Before the
Pennsylvania Public Utility Commission

SCHOENECK #1 & #2 138/69 kV TAP LINE

Exhibits and Appendices in Support of the Letter of Notification

Application Docket No. ____________

Submitted by: PPL Electric Utilities Corp.

SUMMARY

This filing is submitted by PPL Electric Utilities Corporation (PPL Electric) pursuant to the Pennsylvania Public Utility Commission's (PUC) regulations at 52 Pa. Code §§ 57.71 through 57.77 for PUC approval to site and construct the Schoeneck #1 and #2 138/69 kV Transmission Tap Line. The proposed project is located in Lower Macungie Township, Lehigh County.

The proposed tap line will provide the source of electrical supply to the new Schoeneck 69 – 12 kV Substation. The substation and associated 12 kV distribution facilities are required to meet the increasing demand for electricity and improve the reliability of service in the southwestern section of Lehigh County.

The estimated cost to design and construct the proposed 138/69 kV tap line is $412,400. Due to difficulties in finding a suitable site for the substation, the required in-service date for this project will not be met. Project construction will begin as soon as possible after Commission approval to minimize the potential exposure of an unplanned interruption of electrical service.

This document, which describes the need for the project and discusses the engineering and siting analysis for the proposed construction, consists of the following exhibits and appendices:

PPL ELECTRIC UTILITIES SERVICE TERRITORY

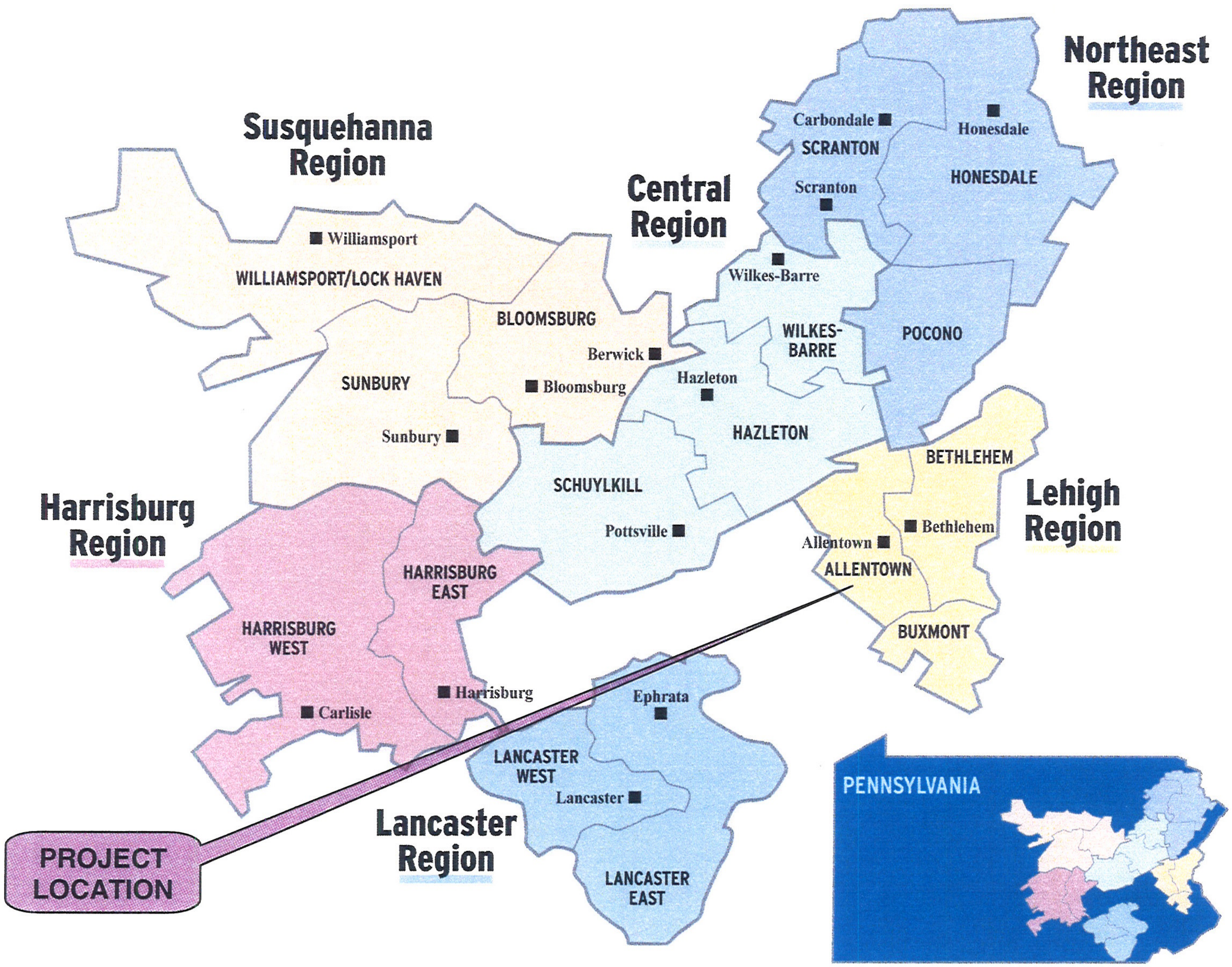

EXHIBIT A

EXHIBIT "A"

SCHOENECK #1 & #2 138/69 kV TAP LINE

NECESSITY STATEMENT

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EXHIBIT "A"

SCHOENECK #1 & #2 138/69 kV TAP LINE

NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to install a double-circuit 138/69 kV transmission tap line. The proposed Schoeneck #1 & #2 138/69 kV Tap Line will extend approximately 1700 feet from the Victaulic 138/69 kV Tap to the new PPL Electric-owned Schoeneck 69 - 12 kV Substation. The proposed tap line will be designed and constructed to operate as a double-circuit 138 kV line although initially, it will operate as a single-circuit 69 kV tap line until future load increases make it appropriate for the installation of the second circuit and the system to be operated at 138 kV. The proposed facilities are required to serve the projected load increases in the area due to residential growth as well as increased demand at Lower Macungie Industrial Park.

The estimated cost to design and construct the proposed tap line is approximately $412,400. The required in-service date for this project is May 2010. The required in-service date is defined as the date the proposed facility needs to be placed in service to prevent overloading existing facilities that could potentially damage equipment and result in interruption of service to customers. Due to difficulties in finding a suitable site for the substation, the required in-service date for this project will not be met. Project construction will begin as soon as possible after Commission approval to minimize the potential exposure of an unplanned interruption of electrical service.

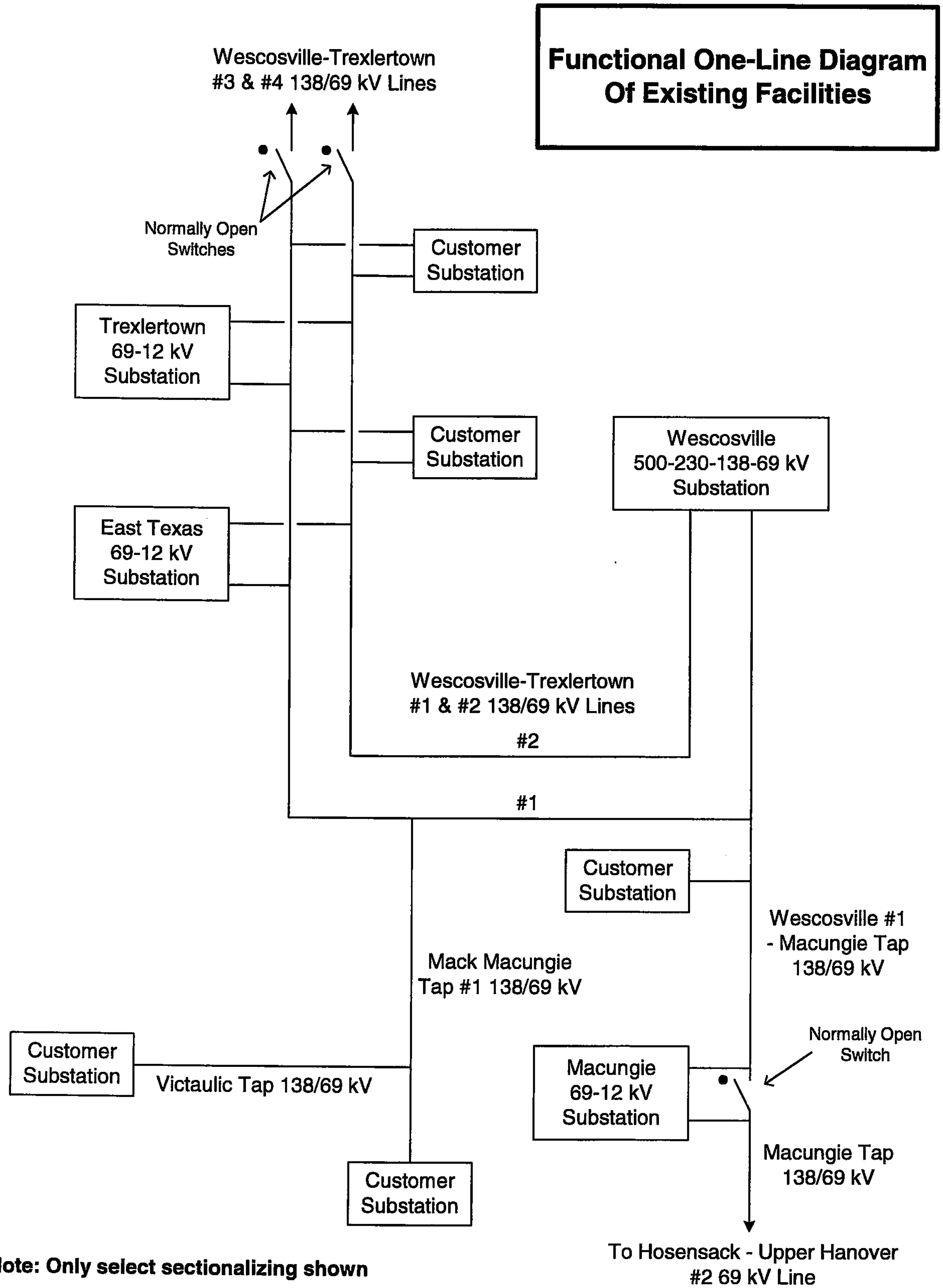
A PPL Electric system map showing existing transmission facilities with a design voltage of 35 kV or greater is included in the Exhibit "A" map pocket. This filing addresses only the existing and proposed 138/69 kV system in the Lower Macungie area.

