National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

0 3 6

Approximate Graphic Scale (Miles)

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 3 miles

N

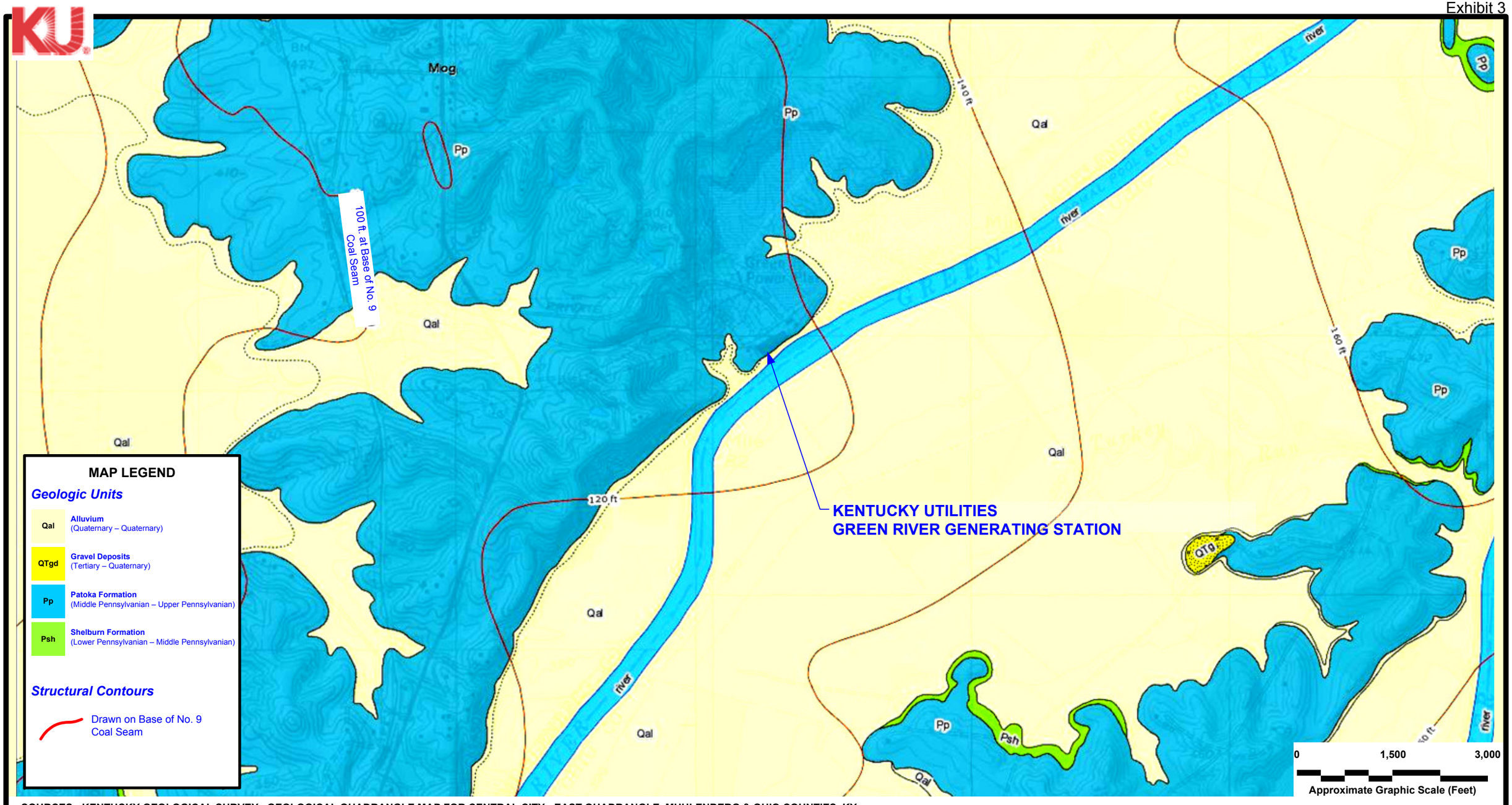
FIGURE 5

PIPELINE CANDIDATE ROUTES

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299



MAP LEGEND

Geologic Units

Qal	**Alluvium**	(Quaternary – Quaternary)
QTgd	**Gravel Deposits**	(Tertiary – Quaternary)
Pp	**Patoka Formation**	(Middle Pennsylvanian – Upper Pennsylvanian)
Psh	**Shelburn Formation**	(Lower Pennsylvanian – Middle Pennsylvanian)

Structural Contours

Drawn on Base of No. 9 Coal Seam

SOURCES: KENTUCKY GEOLOGICAL SURVEY. GEOLOGICAL QUADRANGLE MAP FOR CENTRAL CITY - EAST QUADRANGLE, MUHLENBERG & OHIO COUNTIES, KY, GQ-1031 (1972); GEOLOGICAL QUADRANGLE MAP FOR CENTRAL CITY - WEST QUADRANGLE, MUHLENBERG & OHIO COUNTIES, KY, GQ-81 (1969)

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 1,500 feet

FIGURE 6

GEOLOGIC VICINITY MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

Source: Custom Soil Resource Report for McLean and Muhlenberg Counties, Kentucky LG&E-KU Green River Station
United States Department of Agriculture - Natural Resources Conservation Service (12/03/2013)

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 500 feet

N

FIGURE 7

SOILS MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

SOURCE: Draft Assessment of Dam Safety - Coal Combustion Surface Impoundments; Green River Power Station, Central City, KY, AMEC Earth & Environmental (09/14/2010)

0 500 1,000

Approximate Graphic Scale (Feet)

DATE

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 500 feet

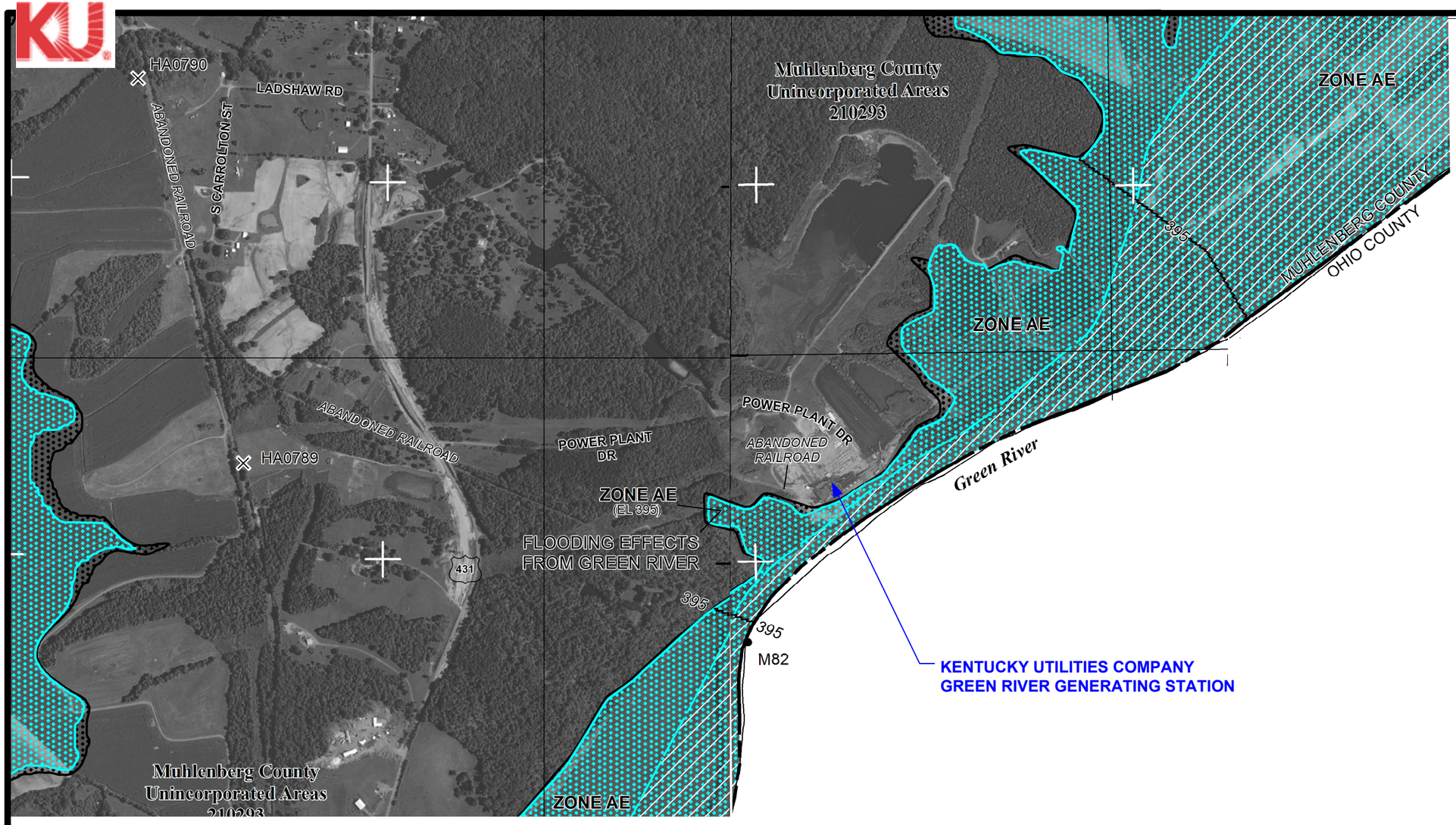
N

FIGURE 8

SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC
11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0135C

FIRM
FLOOD INSURANCE RATE MAP

MUHLENBERG COUNTY, KENTUCKY
AND INCORPORATED AREAS

PANELS 135 AND 155 OF 400
(SEE LOCATOR DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MUHLENBERG COUNTY	210293	0135	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

EFFECTIVE DATE	MAP NUMBER
OCTOBER 16, 2013	21177C0135C

State of Kentucky
Federal Emergency Management Agency

0 1,000 2,000
Approximate Graphic Scale (Feet)

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 1,000 feet

N

FIGURE 9

FEMA FIRMETTE MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

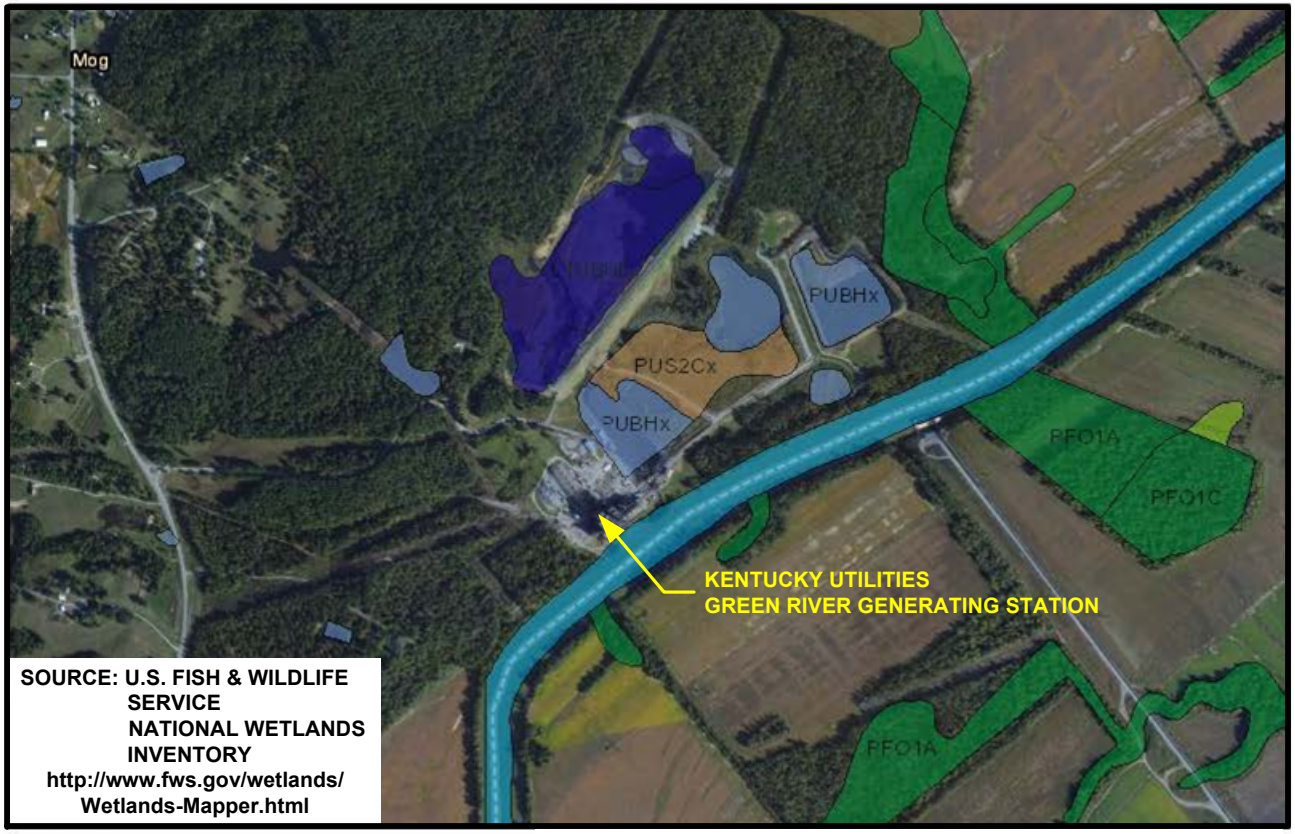
11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

U.S. Fish and Wildlife Service

National Wetlands Inventory

KU GREEN RIVER GENERATING STATION

Dec 3, 2013



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

SOURCE: U.S. FISH & WILDLIFE SERVICE
NATIONAL WETLANDS INVENTORY
http://www.fws.gov/wetlands/Wetlands-Mapper.html

0 1,500 3,000

Approximate Graphic Scale (Feet)

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 1,500 feet

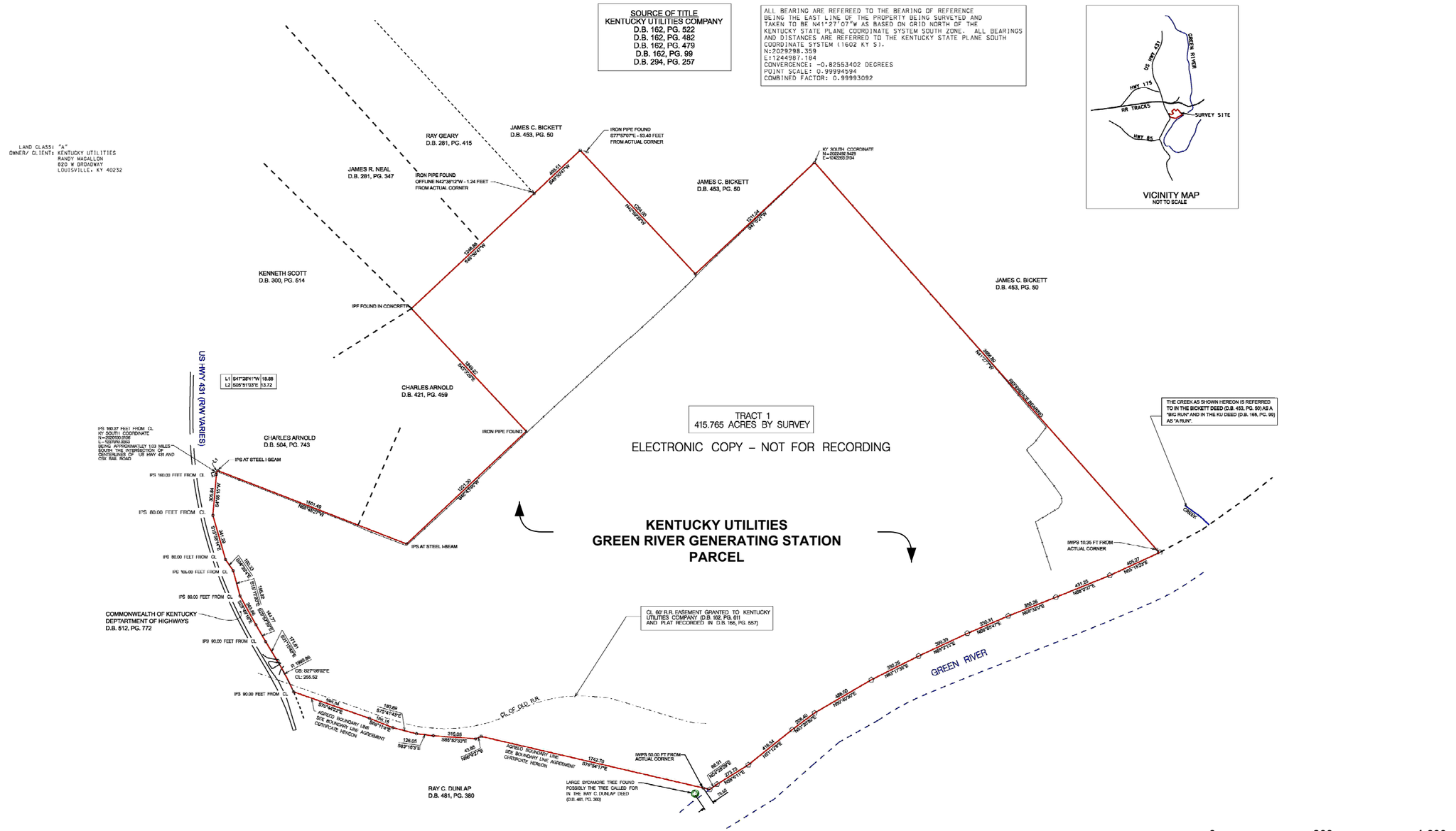
N

FIGURE 10

WETLANDS MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC
11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299



SOURCE: DRAWING FILE NAME 07127 KU GREEN RIVER REC
BOUNDARY SURVEY, KENTUCKY UTITLIES PROPERTY, 415.765 ACRES BY SURVEY LYING NEAR THE COMMUNITY OF MOORMAN ON THE WEST BANK OF THE GREEN RIVER, MUHLENBERG COUNTY, KENTUCKY, AGE ENGINEERING SERVICES, INC. (07/13/07)

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 800 feet

FIGURE 11

PARCEL MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

175

CSXT

Abandoned Section of CSXT Rail Line

CSXT

CSXT

Power Plant Road

GREEN RIVER

431

Kentucky Utilities Generating Station

81

LEGEND

431 — U.S. 431: two-lane undivided rural principal arterial

81 — KY 81: rural two-lane undivided major collector

175 — KY 175: two-lane undivided minor collector

Power Plant Road: two-lane, undivided local road that intersects with U.S. 431 between KY 81 and KY 175

CSXT — CSX Transportation Raiload

Green River: open to traffic up to Lock and Dam #3 (known as the Rochester Dam) at mile 108.5, approximately 26.5 miles upstream from LG&E-KU Green River Generating Station

0 2,500 5,000

Approximate Graphic Scale (Feet)

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 2,500 feet

N

FIGURE 12

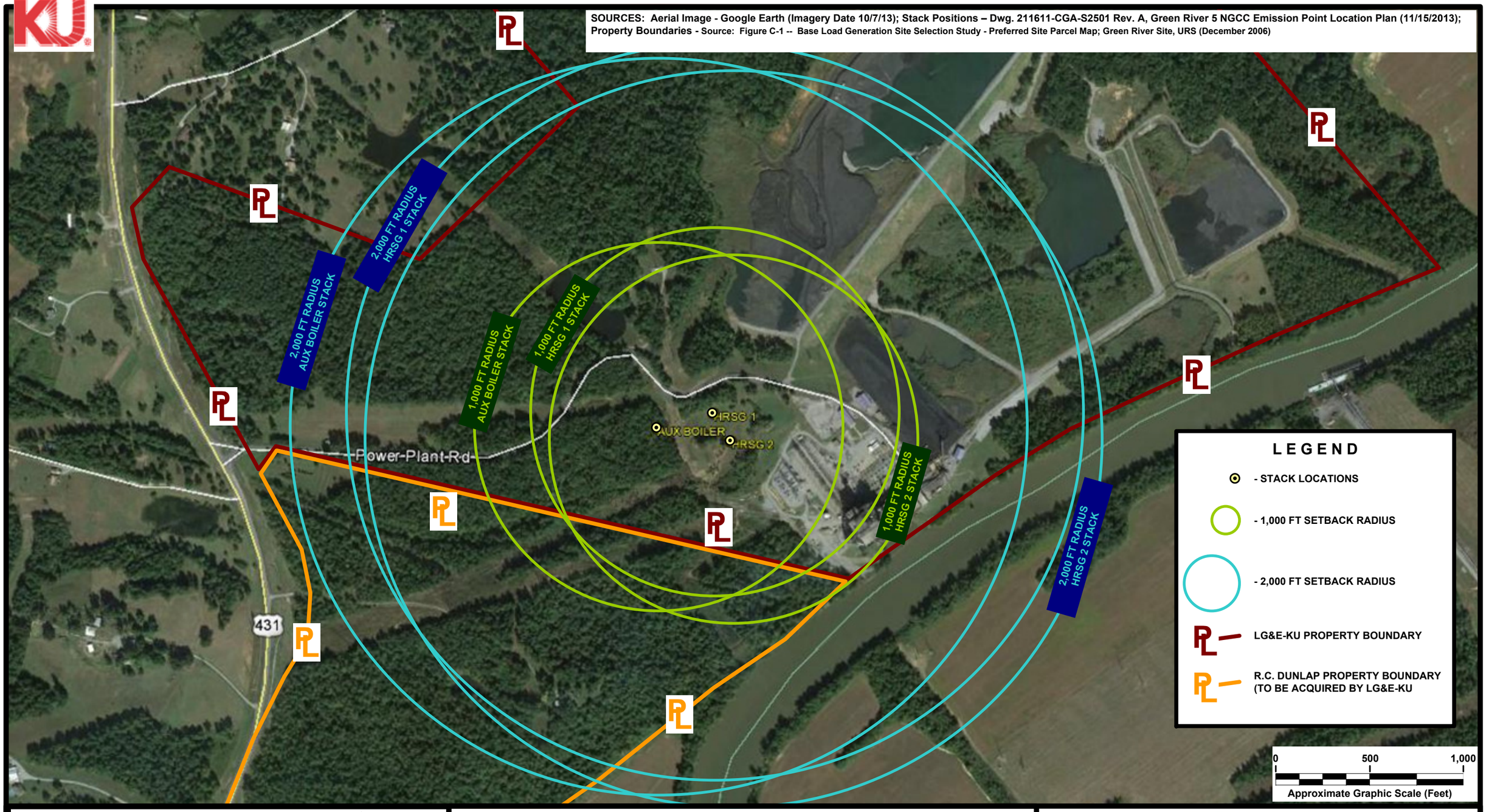
TRANSPORTATION INFRASTRUCTURE MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

SOURCES: Aerial Image - Google Earth (Imagery Date 10/7/13); Stack Positions – Dwg. 211611-CGA-S2501 Rev. A, Green River 5 NGCC Emission Point Location Plan (11/15/2013);
Property Boundaries - Source: Figure C-1 -- Base Load Generation Site Selection Study - Preferred Site Parcel Map; Green River Site, URS (December 2006)



DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 500 feet

N

FIGURE 13

SETBACK RADII MAP

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

KEY TO SYMBOLS

N01 — Ambient Background Noise Monitoring Location

N02 — Failed Ambient Background Noise Monitoring Location Omitted from Assessment.