Schoeneck #1 & #2 138/69 kV Tap Line. PPL Electric will own, operate and maintain the new Schoeneck 69 – 12 kV Substation and the Schoeneck 138/69 kV Tap Line. The new Schoeneck 69 - 12 kV Substation will relieve the loading on the Trexlertown 69 - 12 kV Substation and the Macungie 27-4 12 kV Line. Transfer of a portion of the existing load to the new Schoeneck Substation and Tap Line will also improve the reliability and operating flexibility in the area.

The total estimated cost of this project is approximately $2.7 million, which includes $2.0 million for the new substation, $0.4 million for the transmission, and $0.3 million for distribution work.

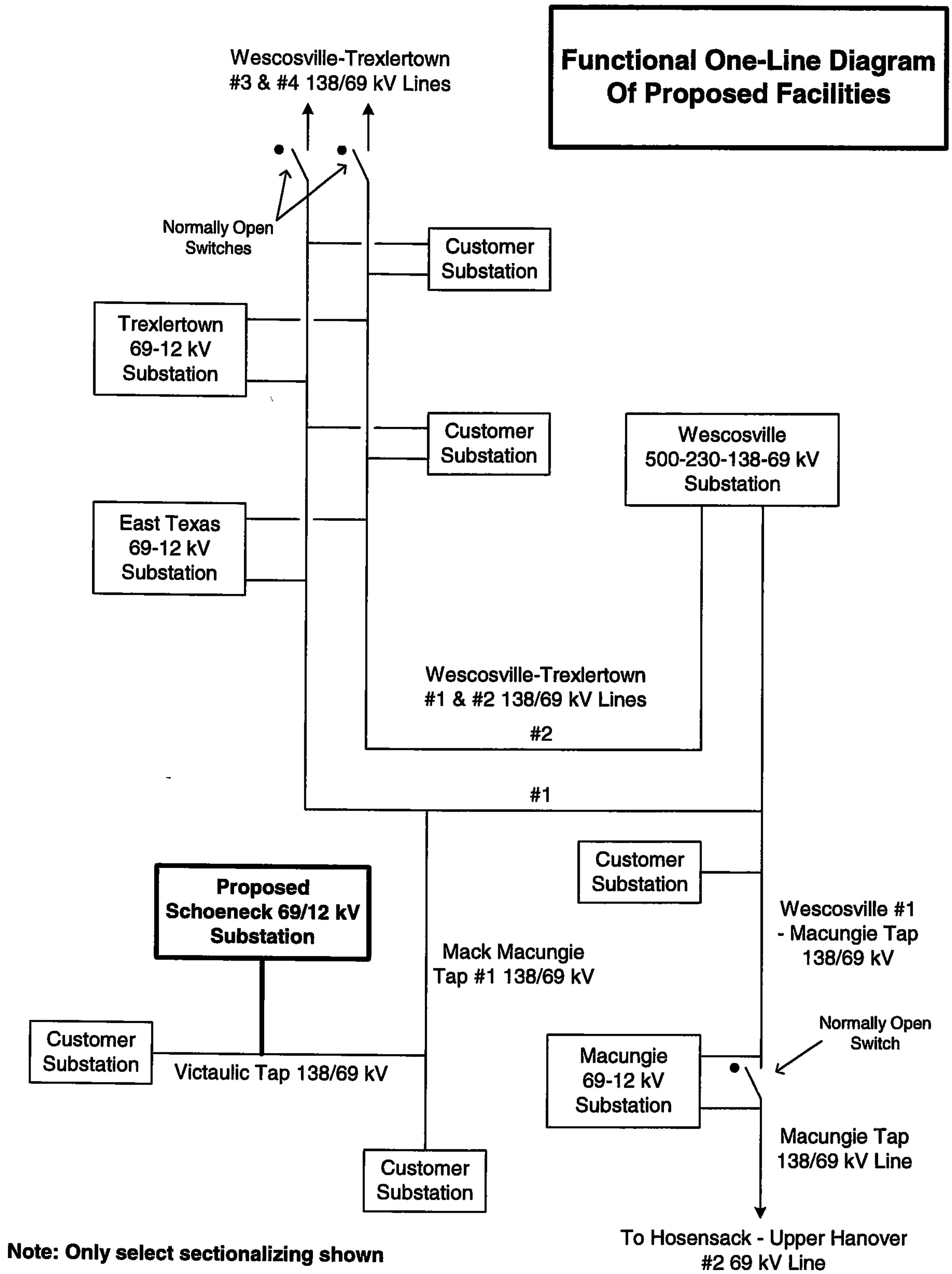
E. <u>FUNCTIONAL ALTERNATIVE</u>

An alternative to building the new substation and transmission line would be to increase the transformer capacity at PPL Electric's existing Trexlertown Substation, and build two new lines and terminals; one at Trexlertown Substation and one at Macungie Substation. At an estimated cost of $3.0 million, this alternative is more expensive to implement. PPL Electric rejected this alternative because the preferred alternative described in Section D above, provides sufficient additional capacity at a lower cost. The preferred alternative also offers additional reliability benefits, and increases operational flexibility.



Note: Only select sectionalizing shown

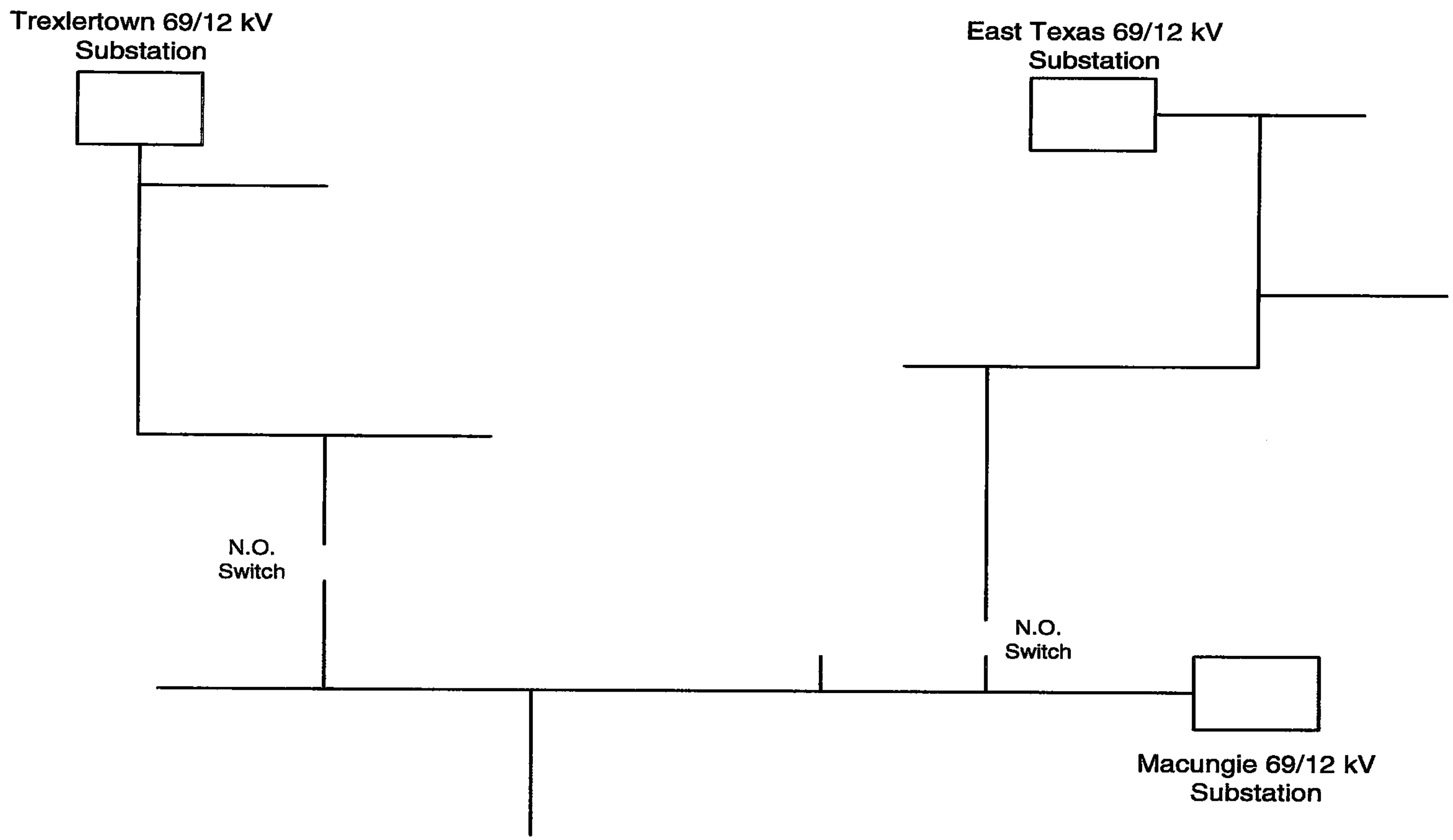
FIGURE 1



Functional One-Line Diagram Of Proposed Facilities
Wescosville-Trexlertown #3 & #4 138/69 kV Lines
Normally Open Switches
Customer Substation
Trexlertown 69-12 kV Substation
Customer Substation
Wescosville 500-230-138-69 kV Substation
East Texas 69-12 kV Substation
Wescosville-Trexlertown #1 & #2 138/69 kV Lines
#2
#1
Customer Substation
Proposed Schoeneck 69/12 kV Substation
Wescosville #1 - Macungie Tap 138/69 kV
Mack Macungie Tap #1 138/69 kV
Normally Open Switch
Customer Substation
Victaulic Tap 138/69 kV
Macungie 69-12 kV Substation
Macungie Tap 138/69 kV Line
Customer Substation
To Hosensack - Upper Hanover #2 69 kV Line
Note: Only select sectionalizing shown

FIGURE 2

Functional One-Line Diagram Of Existing Distribution Facilities



Note: Only select sectionalizing shown

FIGURE 3

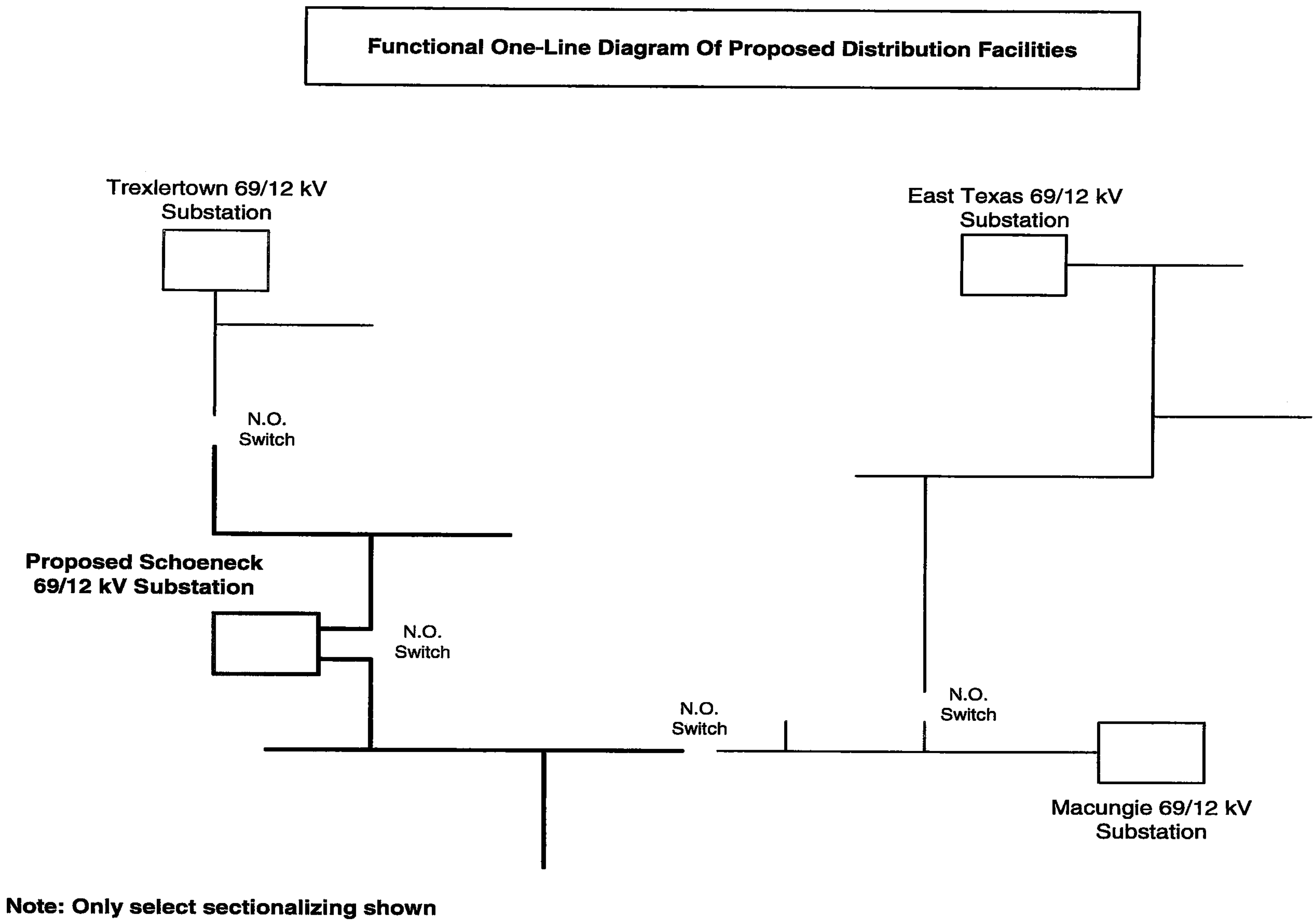

Functional One-Line Diagram Of Proposed Distribution Facilities
Trexlertown 69/12 kV Substation
East Texas 69/12 kV Substation
N.O. Switch
Proposed Schoeneck 69/12 kV Substation
N.O. Switch
N.O. Switch
N.O. Switch
Macungie 69/12 kV Substation
Note: Only select sectionalizing shown

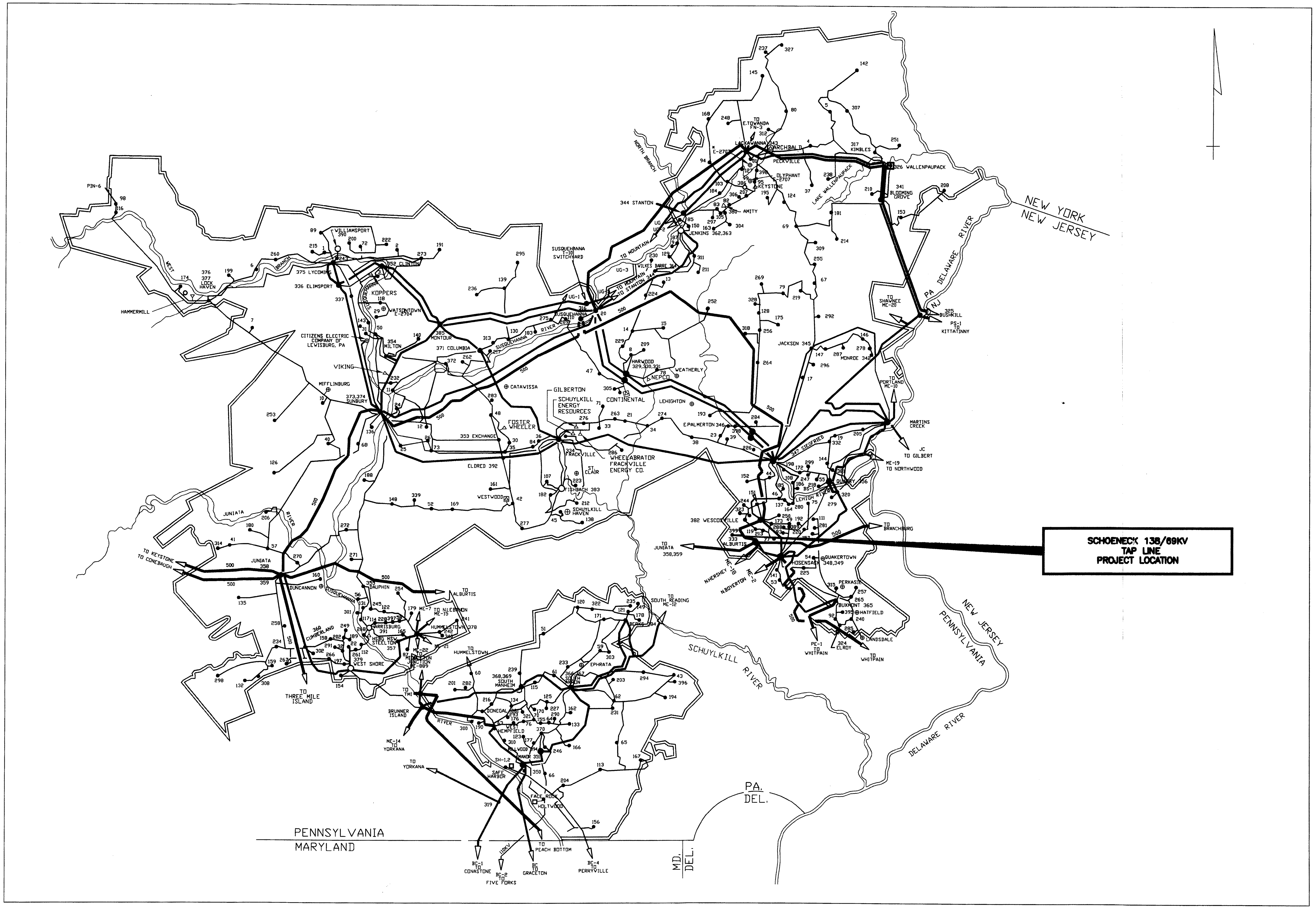
FIGURE 4

THIS DRAWING IS THE PROPERTY OF PPL ELECTRIC UTILITIES AND CONTAINS PROPRIETARY AND CONFIDENTIAL INFORMATION WHICH MAY NOT BE DUPLICATED, USED OR DISCLOSED WITHOUT WRITTEN AUTHORIZATION FROM PPL ELECTRIC UTILITIES.