NOTES: Noise Dosimeters at Locations N02 and N09 Malfunctioned During Study and did not Collect Data During the Second 24-hour Period.. Therefore, these Locations were Omitted from the Assessment.

0 1,000 2,000

Approximate Graphic Scale (Feet)

SOURCE: Aerial Image - Google Earth (Imagery Date 10/7/13)

DATE: 03 January 2014

PROJECT No.: 027.11000.1407

DRAWN BY: MSE

APPROVED BY: JS

APPROXIMATE SCALE: 1 inch = 1,000 feet

N

FIGURE 14

AMBIENT BACKGROUND NOISE MONITORING LOCATIONS

KENTUCKY UTILITIES COMPANY
GREEN RIVER GENERATING STATION
811 Power Plant Drive
Central City, Muhlenberg County, Kentucky

Cardno ATC

11001 Bluegrass Parkway
Suite 250
Louisville, KY 40299

APPENDIX A

NRCS CUSTOM SOIL RESOURCES REPORT

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for McLean and Muhlenberg Counties, Kentucky

LG&E-KU Green River Station

December 3, 2013

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

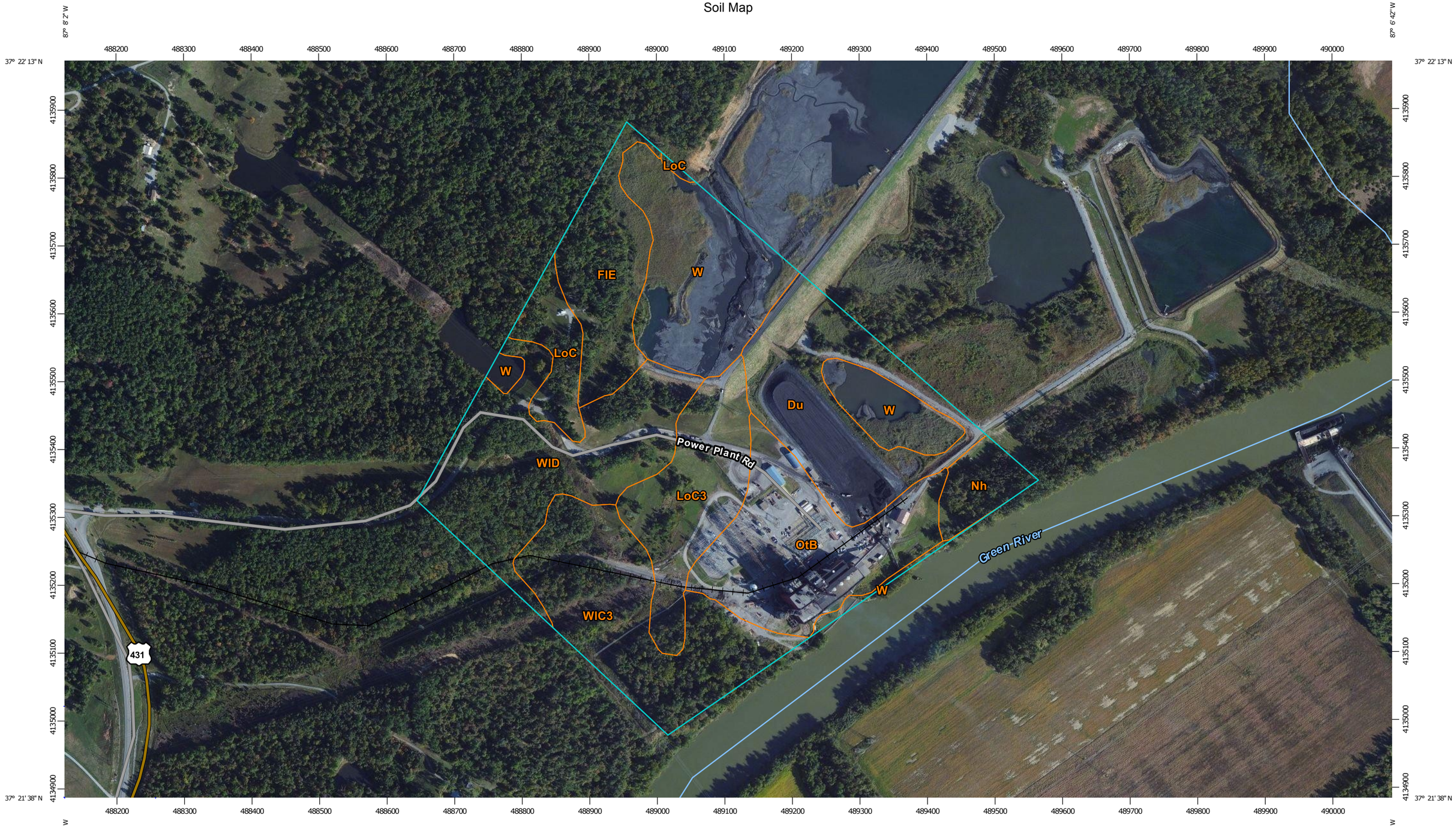
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:5,290 if printed on B landscape (17" x 11") sheet.

N

0 50 100 200 300 Meters

0 250 500 1000 1500 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: McLean and Muhlenberg Counties, Kentucky
Survey Area Data: Version 10, Sep 13, 2012

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 3, 2011—Oct 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

McLean and Muhlenberg Counties, Kentucky (KY631)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Du	Dumps	13.4	13.0%
FlE	Frondorf-Lenberg complex, 20 to 30 percent slopes	8.4	8.1%
LoC	Loring silt loam, 6 to 12 percent slopes	3.8	3.7%
LoC3	Loring silt loam, 6 to 12 percent slopes, severely eroded	10.1	9.7%
Nh	Nolin silt loam	3.0	2.9%
OtB	Otwell silt loam, 2 to 6 percent slopes	14.5	14.0%
W	Water	17.5	16.9%
WlC3	Wellston silt loam, 6 to 12 percent slopes, severely eroded	15.5	15.0%
WlD	Wellston silt loam, 12 to 20 percent slopes	17.1	16.5%
Totals for Area of Interest		**103.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used.

Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

McLean and Muhlenberg Counties, Kentucky

Du—Dumps

Map Unit Setting

Elevation: 370 to 500 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition

Dumps: 95 percent
Minor components: 5 percent

Description of Dumps

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 8

Minor Components

Waverly, occasionally flooded

Percent of map unit: 2 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear

Melvin, occasionally flooded

Percent of map unit: 1 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear

Other soils

Percent of map unit: 1 percent

Waverly, depressional

Percent of map unit: 1 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear

FlE—Frondorf-Lenberg complex, 20 to 30 percent slopes

Map Unit Setting

Elevation: 360 to 760 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition

Frondorf and similar soils: 45 percent
Lenberg and similar soils: 35 percent
Minor components: 20 percent

Description of Frondorf

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Thin fine-loamy noncalcareous loess over loamy residuum weathered from sandstone and siltstone

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.4 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: C

Typical profile

0 to 20 inches: Silt loam
20 to 32 inches: Channery silt loam
32 to 36 inches: Unweathered bedrock

Description of Lenberg

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey residuum weathered from acid shale

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water capacity: Low (about 5.0 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: C

Typical profile

0 to 4 inches: Silt loam
4 to 18 inches: Silty clay loam
18 to 25 inches: Silty clay
25 to 35 inches: Very gravelly silty clay
35 to 39 inches: Weathered bedrock

Minor Components

Wellston

Percent of map unit: 5 percent

Zanesville

Percent of map unit: 5 percent

Other soils

Percent of map unit: 5 percent

Collins

Percent of map unit: 3 percent

Clifty

Percent of map unit: 2 percent

LoC—Loring silt loam, 6 to 12 percent slopes

Map Unit Setting

Elevation: 370 to 660 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition

Loring and similar soils: 80 percent
Minor components: 20 percent

Description of Loring

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Thick fine-silty noncalcareous loess

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 24 to 35 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 20 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.0 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability (nonirrigated): 3e
Hydrologic Soil Group: C

Typical profile

0 to 7 inches: Silt loam
7 to 33 inches: Silt loam
33 to 50 inches: Silt loam
50 to 64 inches: Silt loam

Minor Components

Memphis

Percent of map unit: 5 percent

Wellston

Percent of map unit: 5 percent

Zanesville

Percent of map unit: 5 percent

Other soils

Percent of map unit: 5 percent

LoC3—Loring silt loam, 6 to 12 percent slopes, severely eroded

Map Unit Setting

Elevation: 350 to 620 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition

Loring, severely eroded, and similar soils: 75 percent
Minor components: 25 percent

Description of Loring, Severely Eroded

Setting

Landform: Ridges

Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Thick fine-silty noncalcareous loess

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 16 to 20 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 16 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4e
Hydrologic Soil Group: D

Typical profile

0 to 7 inches: Silt loam
7 to 18 inches: Silt loam
18 to 35 inches: Silt loam
35 to 49 inches: Silt loam

Minor Components

Memphis

Percent of map unit: 5 percent

Wellston

Percent of map unit: 5 percent

Zanesville

Percent of map unit: 5 percent

Grenada

Percent of map unit: 5 percent

Other soils

Percent of map unit: 5 percent

Nh—Nolin silt loam

Map Unit Setting

Elevation: 350 to 560 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition

Nolin, occasionally flooded, and similar soils: 85 percent
Minor components: 15 percent

Description of Nolin, Occasionally Flooded

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed fine-silty alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: Very high (about 12.6 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2w
Hydrologic Soil Group: B

Typical profile

0 to 10 inches: Silt loam
10 to 65 inches: Silt loam

Minor Components

Lindside

Percent of map unit: 5 percent

Newark

Percent of map unit: 5 percent

Other soils

Percent of map unit: 4 percent

Nolin, (hydric)

Percent of map unit: 1 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear

OtB—Otwell silt loam, 2 to 6 percent slopes

Map Unit Setting

Elevation: 350 to 540 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition

Otwell, rarely flooded, and similar soils: 75 percent
Minor components: 25 percent

Description of Otwell, Rarely Flooded

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Fine-silty alluvium

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 32 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 16 to 30 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water capacity: Low (about 5.1 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: C/D

Typical profile

0 to 10 inches: Silt loam
10 to 27 inches: Silt loam
27 to 45 inches: Silty clay loam
45 to 60 inches: Silt loam

Minor Components

Elk

Percent of map unit: 7 percent

Newark

Percent of map unit: 7 percent

Weinbach
Percent of map unit: 7 percent

Other terrace soils
Percent of map unit: 3 percent

Otwell, (hydric)
Percent of map unit: 1 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear

W—Water

Map Unit Setting
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition
Water: 100 percent

WlC3—Wellston silt loam, 6 to 12 percent slopes, severely eroded

Map Unit Setting
Elevation: 360 to 740 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition
Wellston, severely eroded, and similar soils: 75 percent
Minor components: 25 percent

Description of Wellston, Severely Eroded

Setting
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Thin fine-silty noncalcareous loess over loamy residuum weathered from sandstone and shale

Properties and qualities
Slope: 6 to 12 percent

Depth to restrictive feature: 40 to 72 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.6 inches)

Interpretive groups
Farmland classification: Not prime farmland
Land capability (nonirrigated): 4e
Hydrologic Soil Group: B

Typical profile
0 to 8 inches: Silt loam
8 to 22 inches: Silt loam
22 to 44 inches: Loam
44 to 48 inches: Unweathered bedrock

Minor Components

Other upland soils
Percent of map unit: 5 percent

Zanesville
Percent of map unit: 4 percent

Frondorf
Percent of map unit: 4 percent

Lenberg
Percent of map unit: 4 percent

Collins
Percent of map unit: 4 percent

Belknap
Percent of map unit: 4 percent

WID—Wellston silt loam, 12 to 20 percent slopes

Map Unit Setting
Elevation: 370 to 740 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 46 to 68 degrees F
Frost-free period: 168 to 212 days

Map Unit Composition
Wellston and similar soils: 75 percent
Minor components: 25 percent

Description of Wellston

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Thin fine-silty noncalcareous loess over loamy residuum weathered from sandstone and shale

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 40 to 72 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 9.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4e
Hydrologic Soil Group: B

Typical profile

0 to 8 inches: Silt loam
8 to 30 inches: Silt loam
30 to 52 inches: Loam
52 to 56 inches: Unweathered bedrock

Minor Components

Frondorf

Percent of map unit: 5 percent

Lenberg

Percent of map unit: 5 percent

Zanesville

Percent of map unit: 5 percent

Belknap

Percent of map unit: 5 percent

Other upland soils

Percent of map unit: 5 percent

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Glossary

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the "National Soil Survey Handbook."

ABC soil

A soil having an A, a B, and a C horizon.

Ablation till

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

AC soil

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.

Alluvial fan

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

Alluvium

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Alpha,alpha-dipyridyl

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

Animal unit month (AUM)

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon

A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

Aspect

The direction toward which a slope faces. Also called slope aspect.

Association, soil

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity)

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low: 0 to 3
Low: 3 to 6
Moderate: 6 to 9
High: 9 to 12
Very high: More than 12

Backslope

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Backswamp

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

Badland

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluves. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

Bajada

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

Basal area

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Base slope (geomorphology)

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Bedding plane

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology) from the preceding or following layer; a plane of deposition. It commonly marks a change

in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

Bedding system

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout (map symbol)

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

Borrow pit (map symbol)

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

Bottom land

An informal term loosely applied to various portions of a flood plain.

Boulders

Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

Breast height

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

Cable yarding

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

California bearing ratio (CBR)

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy

The leafy crown of trees or shrubs. (See Crown.)

Canyon

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

Capillary water

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena

A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

Cation

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps

See Terracettes.

Cement rock

Shaly limestone used in the manufacture of cement.

Channery soil material

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment

Control of unwanted vegetation through the use of chemicals.

Chiseling

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Cirque

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

Clay

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions

See Redoximorphic features.

Clay film

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay spot (map symbol)

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

Claypan

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

Climax plant community

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil

Sand or loamy sand.

Cobble (or cobblestone)

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility)

See Linear extensibility.

Colluvium

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Complex slope

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions

See Redoximorphic features.

Conglomerate

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

Contour stripcropping

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat)

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

Corrosion (geomorphology)

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

Corrosion (soil survey interpretations)

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system

Growing crops according to a planned system of rotation and management practices.

Cross-slope farming

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown

The upper part of a tree or shrub, including the living branches and their foliage.

Cryoturbate

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

Cuesta

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or clifflike slope (scarp) that cuts through the tilted rocks.

Culmination of the mean annual increment (CMAI)

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age,

the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave

The walls of excavations tend to cave in or slough.

Decreasers

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing

Postponing grazing or resting grazing land for a prescribed period.

Delta

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depression, closed (map symbol)

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

Depth, soil

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Desert pavement

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

Diatomaceous earth

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

Dip slope

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace)

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural)

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface

Runoff, or surface flow of water, from an area.

Drainageway

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

Draw

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

Drift

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of

streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

Duff

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

Earthy fill

See Mine spoil.

Ecological site

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian deposit

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Ephemeral stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (accelerated)

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion (geologic)

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion pavement

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

Erosion surface

A land surface shaped by the action of erosion, especially by running water.

Escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Escarpment, bedrock (map symbol)

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

Escarpment, nonbedrock (map symbol)

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

Esker

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

Extrusive rock

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth’s surface.

Fallow

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown.

The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan remnant

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

Fertility, soil

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat)

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity

The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil

Sandy clay, silty clay, or clay.

Firebreak

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

Flaggy soil material

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Flood-plain landforms

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

Flood-plain splay

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

Flood-plain step

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

Fluvial

Of or pertaining to rivers or streams; produced by stream or river action.

Foothills

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

Footslope

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb

Any herbaceous plant not a grass or a sedge.

Forest cover

All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glaciofluvial deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gleyed soil

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping

Growing crops in strips that grade toward a protected waterway.

Grassed waterway

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel

Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravel pit (map symbol)

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

Gravelly soil material

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gravelly spot (map symbol)

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

Green manure crop (agronomy)

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water

Water filling all the unblocked pores of the material below the water table.

Gully (map symbol)

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hard to reclaim

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Hardpan

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope (geomorphology)

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat)

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Hillslope

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

Horizon, soil

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon: An organic layer of fresh and decaying plant residue.

L horizon: A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

A horizon: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon: The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon: Soft, consolidated bedrock beneath the soil.

R layer: Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

M layer: A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

W layer: A layer of water within or beneath the soil.

Humus

The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

Illuviation

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Very low: Less than 0.2
Low: 0.2 to 0.4
Moderately low: 0.4 to 0.75
Moderate: 0.75 to 1.25
Moderately high: 1.25 to 1.75
High: 1.75 to 2.5
Very high: More than 2.5

Interfluve

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Interfluve (geomorphology)

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

Intermittent stream

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions

See Redoximorphic features.

Irrigation

Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin: Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border: Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding: Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation: Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle): Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow: Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler: Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation: Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding: Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Karst (topography)

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

Knoll

A small, low, rounded hill rising above adjacent landforms.

Ksat

See Saturated hydraulic conductivity.

Lacustrine deposit

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lake terrace

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landfill (map symbol)

An area of accumulated waste products of human habitation, either above or below natural ground level.

Landslide

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lava flow (map symbol)

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

Leaching

The removal of soluble material from soil or other material by percolating water.

Levee (map symbol)

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

Linear extensibility

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^{1}/_{3}$- or $^{1}/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit

The moisture content at which the soil passes from a plastic to a liquid state.

Loam

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Low strength

The soil is not strong enough to support loads.

Low-residue crops

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Marl

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

Marsh or swamp (map symbol)

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

Mass movement

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

Masses

See Redoximorphic features.

Meander belt

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

Meander scar

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

Meander scroll

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

Mechanical treatment

Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil

Very fine sandy loam, loam, silt loam, or silt.

Mesa

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

Metamorphic rock

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth’s crust. Nearly all such rocks are crystalline.

Mine or quarry (map symbol)

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

Mine spoil

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

Mineral soil

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage

Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area

A kind of map unit that has little or no natural soil and supports little or no vegetation.

Miscellaneous water (map symbol)

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

Moderately coarse textured soil

Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil

Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

Muck

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat

See Hemic soil material.

Mudstone

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

Munsell notation

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules

See Redoximorphic features.

Nose slope (geomorphology)

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

Nutrient, plant

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low: Less than 0.5 percent
Low: 0.5 to 1.0 percent
Moderately low: 1.0 to 2.0 percent
Moderate: 2.0 to 4.0 percent
High: 4.0 to 8.0 percent
Very high: More than 8.0 percent

Outwash

Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Outwash plain

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Paleoterrace

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

Pan

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material

The unconsolidated organic and mineral material in which soil forms.

Peat

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped

An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

Pedon

The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation

The movement of water through the soil.

Perennial water (map symbol)

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

Permafrost

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

pH value

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Piping

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting

Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plastic limit

The moisture content at which a soil changes from semisolid to plastic.

Plasticity index

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plateau (geomorphology)

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Playa

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

Plinthite

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan

A compacted layer formed in the soil directly below the plowed layer.

Ponding

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore linings

See Redoximorphic features.

Potential native plant community

See Climax plant community.