SUBSTATION LISTING

1 WEST WILLIAMSPORT
2 FAIRFIELD
3 MONTGOMERY
4 VARDEN
5 HONESDALE
6 JERSEY SHORE
7 LOGANTON
8 VALMONT
9 RIVER
10 LIMESTONE
11 NORTHUMBERLAND
12 REED
13 WRIGHT
14 ST.JOHNS
15 FREELAND
16 *
17 GILBERT
18 *
19 CHERRY HILL
20 SUSQUEHANNA 230KV
21 TAMANEND
22 WHITE HILL
23 PALMERTON
24 HAMILTON
25 HUNTER
26 FAIRVIEW
27 *
28 *
29 MONTOUR PUMP
30 MT. CARMEL
31 KELLY
32 SPORTING HILL
33 MAHANOY CITY
34 GREENWOOD
35 MOWRY
36 ALTAMOUNT
37 HAMLIN
38 ASHFIELD
39 SOUTH SLATINGTON
40 SOUTH MIDDLEBURG
41 WALKER
42 FRAILEY
43 MORGANTOWN
44 EGYPT
45 CRESSONA
46 SOUTH WHITEHALL
47 EAST TOMHICKEN
48 BEAR GAP
49 SALISBURY
50 SOUTH MILTON
51 HEIDELBERG
52 LYKENS
53 UPPER HANOVER
54 RICHLAND
55 MACADA
56 ROCKVILLE
57 THOMPSONTOWN
58 PAXTON
59 COCALICO
60 EAST ELIZABETHTOWN
61 WARWICK
62 EARL
63 HEMPFIELD
64 EAST LANCASTER
65 KINZER
66 MT. NEBO
67 MT. POCONO
68 PENNS
69 GOULDSBORO
70 DILLERVILLE
71 GIRARD MANOR
72 KENMAR
73 GOWEN CITY
74 *
75 ELLIOT HEIGHTS
76 ROHRERSTOWN
77 MACUNGIE
78 EAST HAZLETON
79 WAGNERS
80 EAST CARBONDALE
81 EYNON
82 MINOOKA
83 OLD FORGE
84 FOUNTAIN SPRINGS
85 SULLIVAN TRAIL
86 *
87 SWATARA
88 *
89 HEPBURN
90 *
91 *
92 FRANCONIA
93 EMMAUS
94 MORGAN
95 THROOP
96 *
97 *
98 CHAPMAN
99 SUBURBAN
100 *
101 *
102 *
103 PROVIDENCE
104 *
105 AVOCA
106 *
107 CASS
108 CATASAQUA
109 *
110 SUSQUEHANNA 500KV
111 SEIDERSVILLE
112 ROSEMONT
113 QUARRYVILLE
114 LAWNTON
115 LITITZ
116 RENOVO
117 WALNUT
118 WATSON
119 TREXLERTOWN
120 LAVINO
121 SPRING
122 COLONIAL PARK
123 WEST LANCASTER
124 MADISONVILLE
125 NEFFSVILLE
126 BEAVERTOWN
127 BELMONT
128 LAKE HARMONY
129 GEORGETOWN
130 SCOTT
131 N. HARRISBURG
132 MOUNT ROCK
133 GREENLAND
134 LANDISVILLE
135 GREEN PARK
136 SELINSGROVE
137 SUMNER
138 AUBURN
139 ROHRSBURG
140 DERRY
141 EAST GREENVILLE
142 WEST DAMASCUS
143 NEW COLUMBIA
144 FARMERSVILLE
145 GREENFIELD
146 NORTH STROUDSBURG
147 TANNERSVILLE
148 ELIZABETHVILLE
149 WYOMISSING
150 EXETER
151 CRACKERSPORT
152 SCHNECKSVILLE
153 HEMLOCK
154 MT. ALLEN
155 PRINCE
156 WAKEFIELD
157 COOPERSBURG
158 WERTZVILLE
159 WEST CARLISLE
160 BENVENUE
161 HEGINS
162 LEOLA
163 YATESVILLE
164 CENTRAL ALLENTOWN
165 OBERLIN
166 STRASBURG
167 ATGLEN
168 BROOKSIDE
169 WILLIAMSTOWN
170 E. PETERSBURG
171 WERNERSVILLE
172 N. BETHLEHEM
173 W. ALLENTOWN
174 FLEMINGTON
175 MECKESVILLE
176 DONERVILLE
177 MILLERSVILLE
178 SHILLINGTON
179 DUKE
180 MCALLISTERVILLE
181 NEWFOUNDLAND
182 MARLIN
183 WEST BERWICK
184 KEYSER AVENUE
185 MICKLEYS
186 EAST ALLENTOWN
187 PINE RIDGE
188 DALMATIA
189 PENNSBORO
190 NORTH COLUMBIA
191 HUGHESVILLE
192 SOUTH ALLENTOWN
193 WEISSPORT
194 HONEYBROOK
195 MOSCOW
196 *
197 ROSSMOYNE
198 NORTHAMPTON
199 WOOLRICH
200 FAXON
201 ELIZABETHTOWN
202 ENOLA
203 TERRE HILL
204 BUCK
205 MT. BETHEL
206 RICHFIELD
207 SCRANTON
208 TWIN LAKES
209 HARLEIGH
210 TAFTON
211 BEAR CREEK
212 ORWIGSBURG
213 EAST TEXAS
214 CANDENSIS
215 LINDEN
216 MT. JOY
217 WEST BLOOMSBURG
218 MINSI TRAIL
219 LAKE NAOMI
220 LANARK
221 *
222 MONTOURSVILLE
223 PORT CARBON
224 BLYTHEBURN
225 MILFORD
226 TREICHLERS
227 ROSEVILLE
228 RUTHERFORD
229 HARTLAND
230 PARRISH
231 WEST NEW HOLLAND
232 POINT
233 LINCOLN
234 MIDDLETON
235 STATE HILL
236 MILLVILLE
237 TINKER
238 LAKEVILLE
239 NORTH MANHEIM
240 HATFIELD
241 HERSHEY
242 S. HERSHEY
243 S. WILLIAMSPORT
244 FOGELSVILLE
245 WINDSOR
246 W. WILLOW
247 WESTGATE
248 EDELLA
249 SUMMERDALE
250 DORNEYVILLE
251 BOHEMIA
252 WHITE HAVEN
253 LAURELTON
254 LINGLESTOWN
255 POCONO FARMS
256 HICKORY RUN
257 BLOOMING GLEN
258 SHERMANSDALE
259 *
260 LARRYS CREEK
261 SPANGLER MILLS
262 E. DANVILLE
263 DELANO
264 CARBON
265 SELLERSVILLE
266 MECHANICSBURG
267 CARLISLE
268 CEDAR
269 ARROWHEAD
270 NEWPORT
271 HALIFAX
272 MILLERSBURG
273 MUNCY
274 HAUTO
275 BERWICK
276 SHENANDOAH
277 PINE GROVE
278 STROUDSBURG
279 FREEMANSBURG
280 ALLENTOWN
281 BINGEN
282 RHEEMS
283 CLEVELAND
284 LITTLE GAP
285 ORVILLA
286 TUSCARORA
287 BARTONSVILLE
288 ALTON PARK
289 SALEM
290 NORTH BRIDGEPORT
291 HAMPDEN
292 CAMELBACK
293 SILVER SPRING
294 BRECKNOCK
295 BENTON
296 MCMICHAELS
297 HUGHESTOWN
298 NEWVILLE
299 POINTE NORTH
300 MARIETTA
301 CENTER CITY
302 NEW KINGSTOWN
303 REAMSTOWN
304 DUPONT
305 HUMBOLDT
306 CEDAR AVE.
307 INDIAN ORCHARD
308 NOTTINGHAM
309 NORTH COOLBAUGH
310 LETORT
311 EAST MOUNTAIN
312 JERMYN
313 BLOOMSBURG
314 MIFFLINTOWN
315 RIDGE ROAD
316 SUSQUEHANNA T-10 SW. YD.
317 KIMBLES
318 CHRISTMANS
319 OTTER CREEK
320 STEEL CITY
321 McGOVERNVILLE
322 ROBESONIA
323 SFOGELSVILLE
324 ELROY
325 BUSHKILL
326 WALLENPAUPACK
327 ELK MOUNTAIN
328 JACK FROST
329 HARWOOD 230/69KV
330 HARWOOD CTG
331 HARWOOD 69/12KV
332 NAZARETH
333 ALBURTIS
334 FRACKVILLE
335 *
336 ELIMSPORT
337 ALLENWOOD
338 *
339 GRATZ
340 HOCKERSVILLE
341 BLOOMING GROVE
342 MONROE
343 LACKAWANNA ##
344 STANTON
345 JACKSON
346 EAST PALMERTON
347 SIEGFRIED
348 HOSENSACK 230/69KV
349 HOSENSACK 500KV
350 CONESTOGA
351 MANOR
352 CLINTON
353 EXCHANGE
354 MILTON
355 DAUPHIN
356 QUARRY SUB.
357 STEELTON
358 JUNIATA 500/230KV
359 JUNIATA 230/69KV
360 CUMBERLAND
361 DONEGAL
362 JENKINS 230/69KV
363 JENKINS CTG
364 WILKES-BARRE
365 BUXMONT
366 SOUTH AKRON 230/138/69KV
367 SOUTH AKRON 69/12KV
368 SOUTH MANHEIM 69/12KV
369 SOUTH MANHEIM 230/69KV
370 ENGLESIDE
371 COLUMBIA
372 DANVILLE
373 SUNBURY
374 HUMMELS WHARF
375 LYCOMING
376 LOCK HAVEN CTG
377 LOCK HAVEN 69/12KV
378 HUMMELSTOWN
379 WEST SHORE
380 MONTAGE
381 SOUTH FARMERSVILLE
382 WESCOSVILLE
383 FISHBACH
384 BERKS
385 MONTOUR
386 SUBURBAN YARD
387 *
388 *
389 MACK
390 WILLIAMSPORT
391 HARRISBURG
392 ELDRED
393 *
394 MILLWOOD
395 TELFORD
396 TWIN VALLEY
397 DEVONSHIRE
398 JESSUP
399 BELTZVILLE
399 SCHOENECK