Potential rooting depth (effective rooting depth)

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil

The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil

A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid: Less than 3.5
Extremely acid: 3.5 to 4.4
Very strongly acid: 4.5 to 5.0
Strongly acid: 5.1 to 5.5
Moderately acid: 5.6 to 6.0
Slightly acid: 6.1 to 6.5
Neutral: 6.6 to 7.3
Slightly alkaline: 7.4 to 7.8
Moderately alkaline: 7.9 to 8.4
Strongly alkaline: 8.5 to 9.0
Very strongly alkaline: 9.1 and higher

Red beds

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations

See Redoximorphic features.

Redoximorphic depletions

See Redoximorphic features.

Redoximorphic features

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they

form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
   A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
   B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
   C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
   A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
   B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Reduced matrix

See Redoximorphic features.

Regolith

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

Relief

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

Residuum (residual soil material)

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Rill

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

Riser

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Road cut

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop (map symbol)

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where “Rock outcrop” is a named component of the map unit.

Root zone

The part of the soil that can be penetrated by plant roots.

Runoff

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline spot (map symbol)

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

Sand

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone

Sedimentary rock containing dominantly sand-sized particles.

Sandy spot (map symbol)

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

Sapric soil material (muck)

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated hydraulic conductivity (Ksat)

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are:

Very high: 100 or more micrometers per second (14.17 or more inches per hour)

High: 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

Moderately high: 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

Moderately low: 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

Low: 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

Very low: Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

Saturation

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

Sequum

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Severely eroded spot (map symbol)

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which “severely eroded,” “very severely eroded,” or “gullied” is part of the map unit name.

Shale

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

Sheet erosion

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Short, steep slope (map symbol)

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

Shoulder

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

Shrink-swell

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Shrub-coppice dune

A small, streamlined dune that forms around brush and clump vegetation.

Side slope (geomorphology)

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silica

A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

Similar soils

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole (map symbol)

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

Site index

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides (pedogenic)

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slide or slip (map symbol)

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

Slope

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope alluvium

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds

and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Slow refill

The slow filling of ponds, resulting from restricted water transmission in the soil.

Slow water movement

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

Sodic (alkali) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodic spot (map symbol)

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

Sodicity

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to Ca^{++} + Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight: Less than 13:1

Moderate: 13-30:1

Strong: More than 30:1

Sodium adsorption ratio (SAR)

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand: 2.0 to 1.0
Coarse sand: 1.0 to 0.5
Medium sand: 0.5 to 0.25
Fine sand: 0.25 to 0.10
Very fine sand: 0.10 to 0.05
Silt: 0.05 to 0.002
Clay: Less than 0.002

Solum

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Spoil area (map symbol)

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

Stone line

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

Stones

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stony spot (map symbol)

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

Strath terrace

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents

the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Stripcropping

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

Platy: Flat and laminated
Prismatic: Vertically elongated and having flat tops
Columnar: Vertically elongated and having rounded tops
Angular blocky: Having faces that intersect at sharp angles (planes)
Subangular blocky: Having subrounded and planar faces (no sharp angles)
Granular: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

Single grained: Entirely noncoherent (each grain by itself), as in loose sand
Massive: Occurring as a coherent mass

Stubble mulch

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil

Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum

The part of the soil below the solum.

Subsurface layer

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

Terrace (conservation)

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geomorphology)

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Terracettes

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

Texture, soil

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer

Otherwise suitable soil material that is too thin for the specified use.

Till

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tilth, soil

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tread

The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Tuff

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

Upland

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

Variegation

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very stony spot (map symbol)

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

Water bars

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth’s surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

Well graded

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wet spot (map symbol)

A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

Wilting point (or permanent wilting point)

The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow

The uprooting and tipping over of trees by the wind.

APPENDIX B

KU GREEN RIVER PROPERTY LEGAL DESCRIPTION

KU GREEN RIVER GENERATING STATION

PARCEL LEGAL DESCRIPTION

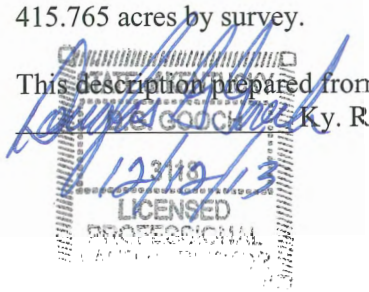
LEGAL DESCRIPTION

This being that property acquired by Kentucky Utilities Company by deeds from Tom & Norma Geary (Deed Book 162, Page 522 - dated the 27th day of May, 1947), Lula Smith (Deed Book 162, Page 479 - dated the 27th day of May, 1947), Retta Thompson (Deed Book 162, Page 482 - dated the 28th day of May, 1947), Lula Smith (Deed Book 165, Page 99 - dated the 19th day of January, 1948), and N.L. Geary (Deed Book 294, Page 257 - dated the 18th day of April, 1973) all in the Muhlenberg County Court Clerk's Office and more particularly described as below:

Tract 1

BEGINNING at an iron pin set (5/8" x 18" rebar with aluminum cap bearing PLS-3118, as will be typical for all set corner monuments) on the East edge of U.S. Highway 431 right-of-way 160.37 feet east of centerline, said pin being approximately 1.03 miles south of the intersection of centerlines of U.S. Highway 431 and CSX Railroad Road, and having Kentucky State Plane South Zone Coordinates of N: 2020190.91; E: 1237819.33 and being the southwest corner of the Charles Arnold property (D.B. 504, Pg. 743) and lying within Muhlenberg County, Kentucky on the waters of Green River and **being the Point of Beginning for this description; THENCE** Leaving the line of Charles Arnold and running with the east right-of-way line of U.S. Highway 431 the following nine calls: S05°51'03"E – 13.72 feet to an iron pin set, S04°55'15"W – 305.84 feet to an iron pin set, S15°58'14"E – 341.29 feet to an iron pin set, S34°20'04"E – 100.33 feet to an iron pin set, S15°12'20"E – 195.92 feet to an iron pin set, S28°49'16"E – 243.66 feet to an iron pin set, S29°57'39"E – 144.77 feet to an iron pin set, S31°15'48"E – 171.81 feet to a point, and with a curve to the right having a radius of 1999.86, a chord bearing of S27°36'02"E and a chord length of 255.52 feet to an iron pin set on the east edge of right-of-way 90.00 feet east of centerline of U.S. Highway 431, said pin being the agreed corner of Ray C. Dunlap (D.B. 481, Pg 380); THENCE leaving the east edge of right-of-way and with the agreed boundary line of Ray C. Dunlap the following seven calls: S70°44'22"E – 598.34 feet to an iron pin set, S68°11'04"E – 186.15 feet to an iron pin set, S75°41'43"E – 180.69 feet to an iron pin set, S83°16'03"E – 126.05 feet to an iron pin set, S85°52'33"E – 316.05 feet to an iron pin set, N66°09'27"E – 43.88 to an iron pin set, and S76°54'17"E – passing an iron witness pin set at 1692.70 feet and continuing at the same bearing for a total distance of 1742.70 feet to a point on the west bank of the Green River; THENCE leaving the line of Ray C. Dunlap and with the west bank of the Green River the following eleven calls (no monuments were set along the Green River): N54°25'29"E – 66.91 feet to a point, N58°06'11"E – 273.73 feet to a point, N51°12'08"E – 416.54 feet to a point, N53°20'53"E – 208.40 feet to a point, N59°40'30"E – 488.50 feet to a point, N63°17'38"E – 392.25 feet to a point, N65°02'13"E – 399.39 feet to a point, N66°55'47"E – 330.31feet to a point, N68°32'00"E – 380.26 feet to a point, N68°00'37"E – 431.25 feet to a point, and N65°15'23"E – 405.27 feet to a point, said point being the southeast corner of James C. Bickett (D.B. 453, Pg. 50); THENCE leaving the west bank of the Green River and with the line of James C. Bickett the following four calls: N41°27'07"W – passing an iron witness pin set at 10.35 feet and continuing at the same bearing for a total distance of 3866.89 feet to an iron pin set (Having a KY State Plane South Zone Coordinate of N:2022492.94; E:1242263.02), S47°00'21"W – 1211.24 feet to an iron pin set, N42°59'39"W – 1254.00 feet to an iron pin set, and S46°50'47"W – 468.51 feet to an iron pin set being the northeast corner of Ray Geary (D.B. 281, Pg. 415); THENCE leaving the line of James C. Bickett and with the first line of Ray Geary and second with James R. Neal (D.B. 281, Pg. 347) S46°50'47" W – 1248.88 feet to an iron pin found in concrete, which is the common corner of James R. Neal, Kenneth Scott (D.B. 300, Pg. 514) and Charles Arnold (D.B. 421, Pg. 459);

THENCE leaving the line of James R. Neal and the corner of Kenneth Scott and with the line of Charles Arnold (D.B. 421, Pg. 459 and D.B. 504, Pg. 743) the following four calls; S43°03'26"E – 1249.22 feet to an iron pipe found, S46°43'46"W – 1221.30 feet to an iron pin set at the base of a steel I-beam, N68°45'27"W – 1501.49 feet to an iron pin set at the base of a steel I-Beam, and S47°28'41"W – 18.88 feet to the POINT OF BEGINNING for this description and containing 415.765 acres by survey.



This description prepared from a physical survey conducted by AGE Engineering, _____, Ky. R.L.S. #3118, dated the 13th day of July 2007.

LEGAL DESCRIPTION OF PROPERTY TO BE ACQUIRED BY KU

RAY C. DUNLAP - DEED BOOK 481, PAGE 380

THIS DEED OF CONVEYANCE, made and entered into on this the 9th day of NOVEMBER, 2000, by and between **DOYLE BLANKENSHIP, a single person,** of 309 North Cherry Hill Road, Central City, Muhlenberg County, Kentucky 42330, Party of the First Part and **RAY C. DUNLAP,** of Route 1, Box 563, Central City, Muhlenberg County, Kentucky 42330, Party of the Second Part,

WITNESSETH:

That for and in consideration of the sum of FORTY FIVE THOUSAND ($45,000.00) DOLLARS cash in hand paid, the receipt and sufficiency of which is hereby acknowledged, the Party of the First Part has bargained and sold and does by these presents bargain, sell, alien and convey unto the Party of the Second Part, his heirs and assigns forever, the following described property located in Muhlenberg County, Kentucky, and more particularly described as follows:

Beginning at rock 33 lengths due North of Blackgum pointer; thence South 57 East, 92 poles to a small Black Oak, Walnut and Black Oak; thence North 38 East 132 poles to rock; thence South 62 East, 20 poles to Cottonwood on the bank of Green River; thence meanders 380 feet to a stake Elm and Sycamore pointers on the bank of Green River and running with the line of Lot #2 North 81 West to the East right of way line of Highway #431 to the beginning.

The above described property is subject to the easements of record with Kentucky Utilities as set forth in the deed where the Party of the First Part acquired title.

This property is also subject to an easement dated May 22, 1996, to Big Rivers Electric Corporation for electric transmission lines, of record in the office of the Muhlenberg County Clerk in Deed Book 444, Page 478.

All coal, oil, gas and other minerals in and underlying the above described property are excepted only to the extent same may have been excepted, reserved, or conveyed by prior deeds of record.

Being the same property conveyed to Doyle Blankenship a single person, by deed dated October 27, 2000, from Doyle Blankenship, a single person, and Tina Blankenship, a single person, of record in Deed Book 481, Page 378, in the office of the Muhlenberg County Clerk.

Party of the First Part shall have sixty (60) days in which to remove all personalty belonging to him from the hereinabove described property. This shall include, but is not limited to, all scrap metal.

APPENDIX C

PROPERTY LIST (FOR PROPERTY VALUE ASSESSMENT)

Property Value Assessment: Appendix C – Property List

Homes Sold 2011-2013, Central City, KY

Date Sold	Driving Distance from Site (miles)	Nominal Price	Street Address	City	House Sizes (square feet)	Lot Size (acres)
1/20/2011	6.2	95,000	209 E Morehead St.	Central City, KY	1,800	
1/21/2011	13.9	195,000	3890 Paradise Rd	Central City, KY	2,565	2.76
1/27/2011	8.2	145,000	775 Charlie Brown Rd	Central City, KY	1,783	
1/28/2011	5.9	28,000	608 N 3rd st	Central City, KY	897	
1/28/2011	6.3	25,000	130 S 1st St.	Central City, KY	1,384	
1/30/2011	8.1	8,500	84 Gibson Ln	Central City, KY		
1/31/2011	6.2	65,000	213 E Morehead St.	Central City, KY	921	
1/31/2011	10.3	89,000	103 Thomas Ct	Central City, KY	2,024	
2/4/2011	4.6	52,000	1438 N 2nd St.	Central City, KY	1,145	
2/4/2011	6.2	50,000	129 W 4th St.	Central City, KY	1,110	
2/14/2011	15	19,000	55 Phillip Uzzle Ln	Central City, KY		1.01
2/17/2011	7.7	168,000	716 E Everly Brothers Blvd	Central City, KY	1,860	
2/18/2011	4.1	160,000	1420 Clark St.	Central City, KY	1,232	33.00
2/21/2011	6.5	45,000	114 W 2nd Ave	Central City, KY	2,380	
3/11/2011	6.4	320,000	509 Brown Meadow Dr	Central City, KY	2,772	
3/11/2011	7.3	53,500	706 Western St	Central City, KY	2,168	7.30
3/28/2011	7.5	145,000	107 Eastview Dr	Central City, KY	1,690	
3/29/2011	6.2	100,000	602 E Broad St	Central City, KY	2,726	
4/5/2011	13.9	28,000	3990 Paradise Rd	Central City, KY		2.00
4/7/2011	7.1	3,500	230 Brittany Ln	Central City, KY		
4/11/2011	9.3	129,900	1215 Sunnyside Rd	Central City, KY	2,700	5.00
4/15/2011	9.2	98,000	4489 State Route 70 W	Central City, KY	2,133	0.47
4/27/2011	6.5	117,000	3999 State Route 81	Central City, KY		
5/1/2011	6.6	24,500	620 Center St	Central City, KY	1,269	
5/6/2011	9.3	95,745	4509 State Route 70 W	Central City, KY		
5/9/2011	6.7	137,000	155 Fairway Dr	Central City, KY	1,852	
5/24/2011	5.9	45,000	825 Cherry St.	Central City, KY	840	
5/24/2011	6.5	79,000	110 W 2nd Ave	Central City, KY	1,550	0.50
5/24/2011	6.6	110,000	306 N Cherry Hill Rd	Central City, KY	1,884	
5/26/2011	8.4	140,400	400 Oakwood Dr	Central City, KY	1,632	
5/27/2011	5.4	79,900	603 Orchard St.	Central City, KY	916	
6/7/2011	6.3	145,000	516 E Broad St.	Central City, KY	3,784	3.16
6/8/2011	6.5	135,000	514 Center St.	Central City, KY	2,500	1.21
6/30/2011	5.1	174,000	3190 State Route 2584	Central City, KY	1,893	1.81
6/30/2011	7.2	20,000	3711 US Highway 62 E	Central City, KY		
6/30/2011	7.9	226,500	135 Magnolia Dr	Central City, KY	3,300	0.58

Date Sold	Driving Distance from Site (miles)	Nominal Price	Street Address	City	House Sizes (square feet)	Lot Size (acres)
7/11/2011	7.2	107,900	725 E Everly Brothers Blvd	Central City, KY	1,571	
7/11/2011	7.5	52,000	801 E Everly Brothers Blvd	Central City, KY	896	0.75
7/22/2011	6.6	41,000	702 Front St.	Central City, KY	784	
8/2/2011	5.6	65,000	518 Park St.	Central City, KY		
8/5/2011	6.7	89,000	140 Fairway Dr	Central City, KY		
8/10/2011	5.2	120,000	1109 Perkins St.	Central City, KY		
8/17/2011	7.6	105,000	123 Shady Oak Dr	Central City, KY	1,258	
8/23/2011	9.4	35,000	4773 State Route 70 W	Central City, KY		0.33
9/1/2011	6.6	47,500	606 W Reservoir Ave	Central City, KY	884	
9/2/2011	12.5	60,000	2711 Ridge Rd	Central City, KY	768	
9/6/2011	7.3	87,199	110 Cherry Wood Dr	Central City, KY	1,358	
9/8/2011	5.9	52,000	230 Waterwords Rd	Central City, KY	700	1.00
9/12/2011	5.9	28,500	430 N 2nd St	Central City, KY		
9/14/2011	1.8	6,700	92 Highland Ave	Central City, KY		
9/16/2011	7.6	90,000	104 Tanglewood Pl	Central City, KY		
9/19/2011	6.6	125,000	1101 Front St.	Central City, KY	1,312	1.23
9/21/2011	14.3	7,500	2266 Martwick Rd	Central City, KY		
9/30/2011	13.9	32,500	3946 Paradise Rd	Central City, KY	1,344	1.09
10/4/2011	5.9	20,000	101 N Pendleton	Central City, KY		
10/19/2011	6.5	145,000	305 Meadow Hill Blvd	Central City, KY	2,309	
10/27/2011	6.2	27,050	118 S 6th St.	Central City, KY	1,260	
10/30/2011	6.1	77,000	207 N 4th St.	Central City, KY	3,656	
11/1/2011	7	52,000	103 Ryan St.	Central City, KY	950	
11/4/2011	5.6	88,500	818 N 2nd St	Central City, KY		
11/4/2011	14.8	53,000	1871 Martwick Rd	Central City, KY	1,500	1.08
11/16/2011	6.7	110,000	839 Humphrey Rd	Central City, KY		2.00
11/16/2011	6.7	179,000	122 Fairway Dr	Central City, KY		
12/20/2011	4.5	26,000	1443 N 2nd St.	Central City, KY		
12/20/2011	6.2	11,000	1311 River Rd	Central City, KY	832	0.50
12/21/2011	6.5	140,000	110 Country club Dr	Central City, KY		
12/21/2011	6.9	155,000	177 Fairview Rd	Central City, KY	1,904	1.33
12/29/2011	6.9	80,000	511 W 4th Ave	Central City, KY		
12/30/2011	7.3	72,000	512 Rose Hill Drive	Central City, KY	1,511	
1/4/2012	6.4	154,000	301 Meadow Hill Blvd	Central City, KY	1,945	
1/5/2012	7.5	11,500	70 Brown Ln	Central City, KY		0.75
2/24/2012	5.8	34,000	101 Newman St.	Central City, KY		0.13
3/2/2012	8.6	29,000	100 Mayhugh Ln	Central City, KY		
3/12/2012	7.5	110,000	212 Cherry Jubilee Way	Central City, KY		
3/23/2012	7.3	79,599	103 Cherry Wood Drive	Central City, KY	1,035	0.76

Date Sold	Driving Distance from Site (miles)	Nominal Price	Street Address	City	House Sizes (square feet)	Lot Size (acres)
4/18/2012	6.2	55,000	313 Reynolds St.	Central City, KY	1,000	
4/30/2012	7.5	114,000	211 Cherry Jubilee Way	Central City, KY		
6/8/2012	7.6	93,500	108 Glen Hills Pl	Central City, KY	1,025	
6/29/2012	6.7	26,767	402 Golden Tide Ave	Central City, KY		
6/29/2012	7.1	49,300	901 W Reservoir Ave	Central City, KY		
7/30/2012	6	21,000	508 N 3rd St	Central City, KY		0.19
8/31/2012	5.9	169,500	806 W Whitmer St.	Central City, KY	2,542	1.08
9/12/2012	8.2	247,000	111 Oakwood Drive	Central City, KY		
10/11/2012	5	14,000	927 State Route 602	Central City, KY		3.57
10/29/2012	6.3	85,000	130 S 4th St.	Central City, KY	1,256	0.19
11/26/2012	6.7	144,000	132 Fairway Drive	Central City, KY		
11/26/2012	7.3	72,500	306 Cedar St.	Central City, KY		
11/28/2012	6.5	11,500	427 W Reservoir Ave	Central City, KY	2,842	0.48
12/5/2012	5.4	67,500	509 Orchard St.	Central City, KY	1,000	0.31
12/26/2012	7.8	60,000	105 Green Valley Dr	Central City, KY		0.20
1/28/2013	5.9	54,109	811 Cherry St.	Central City, KY		
2/19/2013	5.5	30,100	807 N 2nd St.	Central City, KY	1,200	0.38
2/22/2013	5.5	37,500	512 Orchard St.	Central City, KY		
3/20/2013	9.5	15,000	4845 State Route 70 W	Central City, KY		
4/8/2013	7.5	115,000	210 Cherry Jubilee Way	Central City, KY		
4/26/2013	5.1	121,500	1000 State Route 602	Central City, KY	1,242	
4/26/2013	9.3	47,500	4635 State Route 70 W	Central City, KY		0.83
5/28/2013	3.8	15,000	941 Clark St.	Central City, KY		0.85
5/29/2013	9.3	230,001	1313 Sunnyside Rd	Central City, KY		1.02
5/30/2013	6.2	42,000	419 E Broad St.	Central City, KY	1,535	
6/11/2013	5.9	60,000	815 Cherry St.	Central City, KY	1,550	
6/17/2013	7.7	13,800	512 Shavers Dr.	Central City, KY	1,440	0.50
6/20/2013	7.4	95,500	64 Jarvis Lane	Central City, KY		0.45
7/5/2013	6.3	31,334	114 S 5th St.	Central City, KY	1,407	0.37
7/18/2013	7.3	101,150	109 Cherry Wood Dr	Central City, KY	1,204	0.75
7/26/2013	7.2	31,000	625 Stringtown Rd	Central City, KY	1,200	0.50

APPENDIX D

LINEAR REGRESSION MODEL OUTPUT

Property Value Assessment: Appendix C – Linear Regression Output

Linear Regression Output, per square foot analysis

Dependent Variable: inflation adjusted price per square foot
Number of Observations: 63
R-squared = 0.0681

Independent Variables	Coefficient (Robust Standard Error)
Shortest driving distance (miles)	-1.33 (1.85)
Sold in 2012	3.00 (10.76)
Sold in 2013	-21.43 (11.88)
Constant	71.64 (15.39)

Driving distance is a continuous variable. *Sold in 2012* and *Sold in 2013* are binary variables (0, 1) indicating the year in which the home was sold. *Sold in 2011* is the omitted category.