* - SUBSTATIONS THAT HAVE BEEN RETIRED.
\## - SITE OF THE EXISTING 230KV SUBSTATION AND PROPOSED 500KV SUBSTATION



INTERCONNECTIONS

PS PUBLIC SERVICE ELECTRIC AND GAS CO. OF N.J.
ME METROPOLITAN EDISON CO. (FIRST ENERGY)
PE PHILADELPHIA ELECTRIC CO. (PECO ENERGY)
BC BALTIMORE GAS AND ELECTRIC CO.
SH SAFE HARBOR WATER POWER CORPORATION
UP THE UNITED GAS IMPROVEMENT CO. - LUZERNE ELECTRIC DIVISION
PN PENNSYLVANIA ELECTRIC CO. (FIRST ENERGY)
JC JERSEY CENTRAL POWER AND LIGHT CO. (FIRST ENERGY)

COMBUSTION TURBINE
HYDRO ELECTRIC
COMBINATION
FIRM SALES
SUBSTATION /SWITCHING STATION
STEAM ELECTRIC
NON-UTILITY GENERATION
INDEPENDENT POWER PRODUCERS

500KV OPERATION
230KV OPERATION
138KV OPERATION
69KV OPERATION

NO.	DATE	ACCT.		BY	REVIEWED	APPROVED
52	2/20/09	0012375	ADDED FIRST QUALITY NONWOVENS 138/69KV TAP LINE	RRC		NHJ
51	2/17/09	389358	ADDED BELTZVILLE 138KV TAP LINE.	RRC		NHJ
50	02/12/09	389346	ADDED JESSUP 138/69KV TAP LINE	RRC		NHJ
53	2/25/09	389349	SCHOENECK 138/69KV TAP LINE	RRC		KBK

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER

ACCT- 805201
SCALE- NONE
BY- CDW
REVIEWED

ELECTRICAL SYSTEM MAP
SCHOENECK 138/69KV TAP LINE

APPROVED G. HAKUN III — DATE 7/17/85 — PPL ELECTRIC UTILITIES

PPL DRAWING NO. D191830 — SHEET NO. 1 — REV. 53

#6000 — LOCATION CODES — PLAN & PROFILE NO. — TRANSMISSION MAP NO.

D191830_S001.DWG

PPL EU FORM 4877 (7/01)

FRACTIONAL — DECIMAL

EXHIBIT B

EXHIBIT "B"
SCHOENECK #1 & #2 138/69 kV TAP LINE
ENGINEERING DESCRIPTION

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MAP

EXHIBIT "B"

SCHOENECK #1 & #2 138/69 kV TAP LINE

ENGINEERING DESCRIPTION

A. DESCRIPTION OF PROPOSED LINE DESIGN

PPL Electric proposes to construct a new approximately 1,700 foot long, double-circuit 138/69 kV Tap from the existing Victaulic 138/69 kV Tap to the new Schoeneck 69 – 12 kV Substation. The proposed tap line will be designed and constructed to operate as a double-circuit 138 kV line although initially, it will operate as a single-circuit 69 kV tap line until future load increases make it appropriate for the installation of the second circuit and the system to be operated at 138 kV. The proposed line will be located in Lower Macungie Township, Lehigh County. Refer to the aerial location map in the Exhibit "B" map pocket.

The proposed line will consist of approximately five single-shaft steel poles. The poles will average approximately 90 feet tall. The tap pole will be guyed and the angle structures will be installed on concrete foundations. Tangent structures will be direct-embedded. The proposed structures are shown in Figures 1 and 2 at the end of Exhibit "B". Initially, three power conductors (single circuit) and one overhead ground wire will be installed. The conductors will be 556.5 kcmil 24/7 stranding ACSR. A 3/8-inch diameter high strength steel overhead ground wire will be installed for lightning protection.

The proposed line will be designed to, and generally exceed, National Electrical Safety Code standards. Design specifications and safety rules practiced by PPL Electric are included in Appendix A. The minimum conductor to ground clearance for the proposed line will be 32 feet which occurs at a maximum conductor temperature of 125°C. The designed minimum conductor clearances and conductor thermal ratings are as follow:

TABLE 1
DESIGN MINIMUM CONDUCTOR CLEARANCES
FOR 556.5 KCMIL 24/7 STRANDING ACSR*
SCHOENECK #1 & #2 138/69 kV TAP LINE

Condition	Transmission Double-Circuit Design Clearance-to-Rail	Transmission Double-Circuit Design Clearance-to-Ground
Normal load average weather (16°C ambient temperature)	47.5 feet	40.2 feet
Predicted extreme thermal load (125°C conductor temperature)	45.0 feet	33.6 feet
Predicted extreme weather conditions (1 inch ice, 4 lb. Wind, -18°C)	46.0 feet	39.0 feet

*Clearances based on a maximum tension of 9,900 pounds and a ruling span of 700 feet.

CONDUCTOR THERMAL RATING
556.5 KCMIL 24/7 STRANDING ACSR
125°C MAXIMUM CONDUCTOR TEMPERATURE

Condition	Ambient Temperature °C	Wind Speed Knots	Ampacity Amps
Summer Normal	35	0	799
Winter Normal	10	0	922
Summer Emergency	35	1-1/2	1045
Winter Emergency	10	1-1/2	1178

B. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program is summarized in Appendix B and applied to reconstruction and new line projects. In order to lower magnetic field exposures, the program generally prescribes the use of line design that provides 5 feet higher ground clearances and reverse phasing new double-circuit lines where it is feasible to do so at low or no cost. The implementation of additional modifications will be considered, provided those modifications can be made at low or no cost.

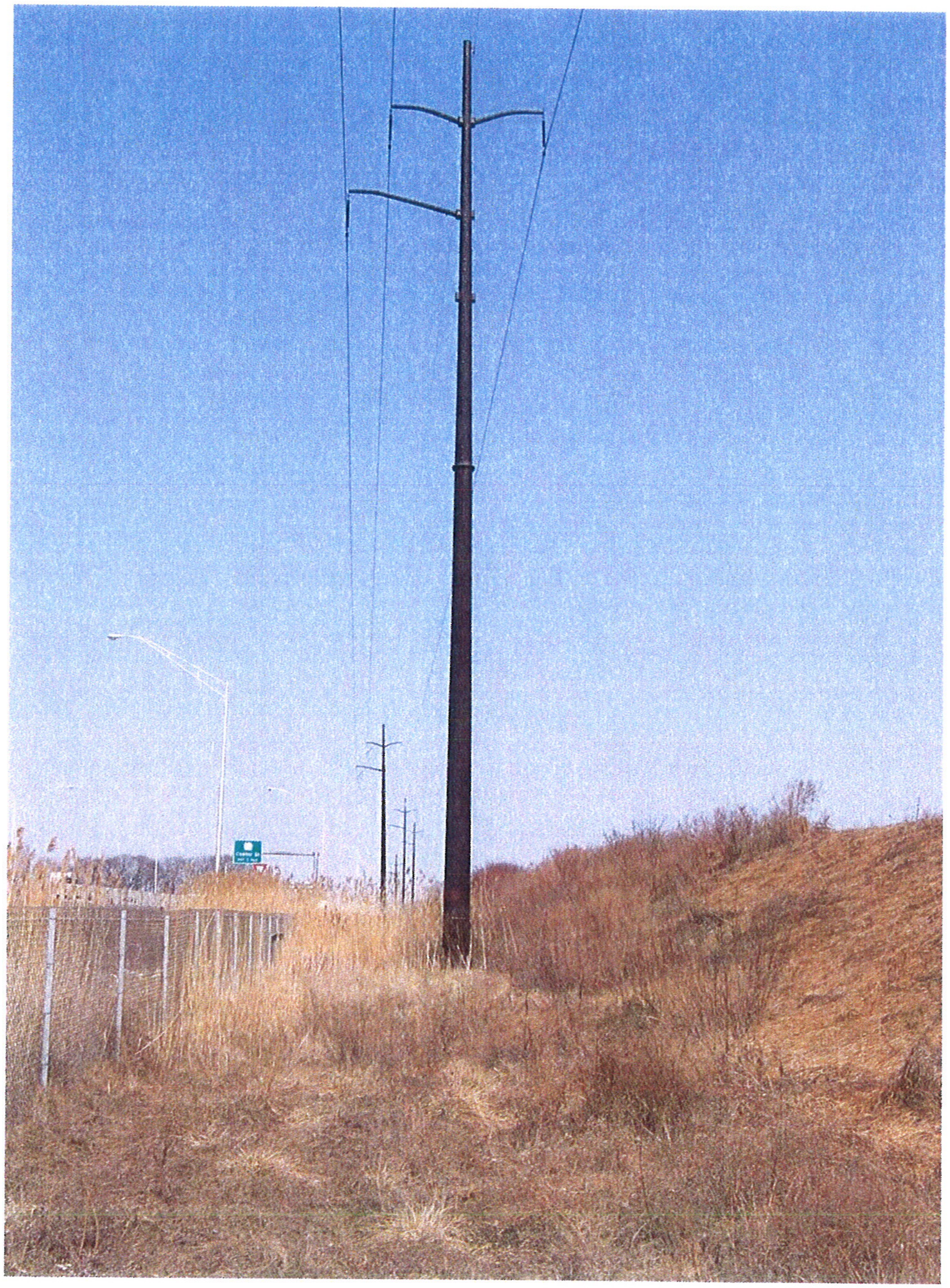
For this project, reverse phasing cannot be utilized to reduce magnetic field levels because initially, only one circuit is being installed. PPL Electric will evaluate reverse phasing when the second circuit is added in the future. However, some reduction of the magnetic field will be achieved through the use of taller poles.

C. RIGHT-OF-WAY STATUS

Right-of-way for the proposed tap is required from three property owners. To date, agreements have been secured from two property owners. PPL Electric continues to negotiate with the remaining property owner and anticipates reaching an agreement in the near future. The Aerial Exhibit at the end of Exhibit "C" shows existing property lines and current ownership along the right-of-way. Appendix "C" identifies the property owners within the proposed right-of-way.

FIGURE 1

PROPOSED 138/69 kV TANGENT STRUCTURE



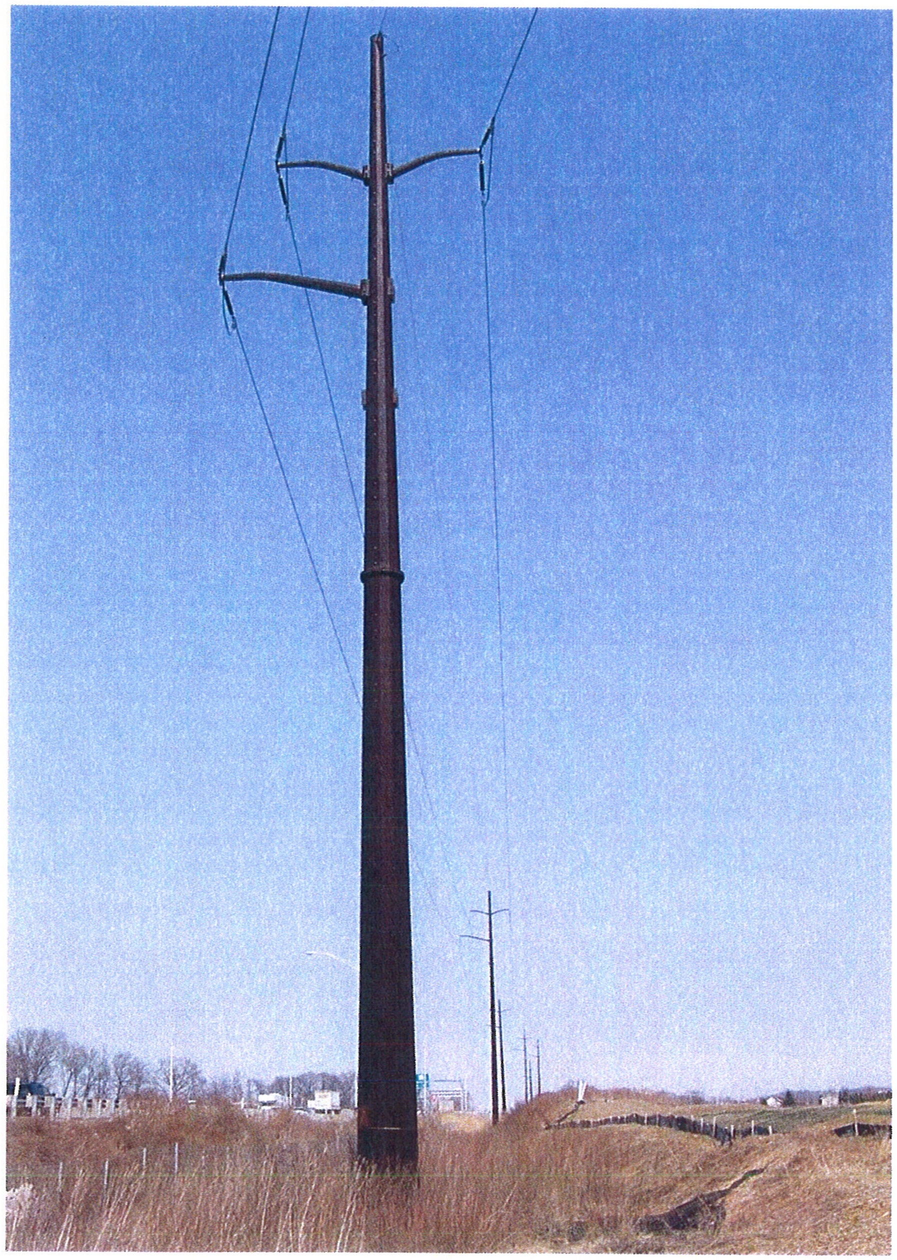
Average Height – 90 Feet

Length of Top Arms – 7 Feet

Length of Lower Arm – 11 Feet

FIGURE 2

PROPOSED 138/69 kV ANGLE STRUCTURE



Average Height – 90 Feet

Length of Top Arms – 7 Feet

Length of Lower Arm – 11 Feet

PROPERTY OWNERS

1. HEADLANDS REALTY CORP.
2. ALEX G. TAMERLER
3. NORFOLK SOUTHERN RAILWAY COMPANY
4. ALTHEA M. WALBERT
5. PPL ELECTRIC CORP.

PPL ELECTRIC UTILITIES

ACCT- 10012611
SCALE- 1"=300'
BY- RWM

SCHOENECK #1 & #2 138/69KV TAP
AERIAL EXHIBIT

REVIEWED

LOWER MACUNGIE TWP. LEHIGH CO., PA.

APPROVED Kenneth B. Kuhns DATE 9/18/09 PPL ELECTRIC UTILITIES

PPL DRAWING NO. EXHIBIT SHEET NO. 1 REV. 0

REFERENCE TITLE	NUMBER	NO	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED

EXHIBIT C

EXHIBIT "C"

SCHOENECK #1 & #2 138/69 kV TAP LINE

ENVIRONMENTAL ASSESSMENT

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EXHIBIT "C"
SCHOENECK #1 & #2 138/69 kV TAP LINE
ENVIRONMENTAL ASSESSMENT

A. INTRODUCTION

PPL Electric is requesting PUC approval to site and construct a double-circuit 138/69 kV transmission tap line. The proposed line is approximately 1,700 feet long and involves the installation of approximately five single-shaft steel poles. The tap line will be designed for ultimate double-circuit 138 kV operation although initially, only one circuit will be installed and it will be operated at 69 kV.

The proposed project was reviewed with representatives of Lower Macungie Township and Lehigh County, and neither the Township nor the County has any objection. A list of involved governmental agencies, municipalities and other public entities is presented in Appendix C.

B. LAND USE

The proposed tap line is located along Quarry Road just north of Alburtis Borough. A new, partially occupied distribution center is found on the east side of Quarry Road. Across the road from the distribution center is a myTableware.com authorized retailer. A Victaulic facility is to the south of myTableware.com. The Lower Macungie Township Community Park is located approximately 500 feet northeast of the northern terminus of the proposed tap. Due to the industrial development in the area, visual impacts to the park will be minimal.

No communication towers, pipelines or other utilities will be affected by the proposed project. A nearby railroad is easily spanned by the proposed line and will not be impacted. Queen City Airport is approximately 6.4 miles from the project area. PPL Electric will file the appropriate documentation with both the Federal Aviation Administration and the PennDOT Bureau of Aviation to ensure the proposed tap line will not be a hazard to the airport's flight operations.

C. CULTURAL RESOURCES

This project was reviewed with the Pennsylvania Historical and Museum Commission (PHMC). PHMC has determined that, based upon their survey files which include both archaeological sites and standing structures, there are no National Register eligible or listed historic or archaeological properties in the area of this proposed project and therefore, no further archaeological investigations are required (File No. ER 2009-1026-077-A).

D. NATURAL FEATURES

The proposed tap line will not affect any unique geological, scenic, or natural areas. No National Natural Landmarks, parks, or recreational facilities are located near the project area. Tree clearing will be minimal and PPL Electric will apply its "Specification for Initial Clearing and Control of Vegetation On or Adjacent to Electric Line Right-of-Way Through Use of Herbicides, Mechanical and Hand Clearing Techniques" to mitigate any impacts. The proposed tap line will not cross any wetlands or other aquatic resources. As required, PPL Electric will acquire and adhere to the terms and conditions of any required soil erosion and sedimentation control plans as appropriate.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric has coordinated with different state and federal agencies to obtain information regarding endangered and threatened plant and animal habitat in close proximity to the project area. Both the Pennsylvania Fish and Boat Commission and the U. S. Fish and Wildlife Service note the potential presence of the bog turtle (*Glyptemys muhlenbergii*, state endangered, federally listed threatened) in the area of the proposed project. PPL Electric retained the services of recognized wetland and bog turtle experts to investigate further.

A review of the substation site and the transmission line route note the absence of wetlands in or near the project area. Because the bog turtle inhabits wetlands with specific characteristics, a lack of wetlands indicates that no bog turtles exist in the project area. PPL Electric will file the proper reports to clear this conflict with both agencies prior to the start of construction.

Appendices

LIST OF APPENDICES

APPENDIX A

PPL DESIGN CRITERIA AND SAFETY PRACTICES

The National Electrical Safety Code (NESC) is a set of rules to safeguard people during the installation, operation, and maintenance of electric power lines. The NESC contains the basic provisions considered necessary for the safety of employees and the public. Although it is not intended as a design specification, its provisions establish minimum design requirements. PPL Electric Utilities Corp. (PPL) has developed design specifications and safety rules which meet or surpass all requirements specified by the NESC.