Linear Regression Output, per acre analysis

Dependent Variable: inflation adjusted price per acre
Number of Observations: 40
R-squared = 0.100

Independent Variables	Coefficient (Robust Standard Error)
Shortest driving distance (miles)	-1,918 (3,913)
Sold in 2012	75,944 (52,988)
Sold in 2013	9,153 (35,235)
Constant	105,705 (44,268)

Driving distance is a continuous variable. *Sold in 2012* and *Sold in 2013* are binary variables (0, 1) indicating the year in which the home was sold. *Sold in 2011* is the omitted category.

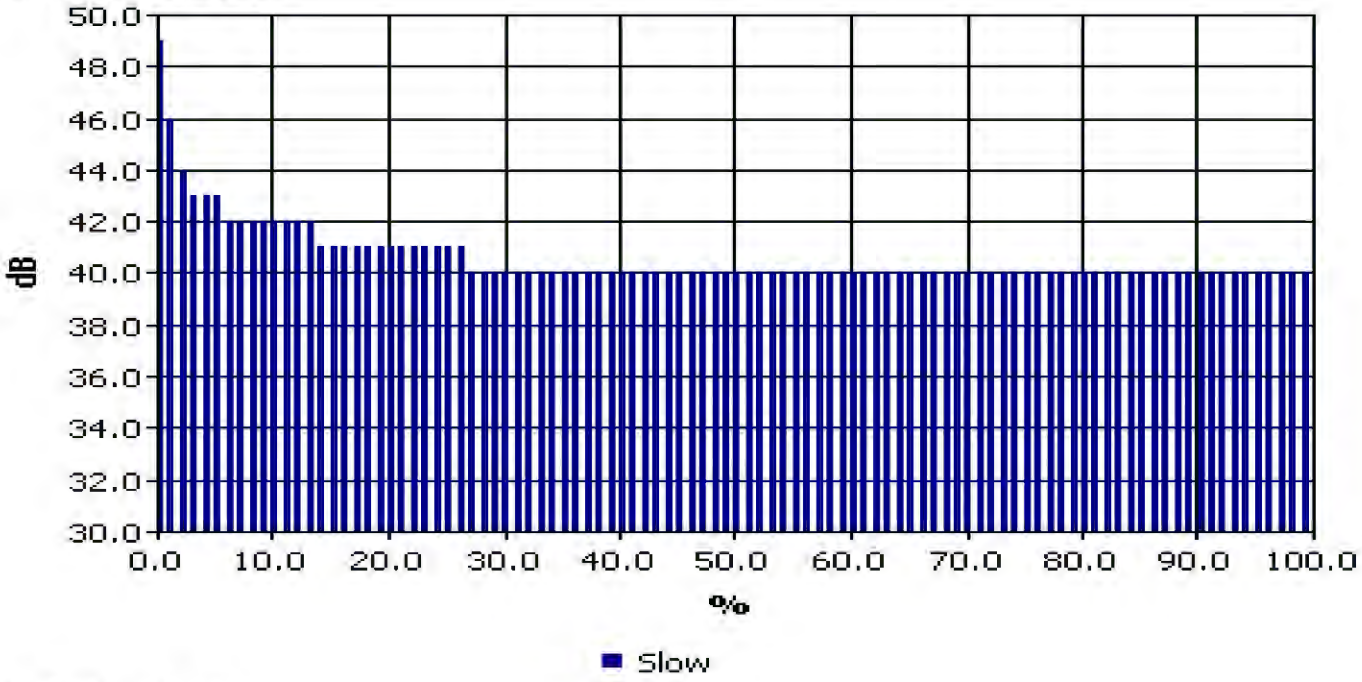
APPENDIX E

NOISE DATA PRINTOUTS

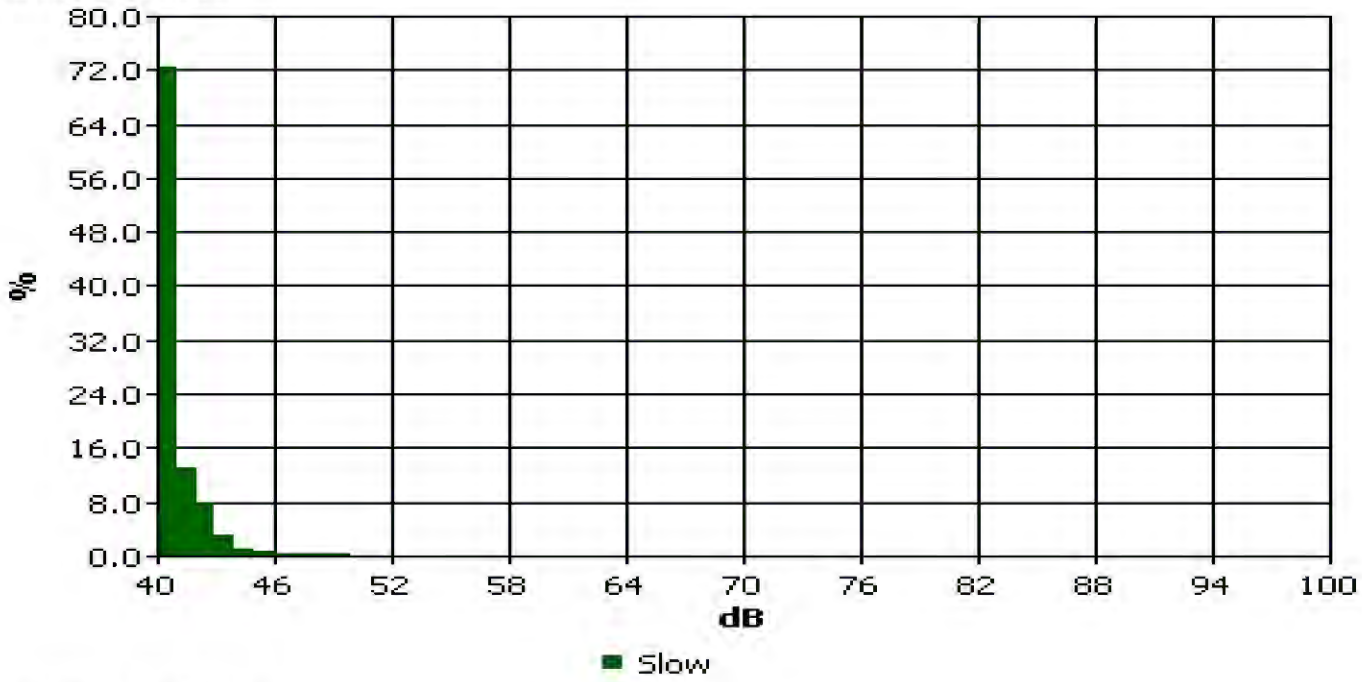
Session Report

1/8/2014

Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens R3375
Comments	
Start Time	Monday, December 16, 2013 12:19:26
Stop Time	Wednesday, December 18, 2013 11:17:31
Device Name	QC9070030
Device Serial Number	QC9070030
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	0 %	Response	1	SLOW
			Lavg	1	47.7 dB

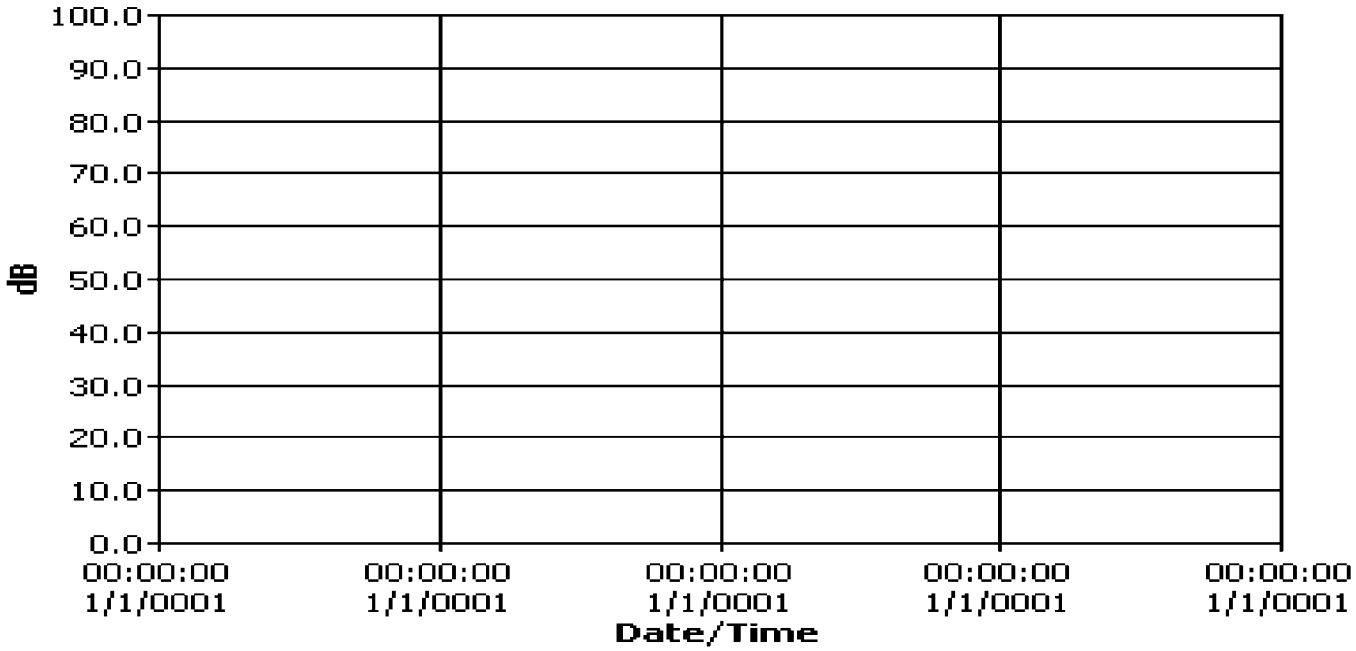
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 12:19:26
Stop Time	Tuesday, December 17, 2013 11:39:39

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	48.3 dB			

Logged Data Chart



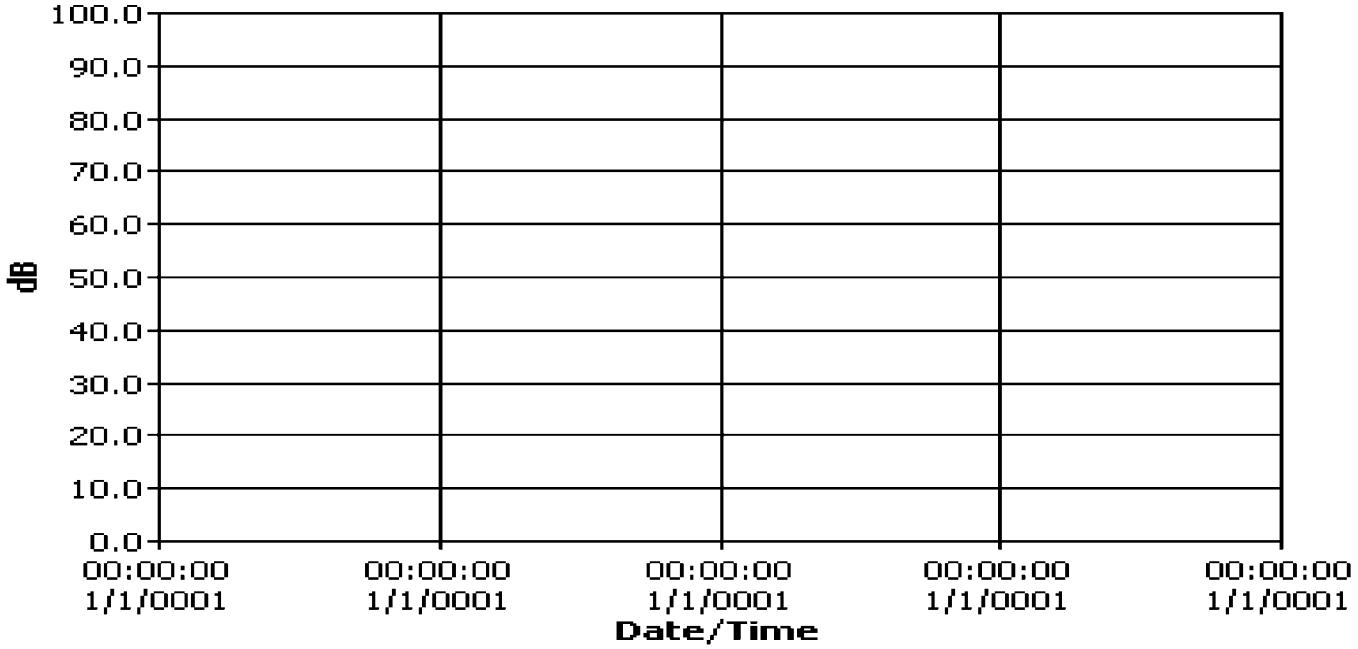
Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Tuesday, December 17, 2013 11:40:09
Stop Time	Wednesday, December 18, 2013 11:17:31

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	47 dB			

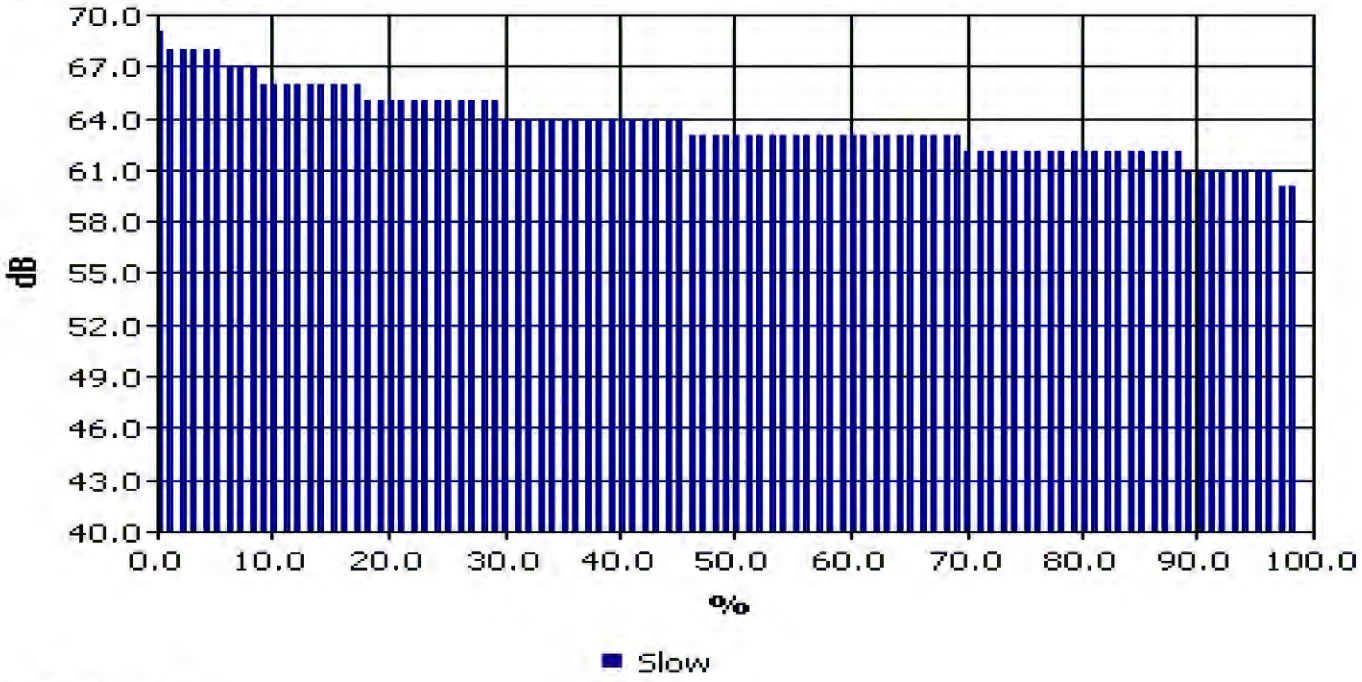
Logged Data Chart



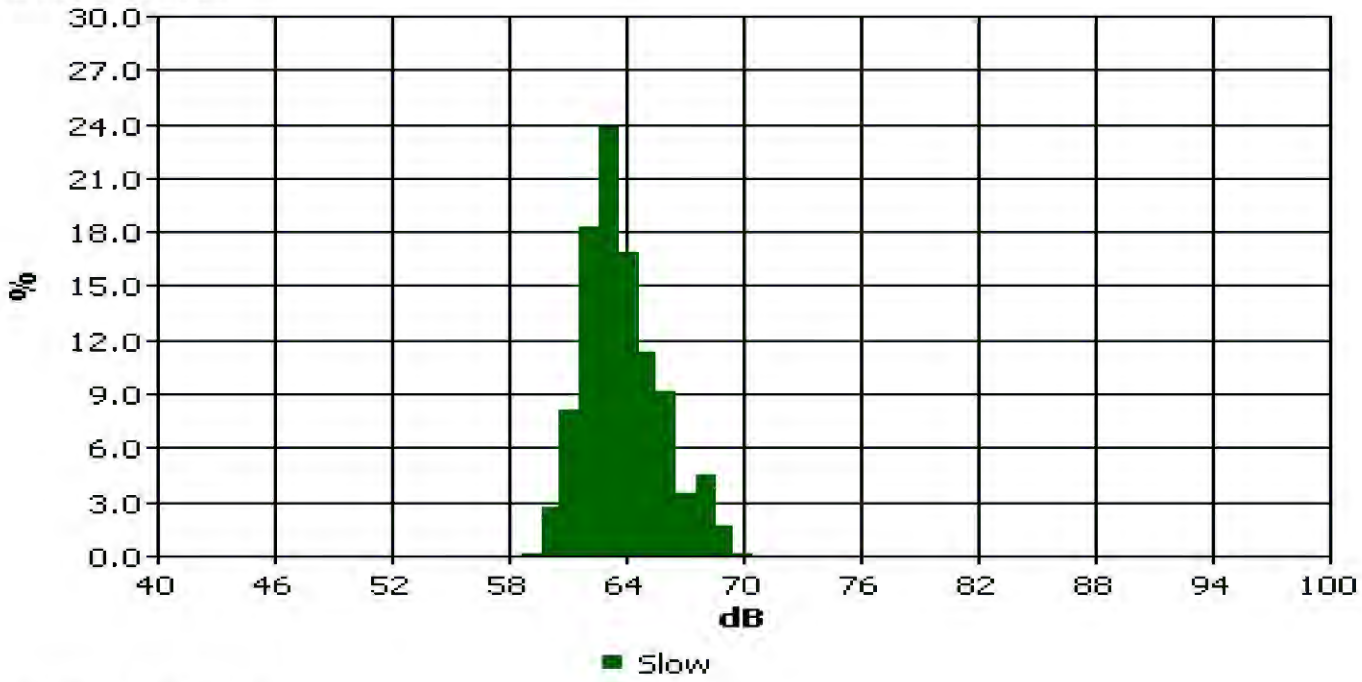
Session Report

1/8/2014

Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens 0970
Comments	
Start Time	Monday, December 16, 2013 11:11:12
Stop Time	Friday, December 20, 2013 09:54:26
Device Name	QC0020059
Device Serial Number	QC0020059
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	1.3 %	Response	1	SLOW
			Lavg	1	63.8 dB

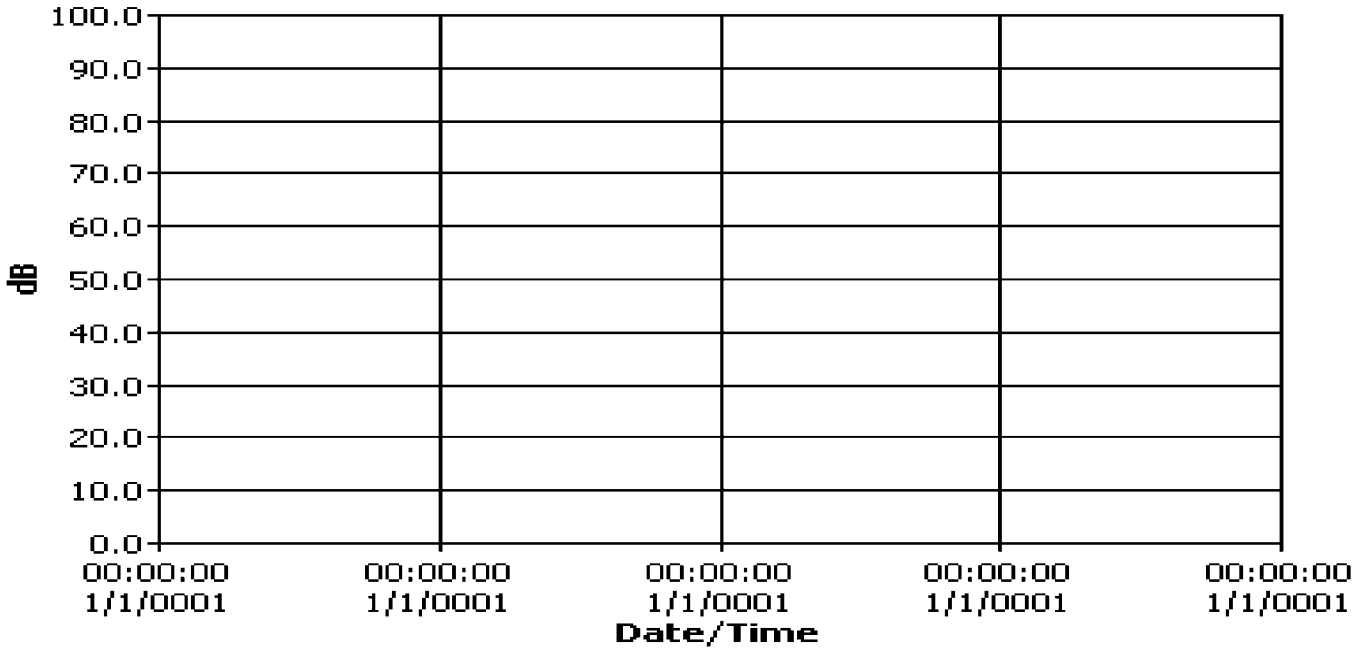
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 11:11:12
Stop Time	Tuesday, December 17, 2013 06:18:44

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.4 %
Lavg	1	62.5 dB			

Logged Data Chart



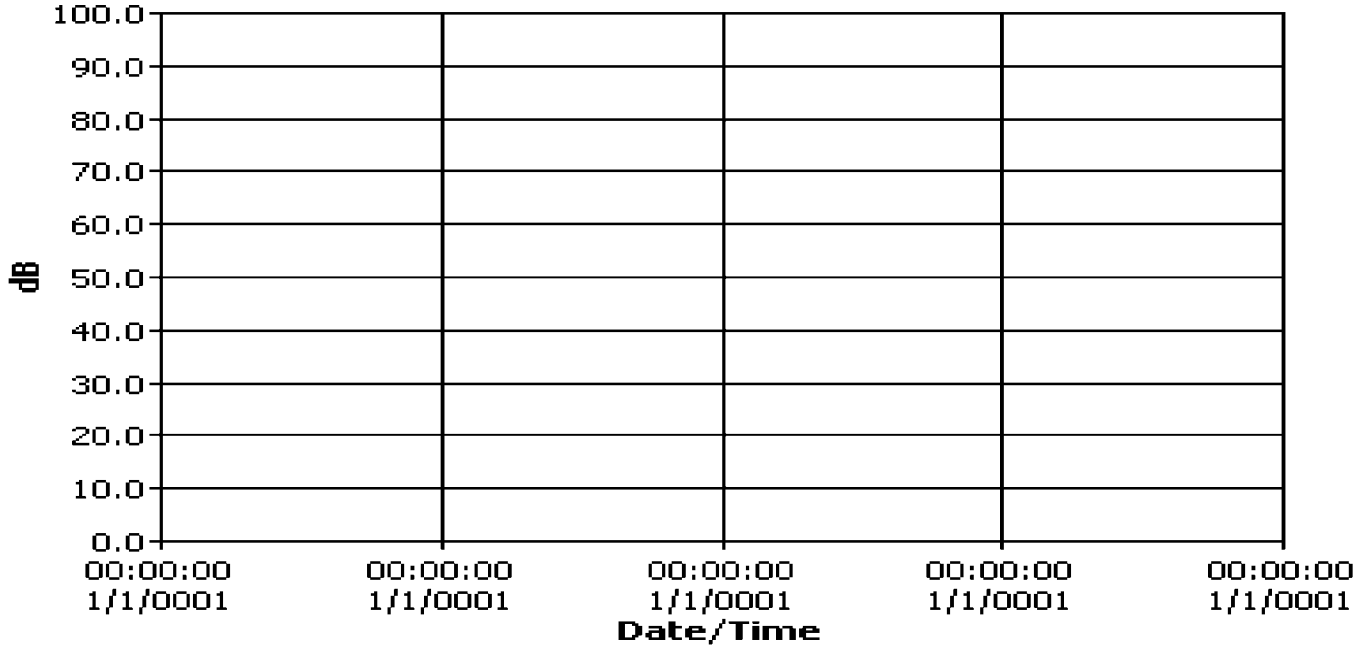
Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Tuesday, December 17, 2013 11:04:46
Stop Time	Wednesday, December 18, 2013 10:47:57

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.9 %
Lavg	1	64.6 dB			

Logged Data Chart



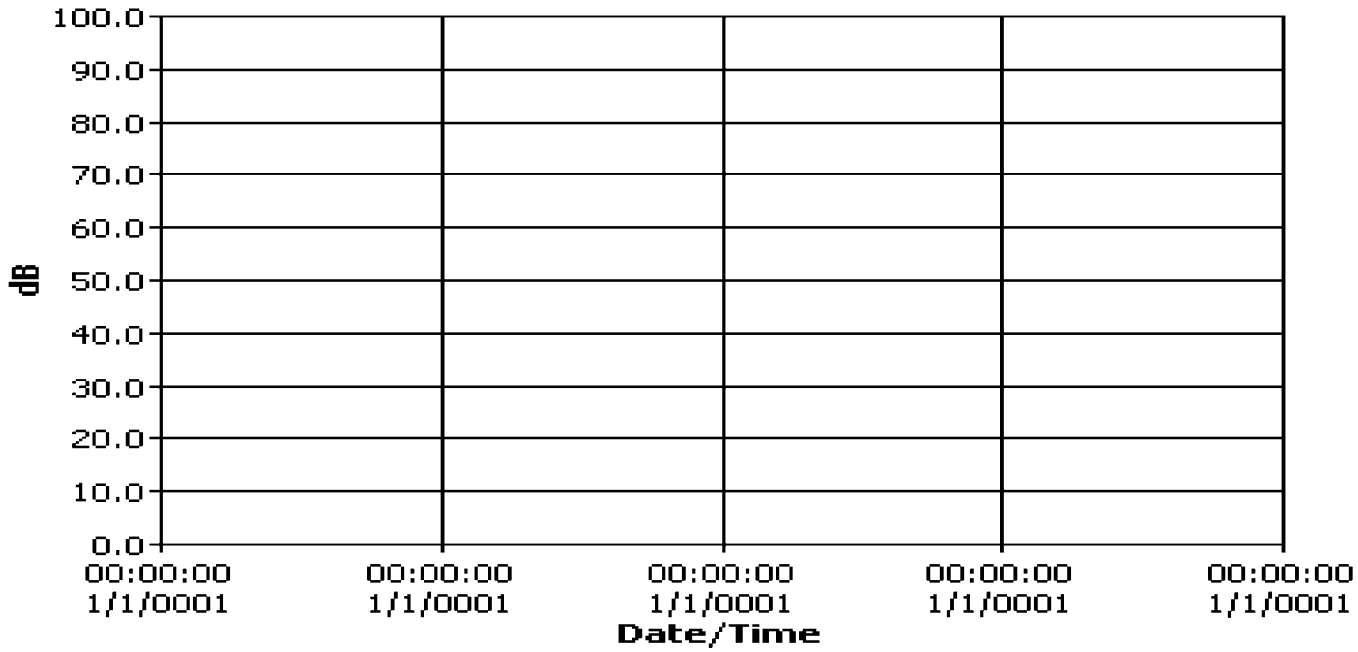
Study 3
Information Panel

Name	Study 3
Comments	
Start Time	Friday, December 20, 2013 09:54:26
Stop Time	Friday, December 20, 2013 09:54:26

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	41.5 dB			

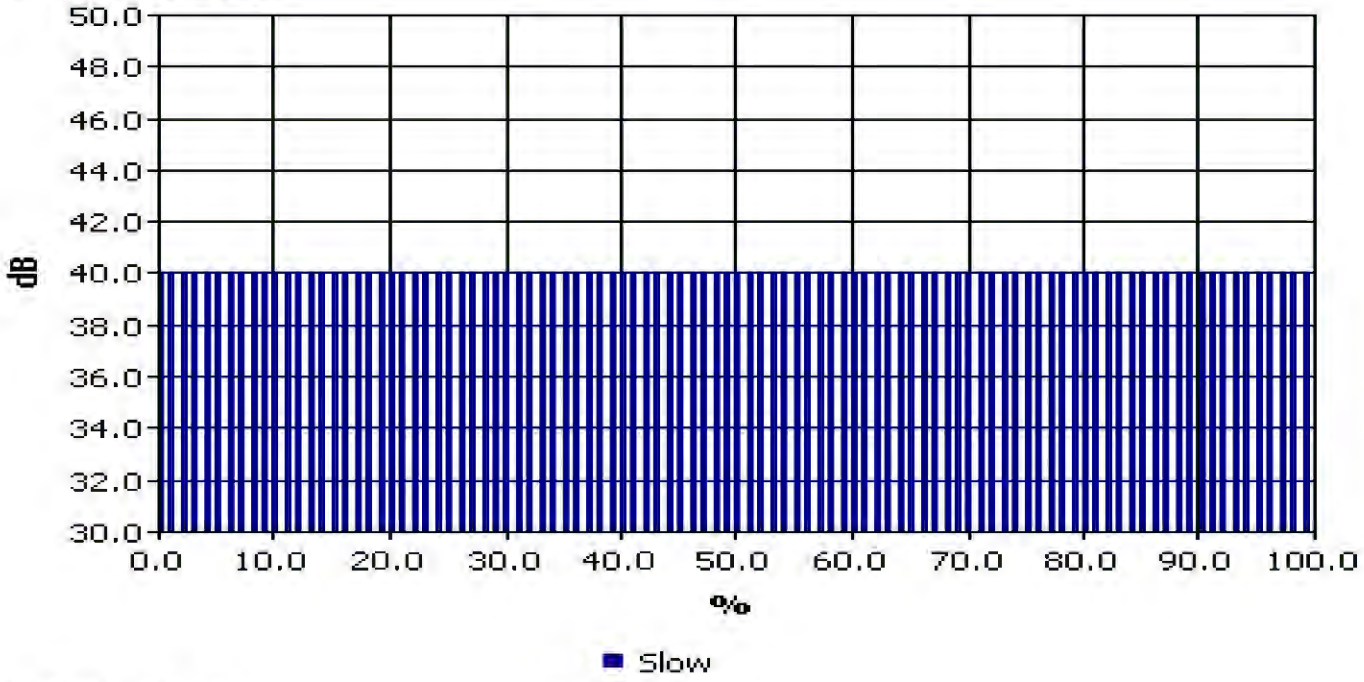
Logged Data Chart



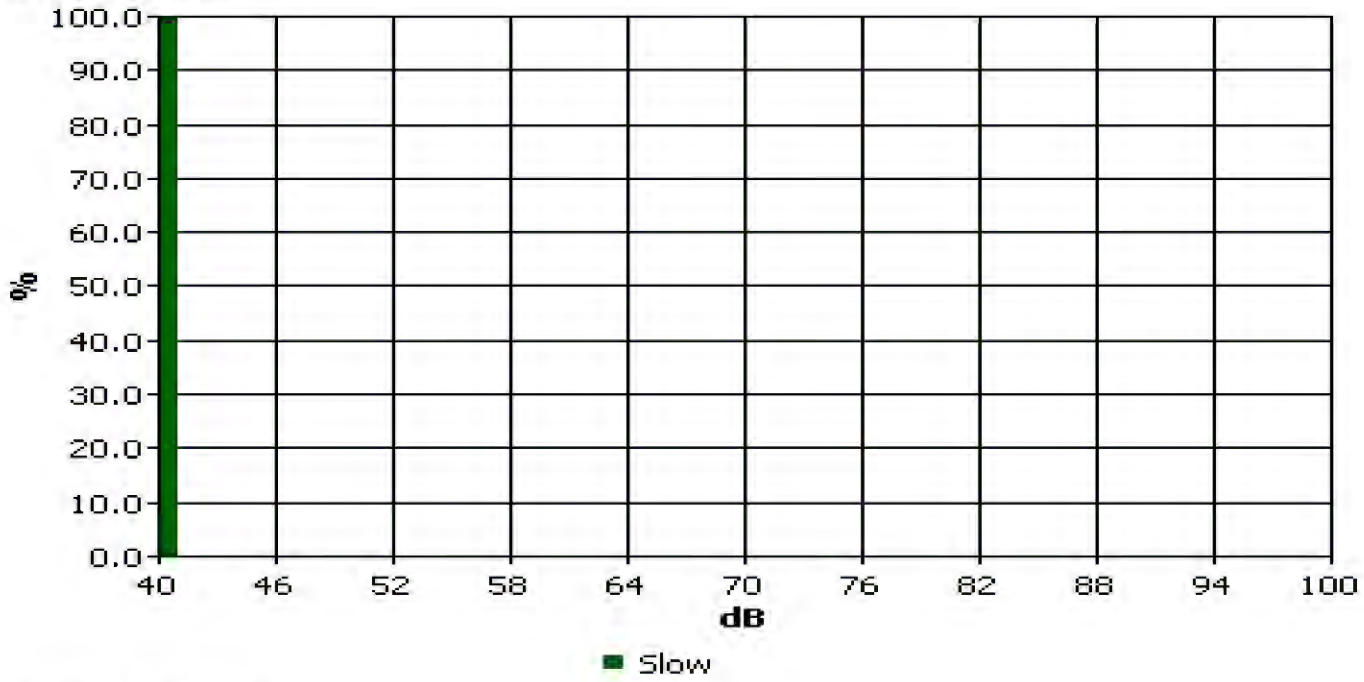
Session Report

1/8/2014

Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens 4518
Comments	
Start Time	Monday, December 16, 2013 12:10:58
Stop Time	Wednesday, December 18, 2013 11:14:53
Device Name	QC3010142
Device Serial Number	QC3010142
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	0.1 %	Response	1	SLOW
			Lavg	1	52.8 dB

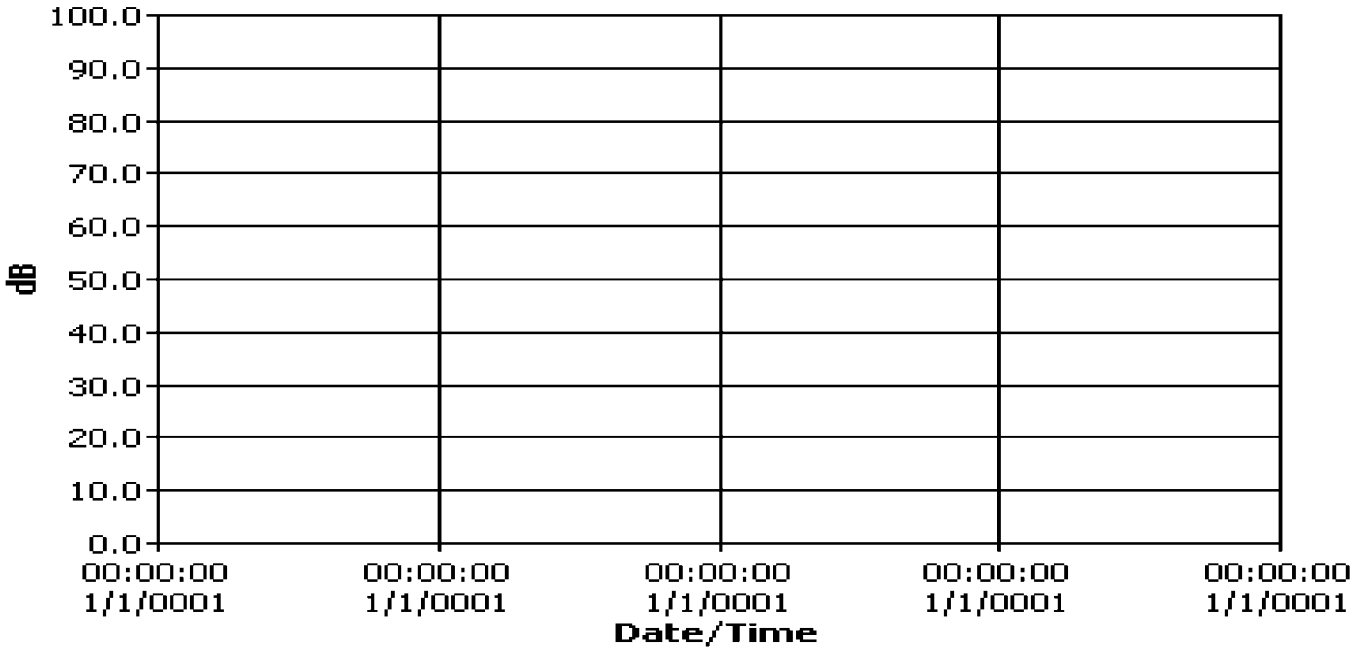
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 12:10:58
Stop Time	Tuesday, December 17, 2013 11:36:31

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.1 %
Lavg	1	54.7 dB			

Logged Data Chart



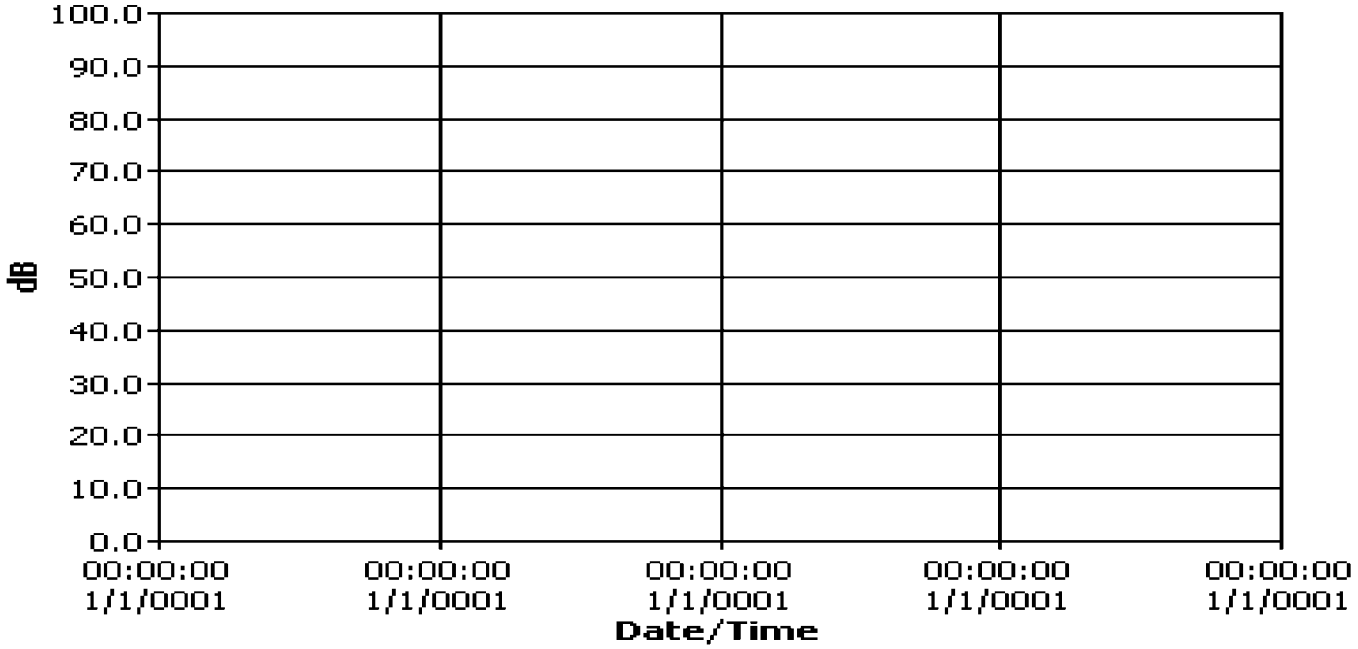
Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Tuesday, December 17, 2013 11:37:06
Stop Time	Wednesday, December 18, 2013 11:14:53