Engineering Design Criteria and Parameters

The NESC includes loading requirements and clearances for the design, construction, and operation of power lines. The "loads" on conductors and supporting structures are the mechanical forces that develop from the weight of the conductors, the weight of ice on the conductors, plus wind pressure on the conductors and supporting structures. Loading requirements are the loads on the conductors and structures that are anticipated assuming certain ice and wind conditions. Loading requirements always contain "safety factors" to allow for unknown or unanticipated contingencies. The clearances and loading requirements contained in the NESC were developed to ensure public safety and welfare.

PPL transmission line design standards meet or surpass the NESC standards. For example, the relative order of grades of construction for conductors and supporting structures is B, C, and N; Grade B being the highest. According to the NESC standards, construction Grades B, C, or N may be used for transmission lines (except at crossings of railroad tracks and limited access highways where Grade B construction is specified). However, PPL designs all of its transmission lines for Grade B construction. The use of Grade B design and construction specifies enhancements such as larger-minimum crossarm dimensions, larger-minimum conductor size, and increased safety factors.

Another example is the design parameters utilized to account for ice and wind loadings on the overhead ground wire (OHGW) and power conductors. The NESC standard ice and wind design magnitudes for the PPL territory are 0.5 inch thickness of radial ice combined with four pounds per square foot horizontal wind pressure (equivalent to 40-mile per hour wind velocity). The conductor sags and tensions used in line designs are the result of various ice and wind combinations, depending on the elevation at the line location and line design voltage. The conductor sags and tensions used in the design of all PPL transmission lines are at least 0.5-inch ice combined with eight pounds wind pressure (equivalent to 57 miles per hour wind velocity). This means that PPL lines are designed to operate safely and reliably during inclement weather even more severe than assumed by the NESC. In addition, PPL transmission lines are designed with more clearance to the ground than required by the NESC. The tables below compare PPL and NESC ground clearances for lines of various voltages.

138 kV

Surface Underneath Conductors	Vertical Clearance to Ground	
	NESC Standard	PPL Design
Roads, streets, alleys	21 Ft.	30 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	21 Ft.	30 Ft.
Spaces accessible to pedestrians only	17 Ft.	30 Ft.
Railroad tracks	31 Ft.	35 Ft.

230 kV

Surface Underneath Conductors	Vertical Clearance to Ground NESC Standard	PPL Design
Roads, streets, alleys	23 Ft.	32 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	23 Ft.	32 Ft.
Spaces accessible to pedestrians only	19 Ft.	32 Ft.
Railroad tracks	31 Ft.	36 Ft.

500 kV

Surface Underneath Conductors	Vertical Clearance to Ground NESC Standard	PPL Design
Roads, streets, alleys	28 Ft.	53 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	28 Ft.	53 Ft.
Spaces accessible to pedestrians only	24 Ft.	53 Ft.
Railroad tracks	38 Ft.	53 Ft.

A relay protection system is used to protect the public safety and welfare as well as equipment and the transmission system. Relay protection is installed for all transmission lines to automatically de-energize the line in the unlikely event that the line or supporting structure fails and the line contacts the ground.

Periodic Maintenance Program on All Transmission Lines

To ensure continued public safety and integrity of service, a periodic maintenance and inspection program is implemented for every transmission line. The program is administered through the use of helicopter patrols, with supplemental foot and structure climbing patrols. A number of helicopter patrols are performed on all lines annually. The two-man helicopter crew flies parallel, to the left, and above the line so that the observer can look for signs of line damage or deterioration and observe clearances between vegetation and conductors. The observations are included in a report that is forwarded to the appropriate department for corrective action.

Foot and structure climbing patrol programs for a transmission line begin approximately three to five years after the line is energized, unless a helicopter patrol reports a need for earlier action. The frequency of foot patrols varies from once every year to once every several years depending on line type and age.

An assigned foot patroller checks right-of-way conditions, including access roads, bridges, pole washouts, tower footers, vegetation height and clearance to conductors, pole and tower deterioration and, with the use of binoculars, insulators, and condition of hardware. Identified problems are included in a report that is forwarded to the appropriate department for corrective action.

A scheduled line outage is required to perform an overhead patrol because of "hands-on" inspection of hardware. Overhead patrols are conducted on a schedule determined by line age, operating record, and observed general condition. The necessary repairs are also done during the inspection outage.

Personnel Safety Rules

The following are a few of the PPL safety rules that demonstrate the Company's concern for employee safety:

- Work procedures have been developed to allow work to be performed on energized facilities in a safe manner. When lines or apparatus are removed from service to be worked on, the Energy Control Process system is applied. This system provides that a red tag must be physically placed on the control handle of the de-energized equipment. The red tag may be removed only after proper authorization to energize the equipment. Various other tags are used for limited operations and informational purposes.

Employees will not apply or remove a tag or change the status of tagged equipment unless authorized.

- Temporary safety grounds are used on de-energized facilities for employee safety during maintenance, construction, or reconstruction work. Safety grounds are wires connecting the de-energized facility to an electrical ground. If the facility should be energized, the safety grounds will divert the current directly to ground and reduce the likelihood of personal injury. The conductor size and attachment clamps of temporary safety grounds must be capable of conducting anticipated fault currents. Rubber gloves, rubber sleeves, and additional rubber protective equipment are used as required when applying or removing temporary safety grounds to or from the lines or apparatus to be grounded. An approved nonconductive working stick of sufficient length to allow workers to maintain the following required minimum clearances is used to test that the line has been de-energized and to apply temporary safety grounds:

Voltage-kV	Minimum Clearance
138	3'-7"
230	5'-3"
500	11'-3"

Before applying grounds, a test is done to confirm that the line is de-energized. The voltage test device is checked before and after use to assure reliability. When ground pins are used to establish proper ground points, they are driven to a depth of not less than four feet as near vertical as possible.

- Poles or structures are inspected and examined for structural integrity before climbing. If there is any reason to believe that a pole is unsafe, it is stabilized before work is performed. Appropriate safety gear in the form of body belts, safety straps, hard hats, gloves, etc., is worn by linemen during line work activity.

MAGNETIC FIELD MANAGEMENT

PPL Electric Utilities Corporation

APPENDIX B

DECEMBER 2004

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INTRODUCTION

At PPL Electric Utilities Corp. (PPL EU), magnetic field management means investigating and implementing methods at low or no cost to reduce magnetic fields in new or rebuilt transmission and distribution lines. This document explains PPL EU's Magnetic Field Management Program, which is part of PPL EU's larger Electric and Magnetic Fields (EMF) policy.

PPL EU's View

Some people are worried that electric and magnetic fields are harming their health. Others think the scientific research does not show a problem at all, and still others believe there's just too much scientific uncertainty to draw any conclusions.

Here's what we do know now. Various panels of scientists that have reviewed the EMF research generally have drawn two main conclusions. First, the large body of evidence does not demonstrate that EMF are harmful. Second, additional research is recommended to explore questions raised in some studies.

Given these conclusions, PPL EU is taking a reasoned approach in responding to the EMF issue. PPL EU's approach to the EMF issue consists of five elements:

- Providing EMF information to customers and employees
- Providing magnetic field measurements
- Establishing and implementing a magnetic field management program to reduce magnetic fields in new or rebuilt facilities when it can be done at no, or low, cost
- Integrating EMF in the public involvement process that PPL EU undertakes in the siting of transmission lines
- Have supported additional research

EMF Are All Around Us

Electric and magnetic fields occur in nature and in all living things. The earth, for instance, has a magnetic field, which makes the needle on a compass point north.

Electric fields and magnetic fields of a different type also surround every wire that carries electricity. In everyday life, these EMF arise from several basic sources, including power lines, electrical appliances, home and building wiring, other utility lines and cables, and currents flowing on water pipes. Though they often occur together, EMF are made up of two separate components:

Electric Fields

Electric fields are produced by the voltage—or electrical pressure—on a wire. The higher the voltage, the higher the electric field. As long as a wire is energized—has voltage present—an electric field is present (see Figure 1). In other words, an appliance, or an electric power line, doesn't actually have to be turned on to create an electric field. It just has to be plugged in. Electric fields diminish with distance and can be blocked or partially shielded by objects such as trees and houses.

Magnetic Fields

Magnetic fields are created by the current or flow of electricity through a wire. Generally speaking, the higher the current, the higher the magnetic field. Because they only occur when current is flowing, magnetic fields are present only when the power is turned on (see Figure 1). Magnetic fields also diminish with distance, but—unlike electric fields—are not blocked by common objects. In recent years, public and scientific interest has turned toward the magnetic field component of EMF because of some scientific studies regarding these fields.