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	49.4 dB			

Logged Data Chart



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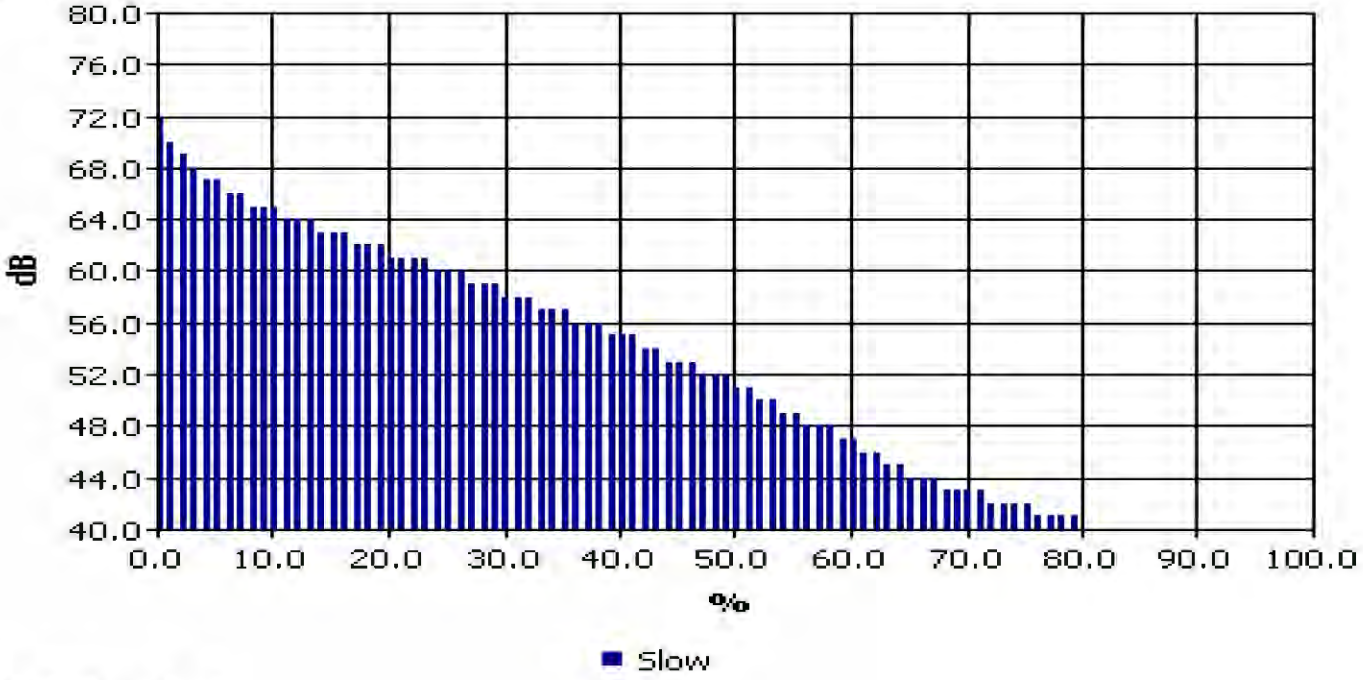
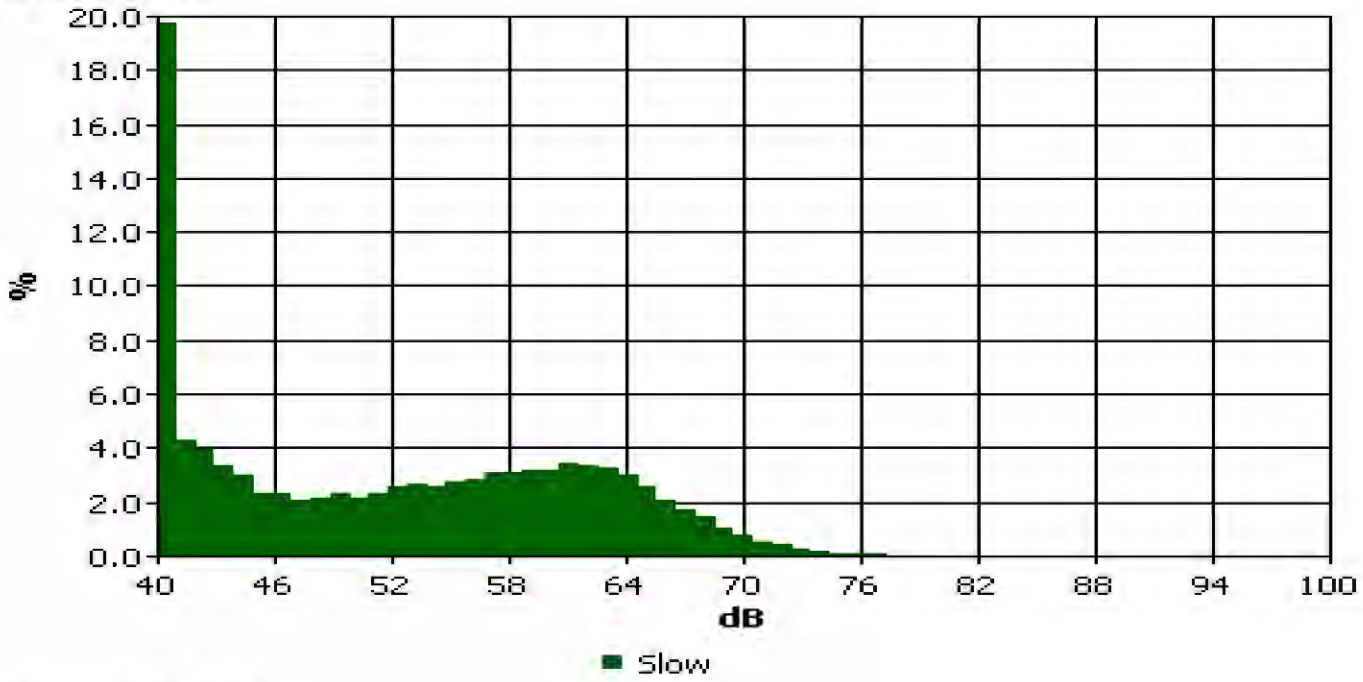
Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens R3259
Comments	
Start Time	Monday, December 16, 2013 13:12:12
Stop Time	Wednesday, December 18, 2013 10:34:22
Device Name	QC9060003
Device Serial Number	QC9060003
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	0.7 %	Response	1	SLOW
			Lavg	1	60.9 dB

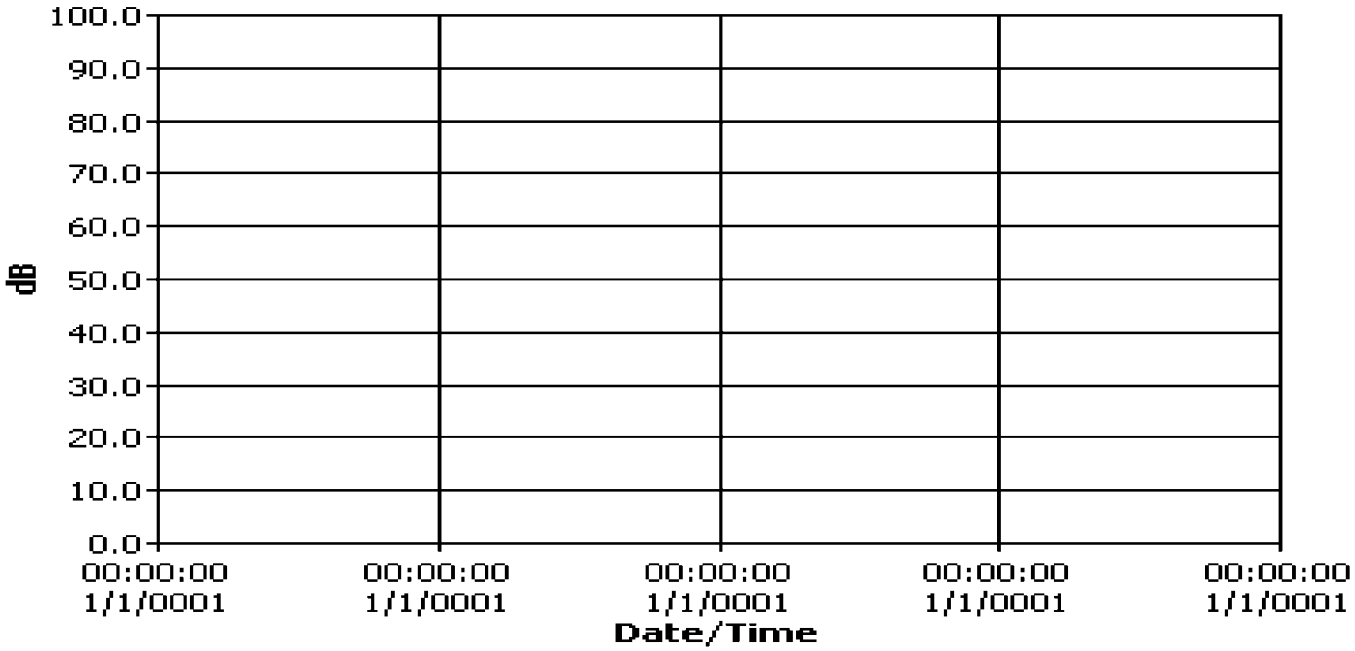
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 13:12:12
Stop Time	Tuesday, December 17, 2013 12:09:04

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.4 %
Lavg	1	61.1 dB			

Logged Data Chart



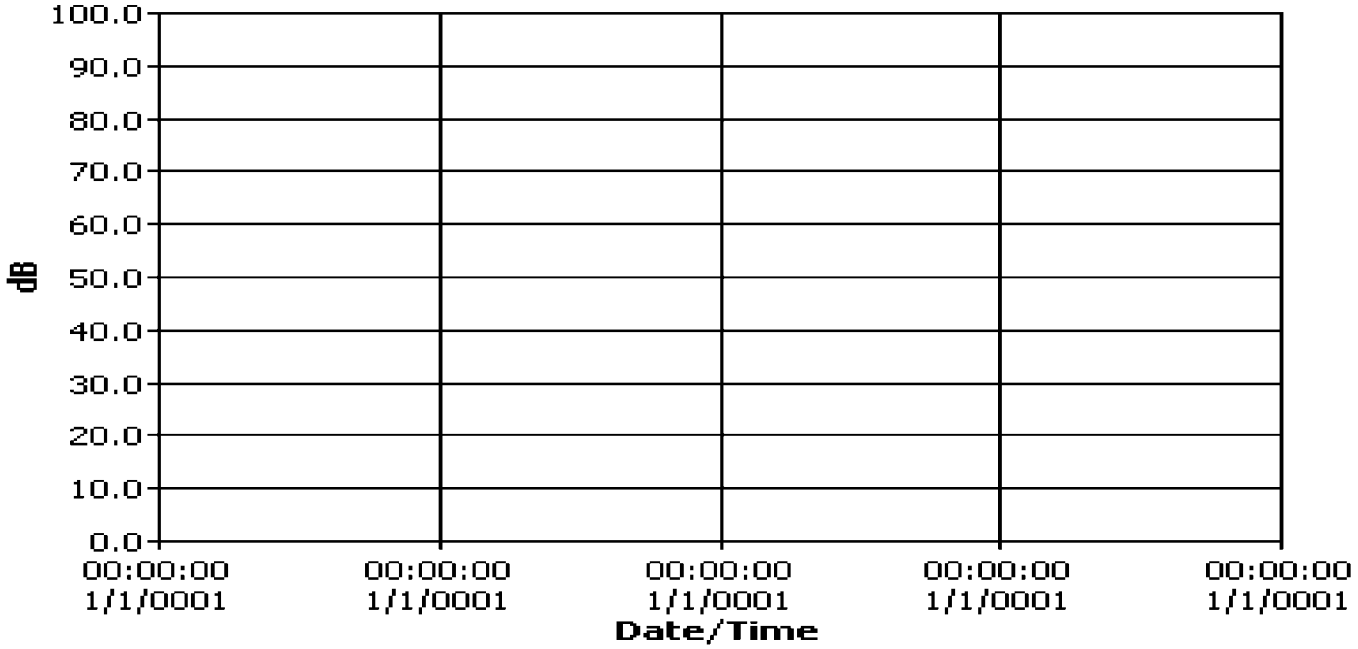
Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Tuesday, December 17, 2013 12:09:34
Stop Time	Wednesday, December 18, 2013 10:34:22

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.3 %
Lavg	1	60.6 dB			

Logged Data Chart



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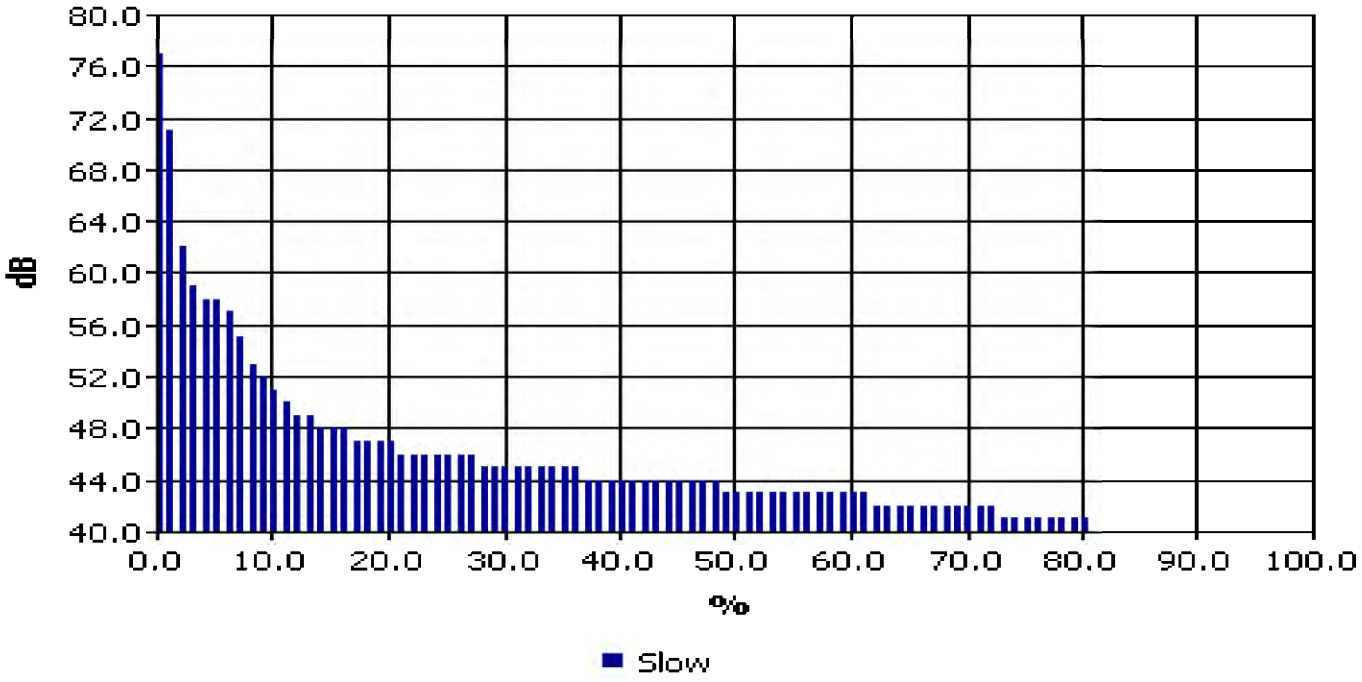
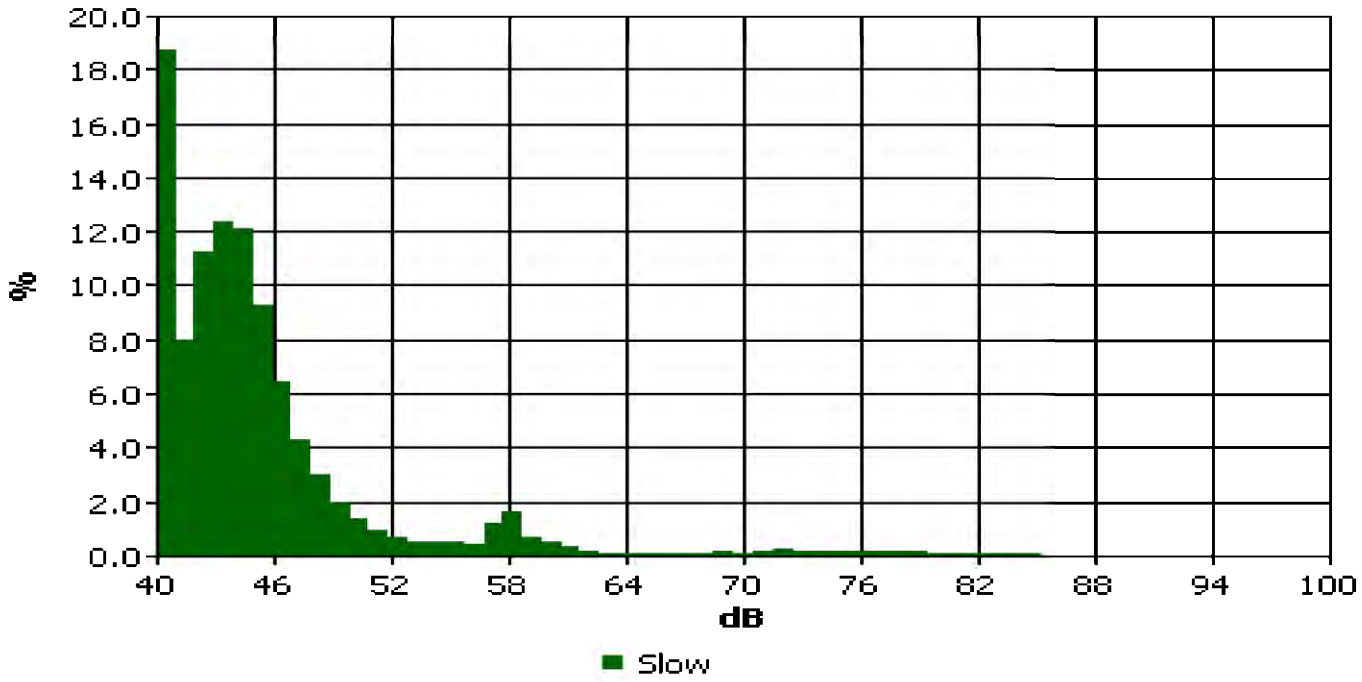
Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens R3407
Comments	
Start Time	Monday, December 16, 2013 12:45:22
Stop Time	Wednesday, December 18, 2013 11:32:10
Device Name	QC9090004
Device Serial Number	QC9090004
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	1.2 %	Response	1	SLOW
			Lavg	1	63.1 dB

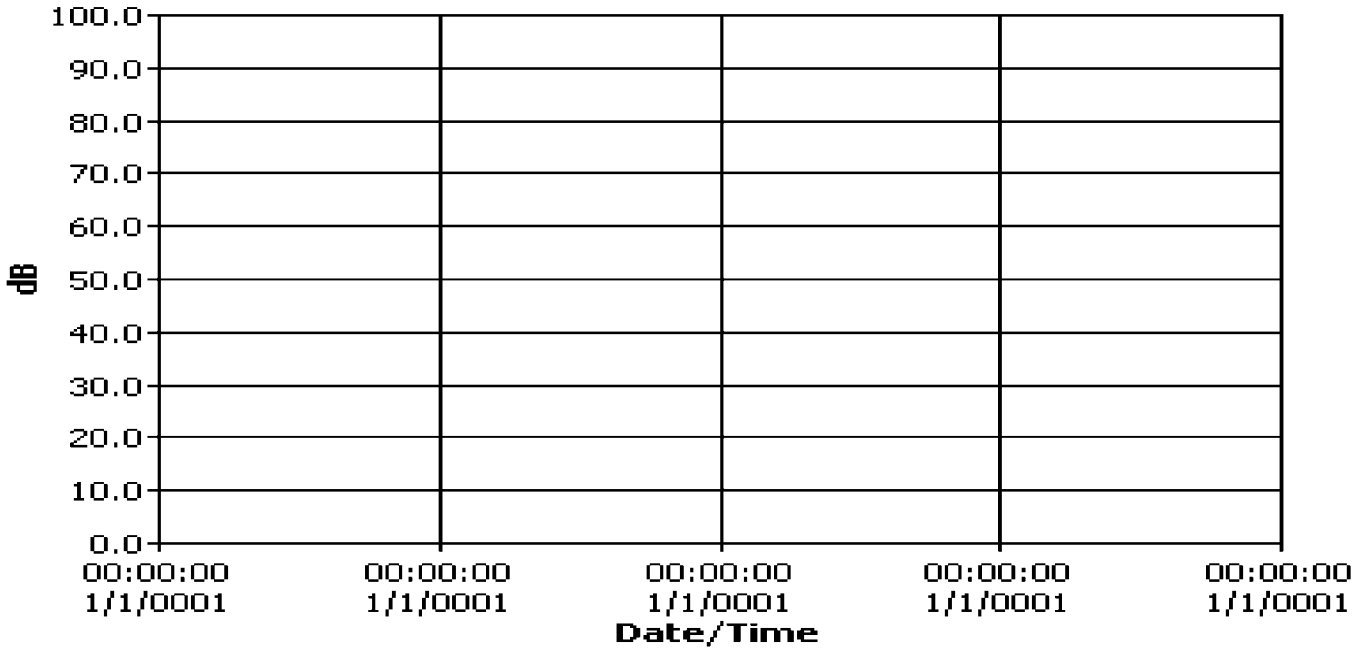
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 12:45:22
Stop Time	Monday, December 16, 2013 12:45:26

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	55.2 dB			

Logged Data Chart



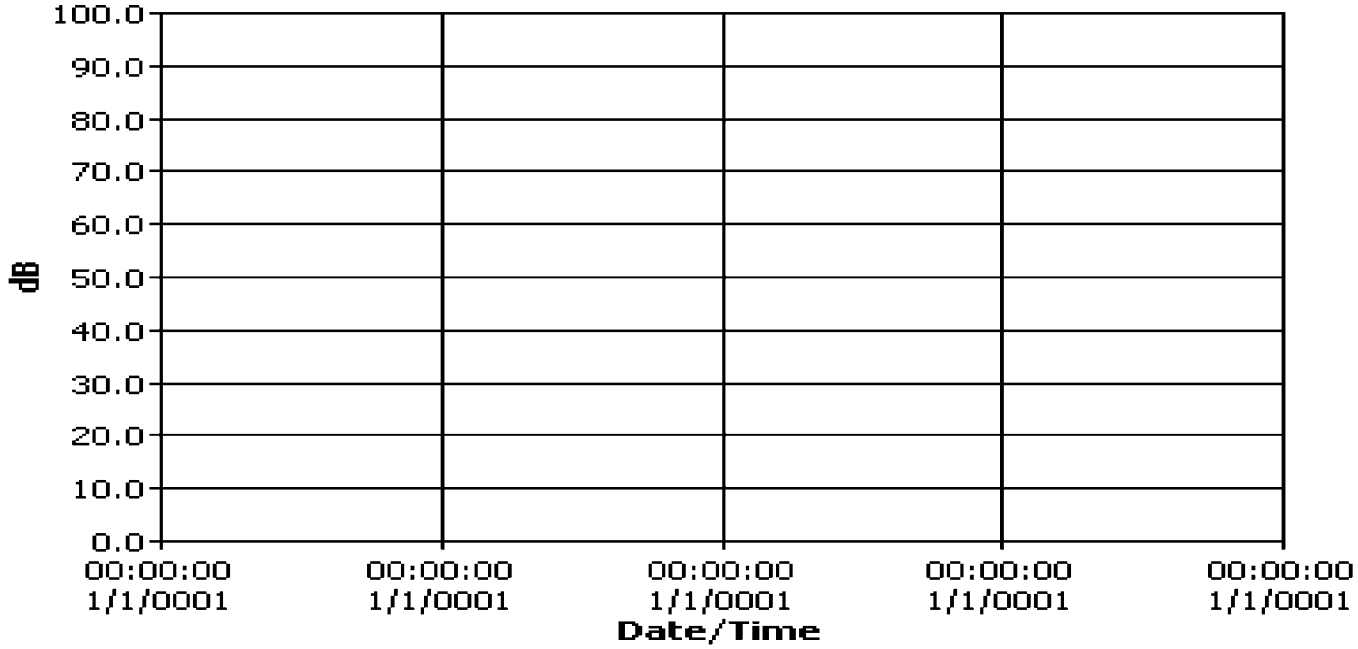
Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Monday, December 16, 2013 12:45:26
Stop Time	Tuesday, December 17, 2013 11:55:14

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.7 %
Lavg	1	63.9 dB			

Logged Data Chart



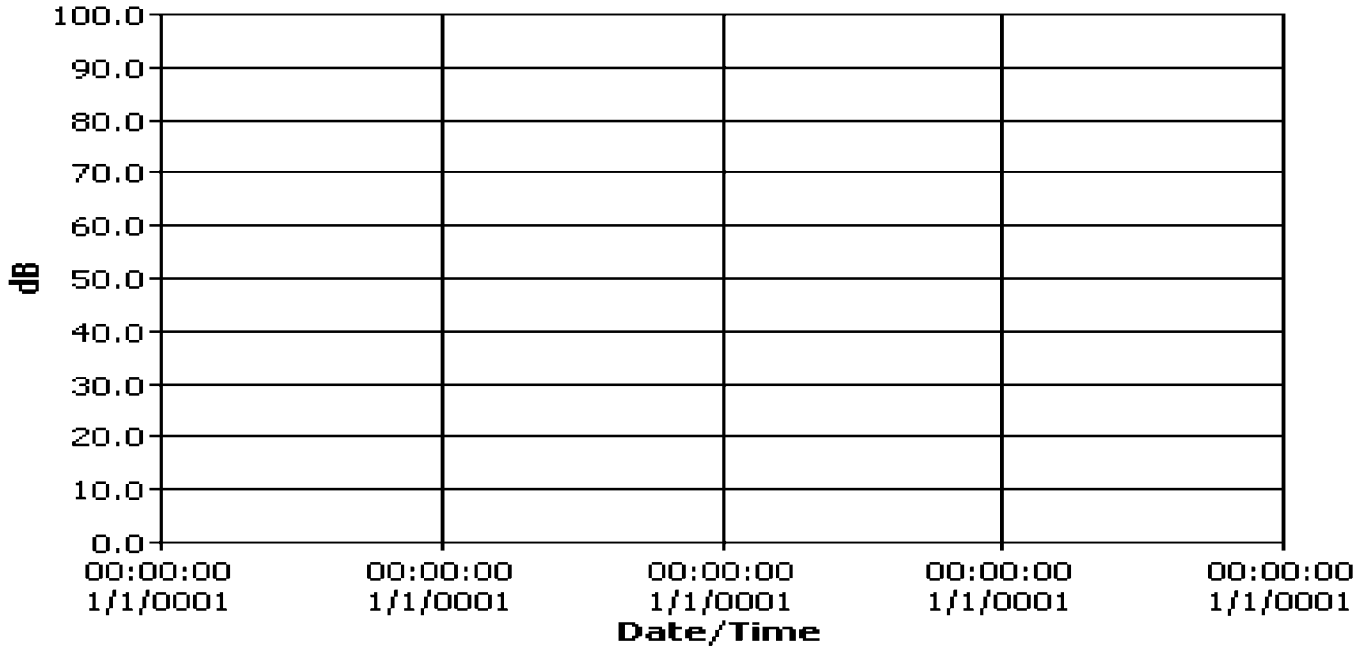
Study 3
Information Panel

Name	Study 3
Comments	
Start Time	Tuesday, December 17, 2013 11:55:48
Stop Time	Wednesday, December 18, 2013 11:32:10

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.5 %
Lavg	1	62.1 dB			

Logged Data Chart



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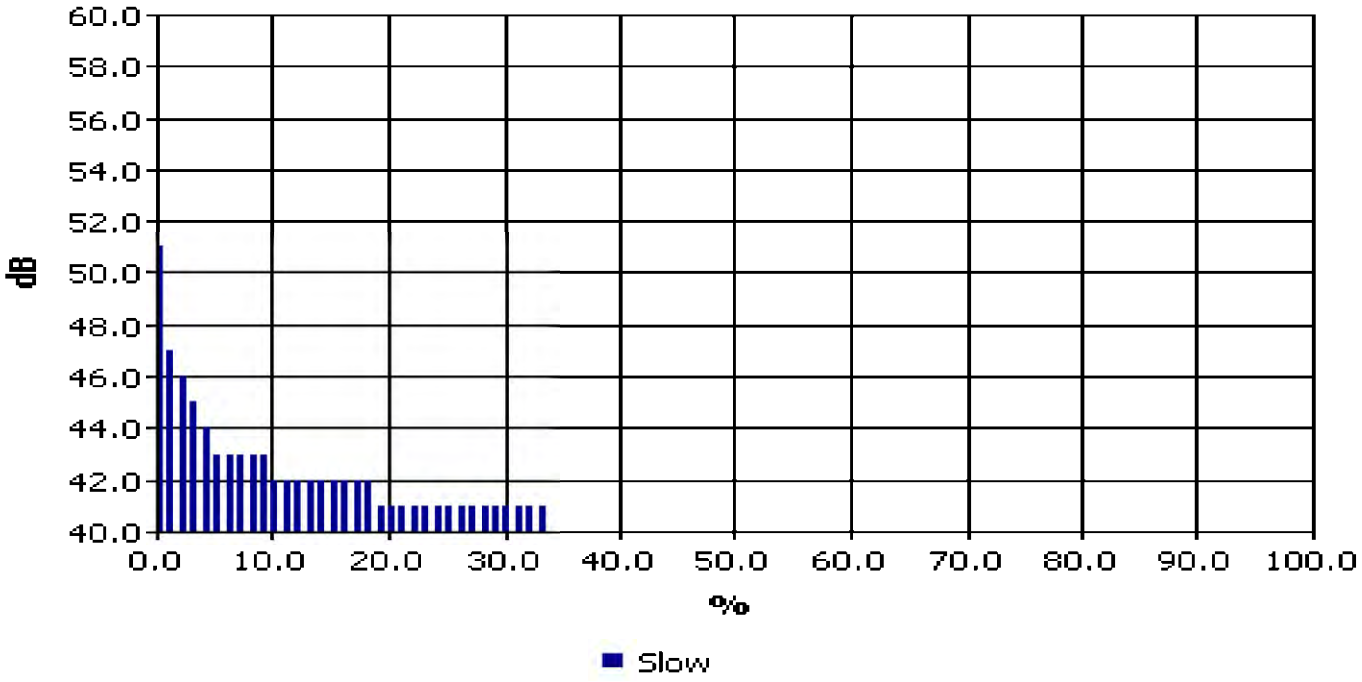
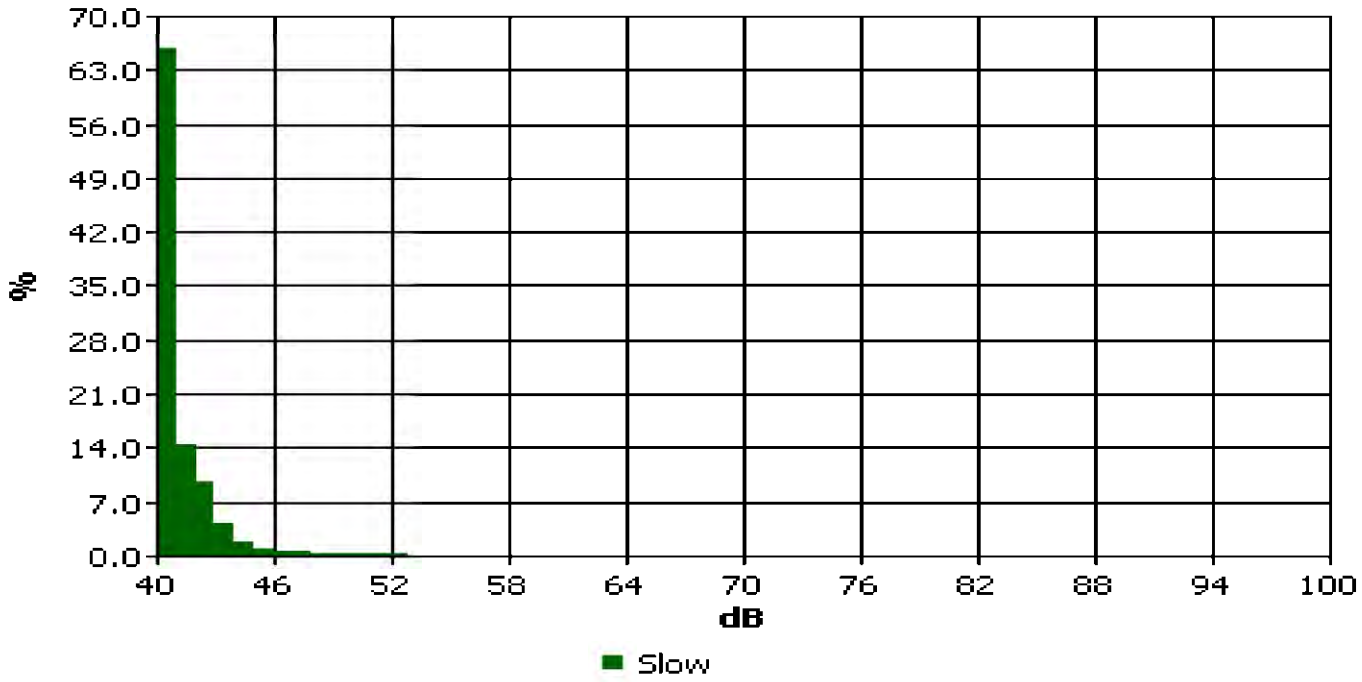
Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens R3471
Comments	
Start Time	Monday, December 16, 2013 12:30:15
Stop Time	Wednesday, December 18, 2013 11:23:36
Device Name	QC9110034
Device Serial Number	QC9110034
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	0 %	Response	1	SLOW
			Lavg	1	48.2 dB

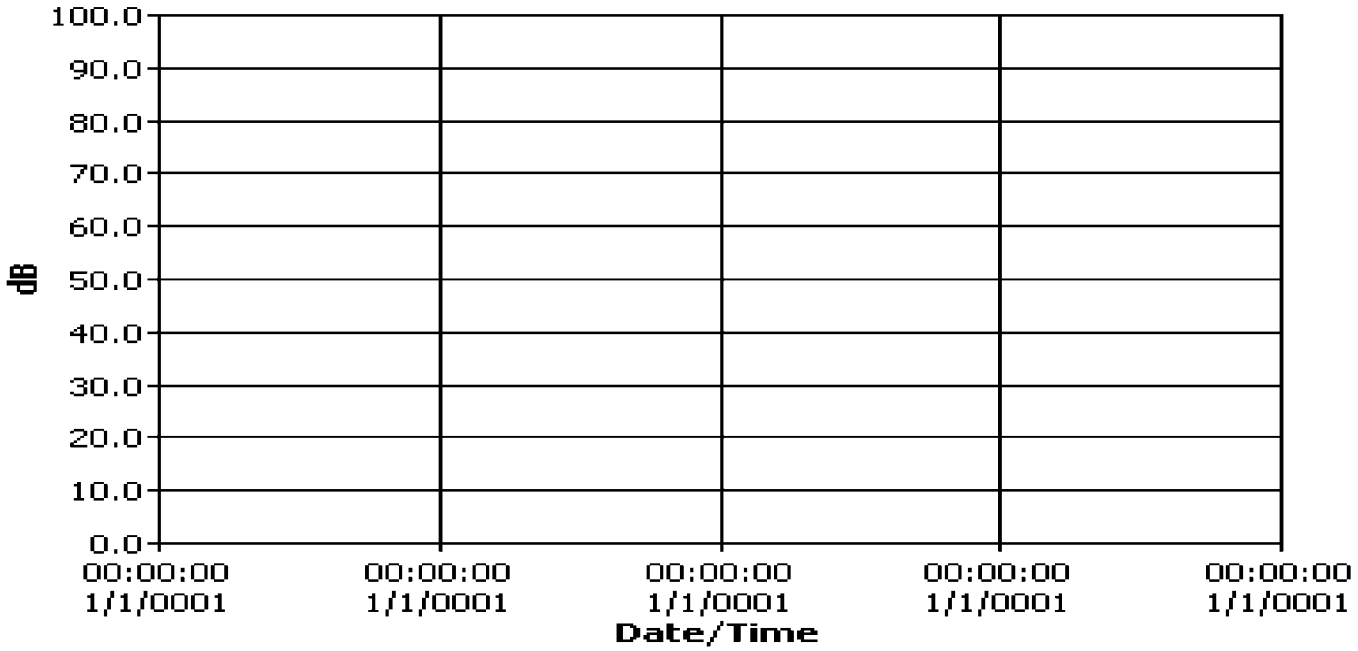
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 12:30:15
Stop Time	Tuesday, December 17, 2013 11:45:57

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	47.2 dB			

Logged Data Chart



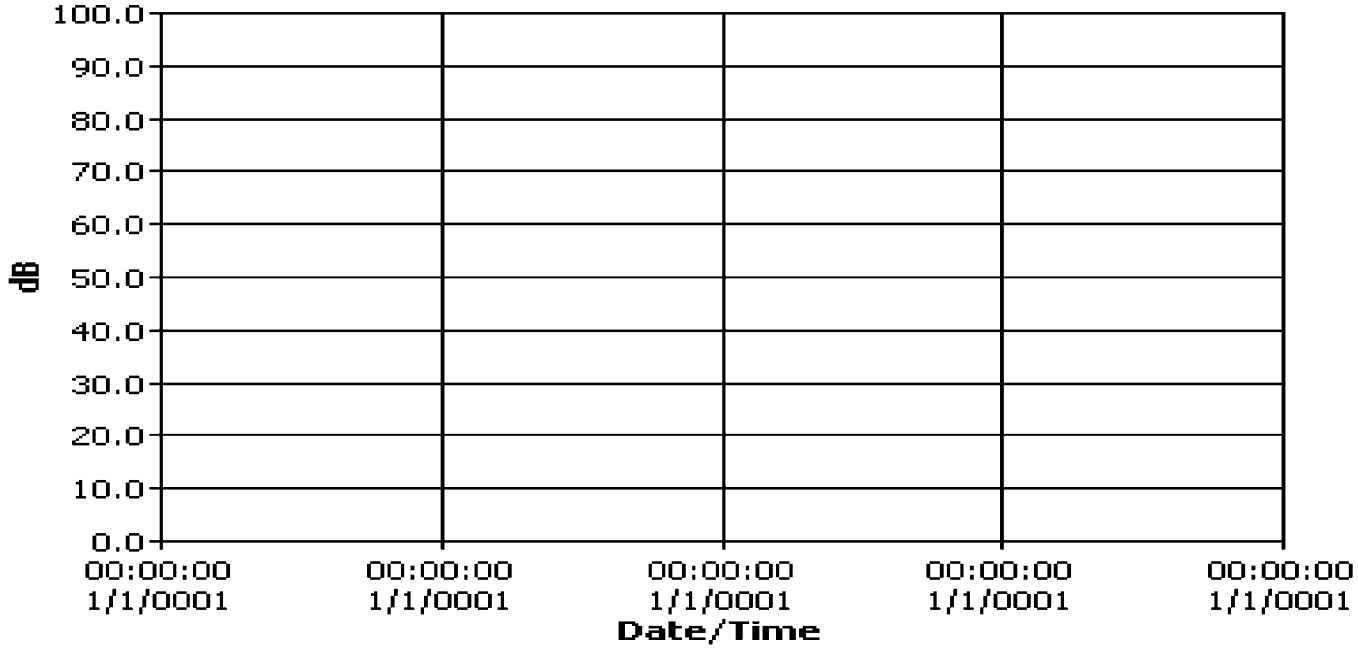
Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Tuesday, December 17, 2013 11:46:35
Stop Time	Wednesday, December 18, 2013 11:23:33

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	49.1 dB			

Logged Data Chart



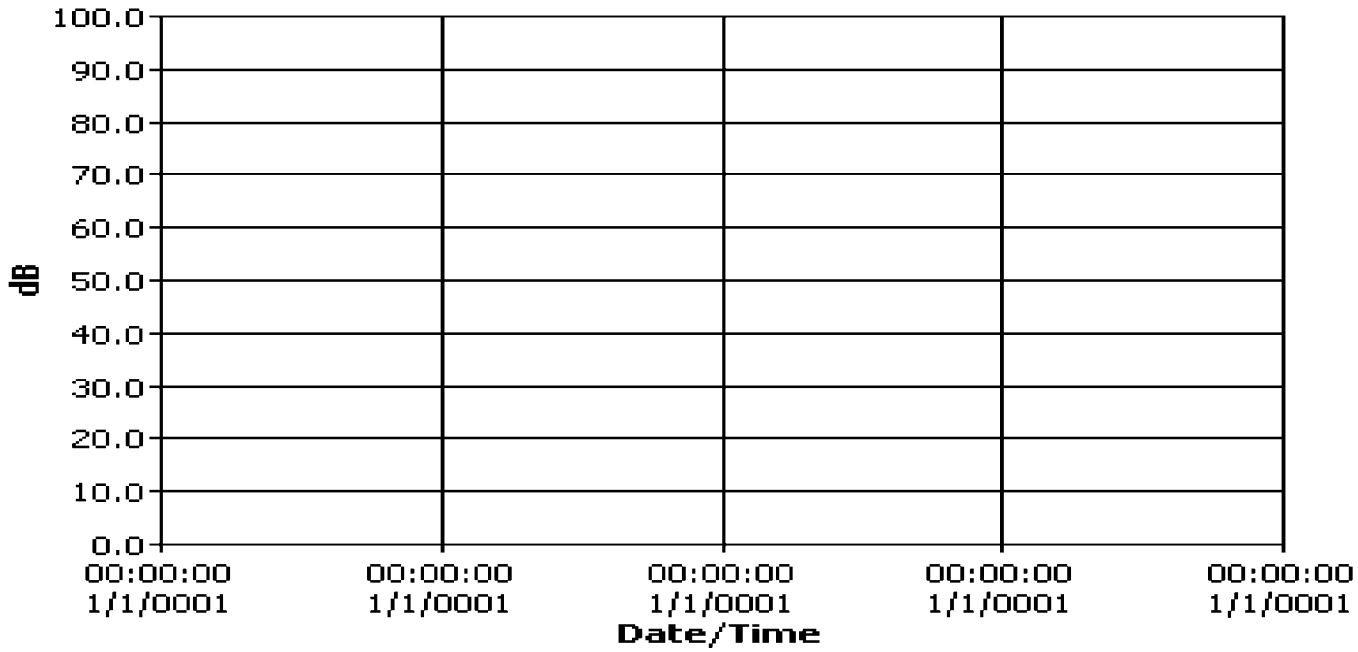
Study 3
Information Panel

Name	Study 3
Comments	
Start Time	Wednesday, December 18, 2013 11:23:35
Stop Time	Wednesday, December 18, 2013 11:23:36

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0 %
Lavg	1	64.6 dB			

Logged Data Chart



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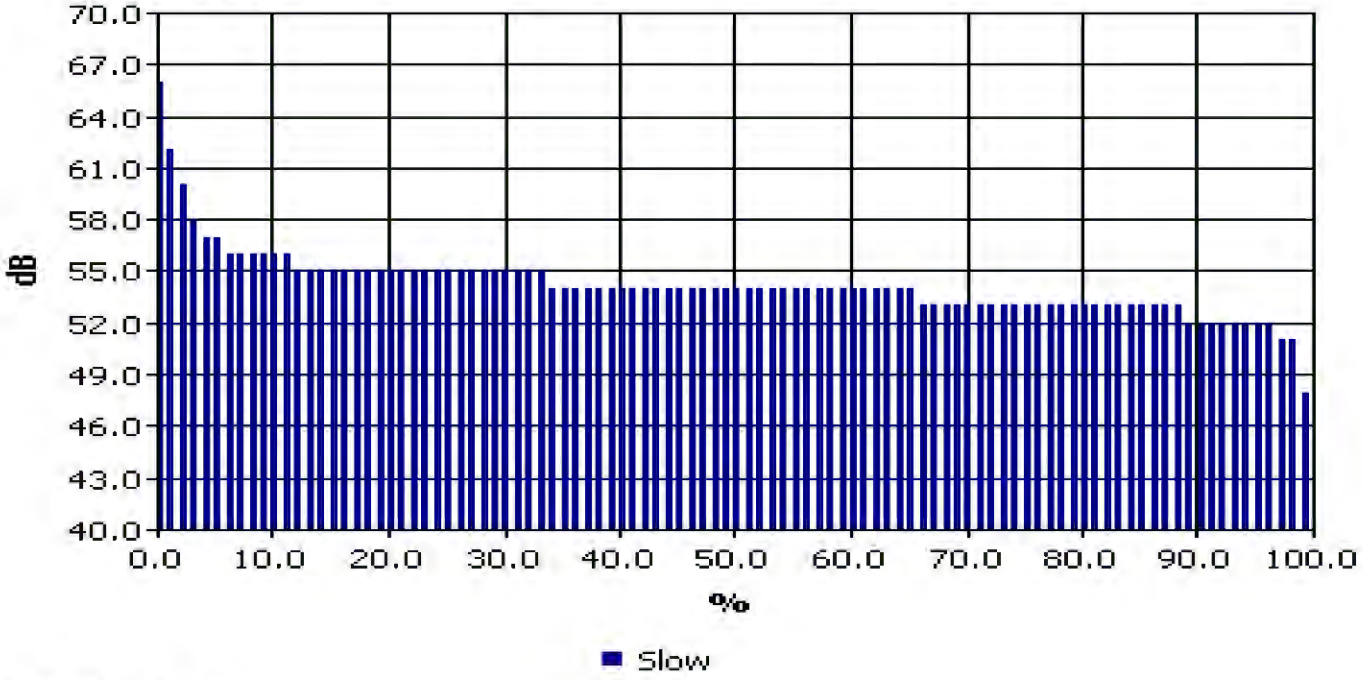
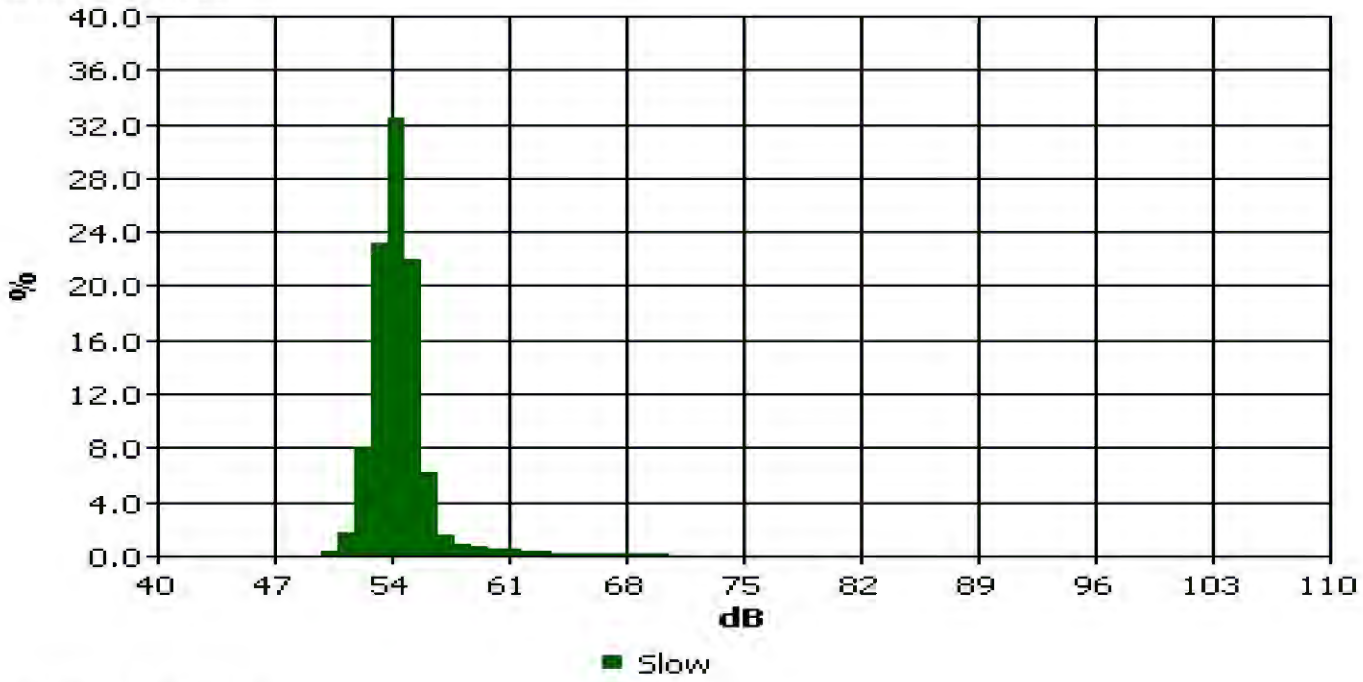
Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens R4631
Comments	
Start Time	Monday, December 16, 2013 11:55:37
Stop Time	Wednesday, December 18, 2013 10:37:20
Device Name	QC1060166
Device Serial Number	QC1060166
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	0.4 %	Response	1	SLOW
			Lavg	1	58.7 dB

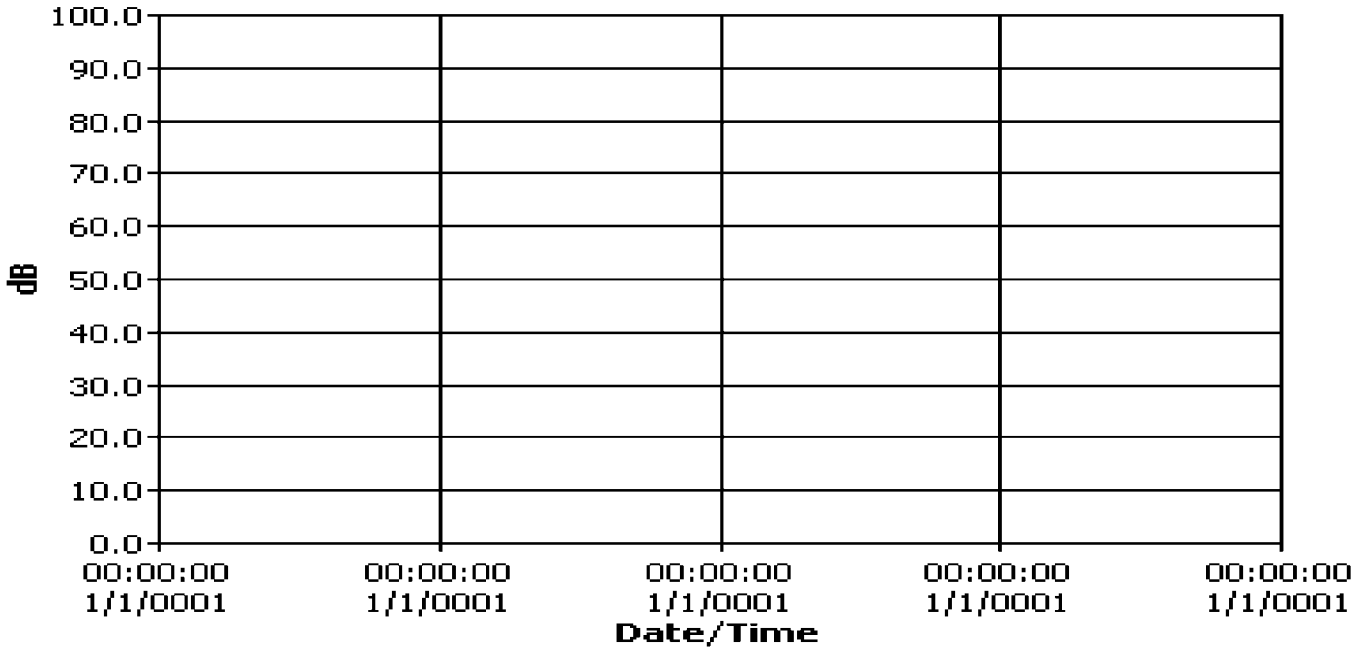
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 11:55:37
Stop Time	Tuesday, December 17, 2013 11:17:21

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.2 %
Lavg	1	59 dB			

Logged Data Chart



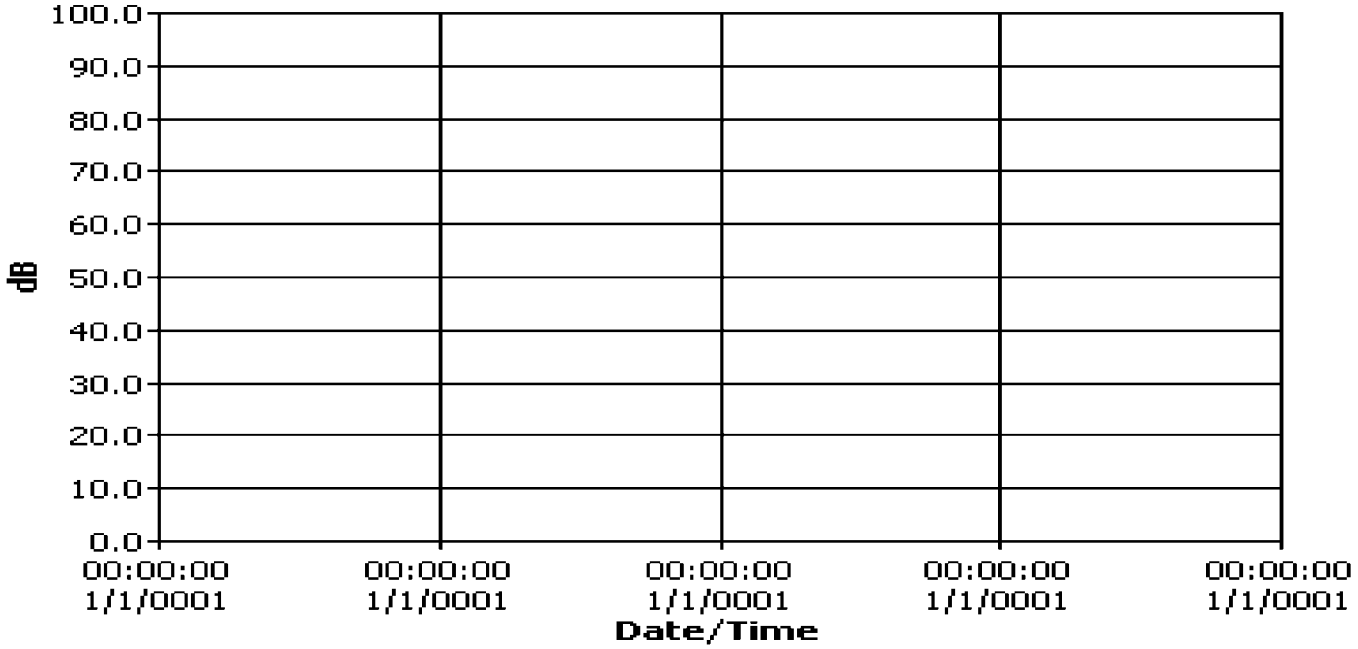
Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Tuesday, December 17, 2013 11:17:57
Stop Time	Wednesday, December 18, 2013 10:37:20

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.2 %
Lavg	1	58.4 dB			

Logged Data Chart



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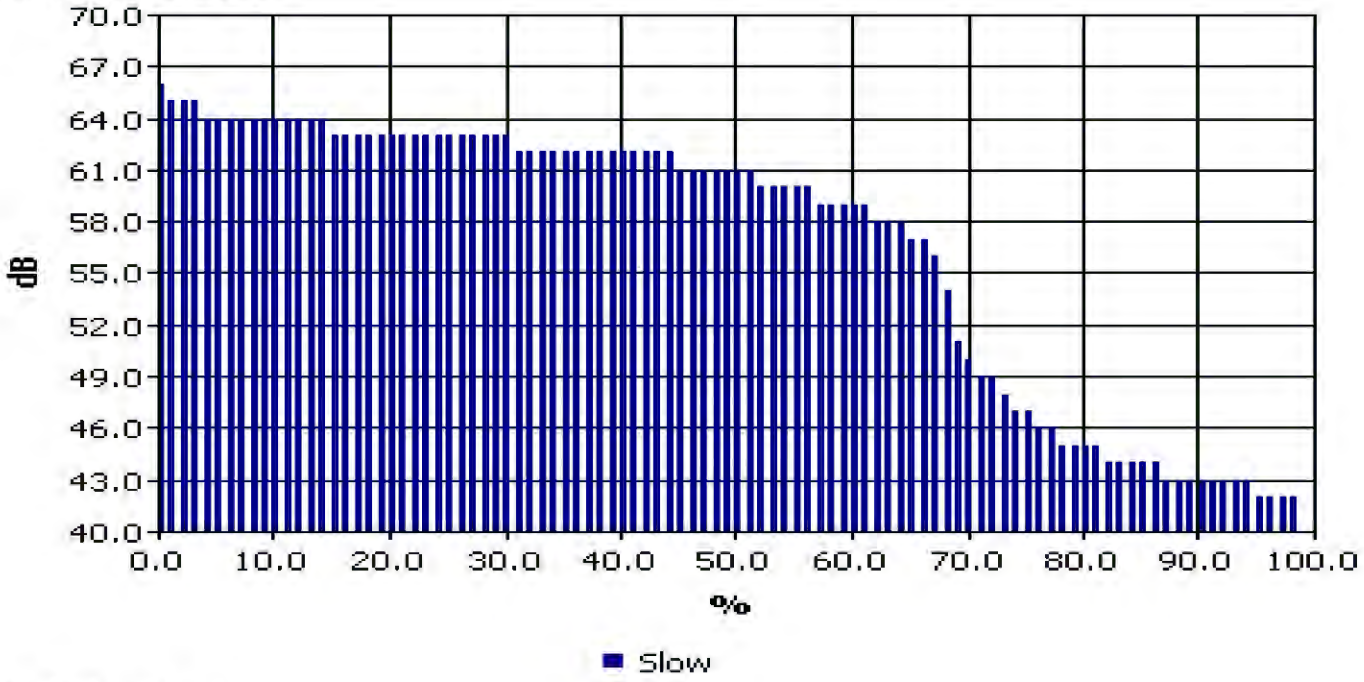
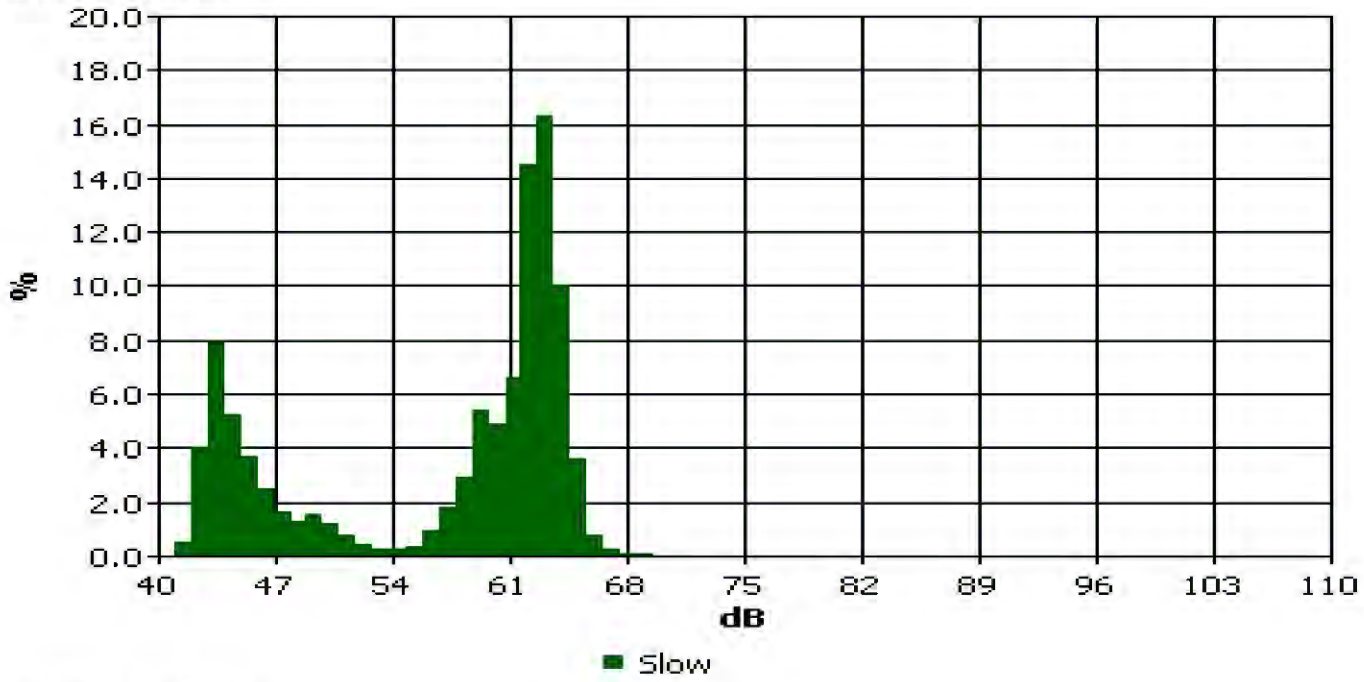
Exceedance Chart



Statistics Chart



Information Panel

Name	Cardno Stephens R7014
Comments	
Start Time	Monday, December 16, 2013 11:43:41
Stop Time	Wednesday, December 18, 2013 11:06:54
Device Name	QC3060078
Device Serial Number	QC3060078
Device Model Type	Q-300
Device Firmware Revision	

General Data Panel

Description	Meter	Value			
Weighting	1	A	Exchange Rate	1	3 dB
Dose	1	0.8 %	Response	1	SLOW
			Lavg	1	61.2 dB

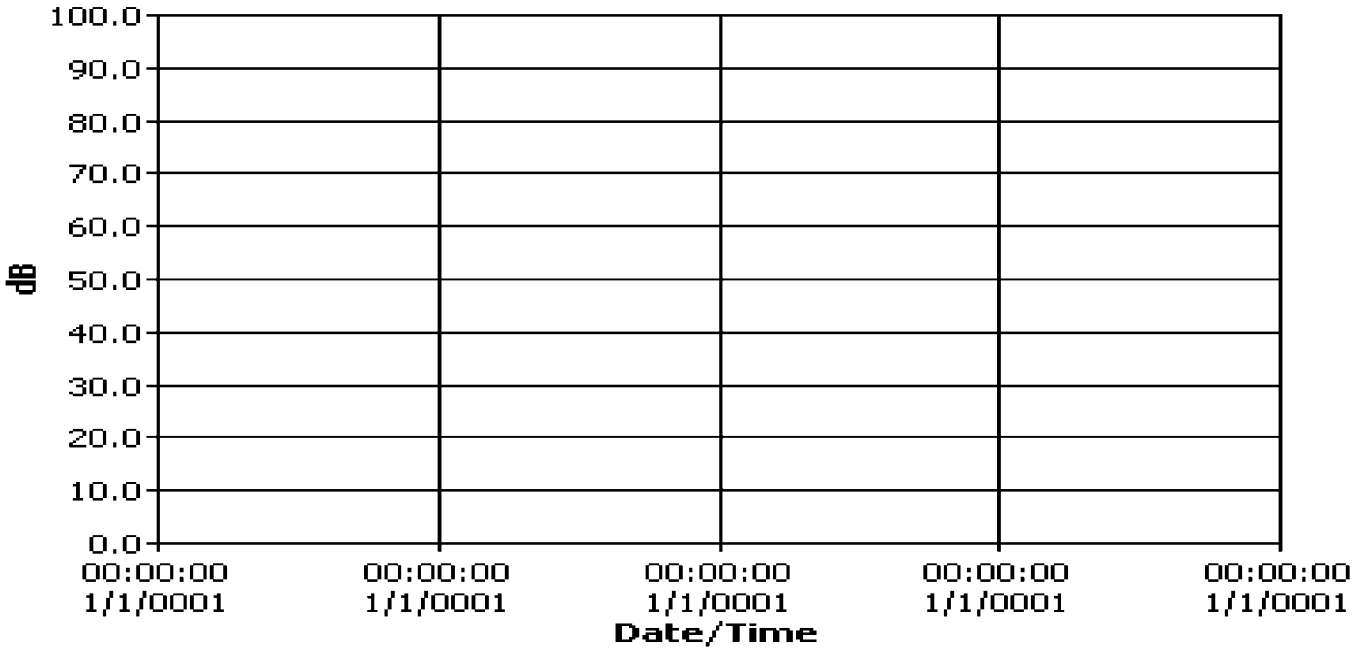
Study 1
Information Panel

Name	Study 1
Comments	
Start Time	Monday, December 16, 2013 11:43:41
Stop Time	Tuesday, December 17, 2013 11:28:53

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.4 %
Lavg	1	61.5 dB			

Logged Data Chart



Study 2
Information Panel

Name	Study 2
Comments	
Start Time	Tuesday, December 17, 2013 11:29:30
Stop Time	Wednesday, December 18, 2013 11:06:54

General Data Panel

Description	Meter	Value	Description	Meter	Value
Exchange Rate	1	3 dB	Response	1	SLOW
Weighting	1	A	Dose	1	0.4 %
Lavg	1	60.8 dB			

Logged Data Chart