Figure 1

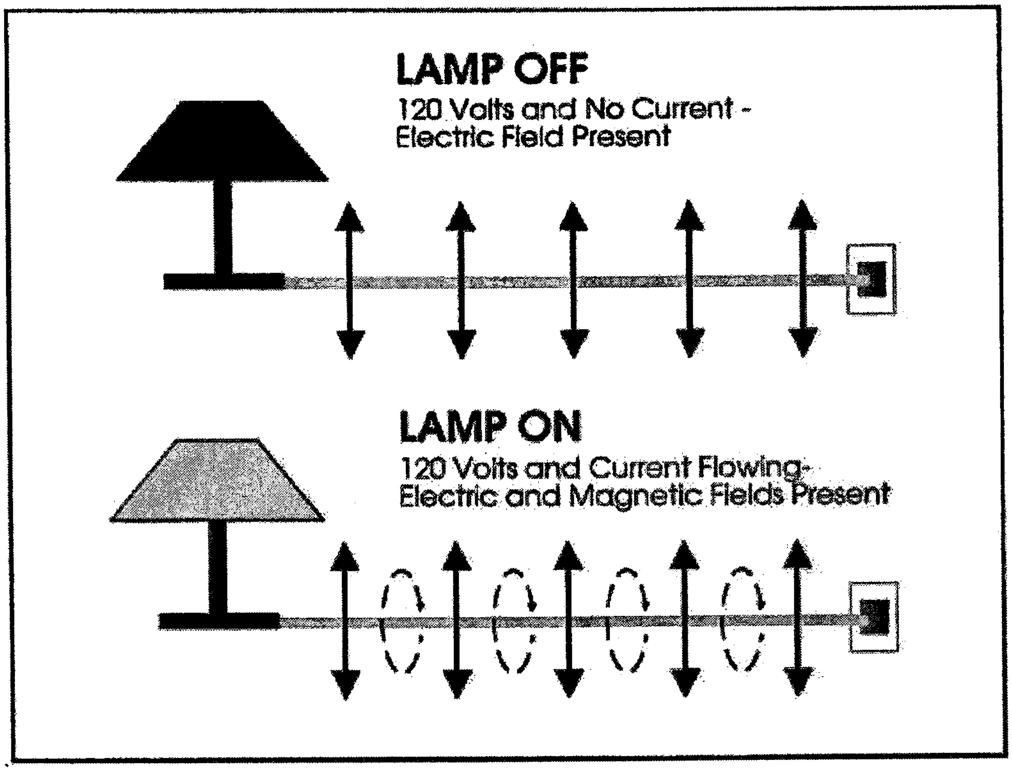

LAMP OFF
120 Volts and No Current - Electric Field Present
LAMP ON
120 Volts and Current Flowing- Electric and Magnetic Fields Present

Figure 2

Magnetic field strengths decrease with distance Magnetic fields are measured in milligauss	Source: "EMF In Your Environment", U.S. Environmental Protection Agency 1992 At 6 inches	At 1 foot	At 2 feet
Clothes dryer	2 to 10	* to 3	*
Microwave oven	100 to 300	1 to 200	1 to 30
Toaster	5 to 20	* to 7	*
Power drill	100 to 200	20 to 40	3 to 6
Can opener	500 to 1500	40 to 300	3 to 30
Mixer	30 to 600	5 to 100	* to 10
Hair dryer	1 to 700	* to 70	* to 10
Color television	Data not available	* to 20	* to 8

FIGURE 2 * The magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

Measuring Magnetic Fields

Magnetic fields usually are measured in a unit called a milligauss. Magnetic field levels found in the living areas of homes typically range from less than 1 milligauss to about 4 milligauss according to the U.S. Environmental Protection Agency. They can be higher in some cases. The levels next to appliances can exceed 1,000 milligauss (1 gauss). Figures 2 and 3 show how the strength of the field falls off as you move away from the source, just as the heat of a campfire grows weaker as you walk away from it. For overhead power lines, the strength of the magnetic fields is dependent upon a number of factors that will be explained later. Those factors produce a magnetic field that drops off rapidly as you move away from the power line.

Figure 3

Sample Magnetic Field Levels in Milligauss

Type of Overhead Power Line	Distance from the line			
	Under the line	50 ft.	100 ft.	200 ft.
220 kV and 500 kV	5-400	5-250	1-75	0.5-20
69 kV and 138 kV	3-80	0.5-2.5	0.1-10	0.1-3
12 kV and below	0.4-20	0.1-1	-	-

The magnetic field values provided in this table represent a general range of values associated with the types of overhead power lines listed and are provided for illustration. There will be circumstances in which there will be magnetic field levels above or below the range of values provided due to variations in such factors as height of the wires, current flow and so on.

DEVELOPMENT OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM

One element of our response to EMF concerns expressed by some of our customers is PPL EU's Magnetic Field Management Program. The program was initiated in March 1991 because PPL EU believes it makes good sense, as a matter of policy, to respond to the concerns expressed by some of our customers and to reduce magnetic fields in new and rebuilt facilities where it can be done with either no-cost or low-cost design changes.

This document updates the original program which has been revised several times since 1991. These guidelines were developed by PPL EU's EMF Working Group.

VARIABLES THAT AFFECT MAGNETIC FIELDS

Magnetic fields from transmission and distribution lines are a function of a number of design variables. The following parameters affect the magnetic field levels produced by transmission and distribution lines:

- Current
- Height of conductors above ground
- Configuration of conductors
- Distance from the line

EFFECT OF PHASE CURRENT ON MAGNETIC FIELDS

At power frequencies (i.e., 60 hertz), the magnetic field level is a function of the current or flow of electricity through a wire. Keeping all other parameters the same, the magnetic field is proportional to the current. Hence, if the current increases by 25 percent, the resulting magnetic field level will increase by 25 percent.

The overall load current on any line varies with the demand for power. It's usually highest during daytime hours and lowest at night. There also are weekly, monthly, seasonal and yearly variations.

The difference in the currents between each phase in a multiphase line also can affect the magnetic field. This difference is called phase unbalance. For a constant load, a statistical analysis of this phase unbalance can be made to determine its effect on the magnetic field. Close to the line, there is very little effect. However, the phase unbalance slows the rate at which the magnetic field decreases with distance from the line.

EFFECT OF CONDUCTOR CONFIGURATION ON MAGNETIC FIELDS

In the transmission and distribution of power, utilities like PPL EU presently use both three-phase and single-phase lines. Each phase on a three-phase power line has either a single conductor or a bundle of two or more conductors. In a three-phase system, the ground-level magnetic field is a result of the fields produced by the currents in each of the phases. Placing the three phases as close together as possible (compaction) creates some field cancellation, and the ground-level magnetic field is reduced. However, appropriate phase separation is required for the reliable operation of the line. In addition, the arrangement of the phases can create some; field cancellation and reduction of the ground-level magnetic field.

EFFECT OF DISTANCE FROM THE MAGNETIC FIELD SOURCE

Magnetic field strength diminishes with the vertical and lateral distances from the magnetic field source. Increasing the height of the conductors above ground is useful for magnetic field reduction at ground level, but may result in increased structure costs and increased aesthetic impact of the structures. Another possible method of increasing the distance to the magnetic field source is to increase the right-of-way requirements. By keeping buildings off increased rights of way, thereby requiring the public to live and work further away from lines, exposure to magnetic fields produced by the lines can be reduced. Increases in right of way are not always practical and may increase costs significantly, however.

SUMMARY OF PPL EU's MAGNETIC FIELD MANAGEMENT PROGRAM

Under its Magnetic Field Management Program, PPL EU has changed the way it builds and rebuilds some of its transmission and distribution lines. These design changes reduce magnetic field levels (assuming balanced circuit loadings and phase currents) by up to 69 percent in most of the company's new transmission lines. These guidelines now are being applied to new and reconstructed transmission facilities, based on this program.

The distribution component of the program focuses on 12 kV lines, the company's standard distribution voltage. It concentrates on the three-phase, primary 12 kV lines, since these are the most heavily loaded facilities and often are located in densely populated areas. The guidelines in this program are being applied to these three-phase, primary 12 kV lines.

A maximum 3-5 percent change in estimated cost was used as the limit for the guidelines since this value is consistent with low cost, is within estimating accuracy and is likely to have little impact on overall line costs.

The magnetic field calculations used in this document for the design of PPL EU's overall magnetic field management plan assume balanced load conditions among the phases and a fixed level of current, not necessarily representative of specific transmission or distribution lines. These levels were calculated using the Electric Power Research Institute's ENVIRO computer program. Under actual operating conditions, the magnetic field levels that result may vary due to such things as actual load per circuit, overall current on each phase conductor and the electrical configuration and operation of each line.

MAGNETIC FIELD MANAGEMENT PROGRAM GUIDELINES

The guidelines for magnetic field management are noted below, with discussion points for each.

OVERHEAD LINES

NEW OR REBUILT TRANSMISSION LINES

1. **Balance transmission circuit loads and phase currents as much as possible.**
   - PPL EU should continue to make every effort to balance loadings between the two circuits of a double circuit line when planning new or rebuilt facilities to maximize the effects of reverse phasing.
   - PPL EU should continue the practice of balancing single-phase loads across the three phases of the distribution system. (Unbalanced phase currents on the distribution system are reflected through to the transmission system.)
     - Unbalanced phase currents result in higher magnetic fields that do not drop off as quickly with distance as do the fields resulting from balanced phase currents.
     - For a 5 percent phase current unbalance, the magnetic field 50 feet from the centerline of a single circuit 138 kV line could be more than twice the value than if the same line had balanced phase circuits.
   - Balanced phase currents on each three-phase distribution circuit also reduce magnetic fields from the distribution circuits themselves. In addition, they reduce magnetic fields on the transmission system from which the distribution system circuits are supplied and connected through substations.
   - Apart from magnetic field considerations, balanced phase currents on each three-phase distribution circuit also reduce line losses and improve the system voltage.

2. **Continue with the present practice of using long-span construction as the PPL EU 138/69 kV standard**

- Structure designs for short-span and long-span construction are illustrated on Charts I and II, respectively.
  - Short-span design does not significantly reduce magnetic fields when compared to long-span design even though it is more compact than long-span design. Comparison of the magnetic field values from Chart III indicates essentially the same values. Therefore, short-span design should not be used solely to reduce magnetic fields.
  - PPL EU will continue to use long-span construction for 138/69 kV double-circuit lines and for single-circuit/future-double-circuit lines.
  - For single-circuit/future-double-circuit lines, PPL EU will continue to install two conductors on the top positions and one in the middle position as shown in Chart IV.
    - This arrangement minimizes magnetic fields as shown in Chart V by placing the three initial conductors higher on the structure, which increases the ground clearances, and by placing the conductors in a triangular configuration.

3. **Compact design structures are not a low-cost alternative and should be used for magnetic field reduction only in special applications.**

Chart VI illustrates the compact design structure.

- The compact design increases the initial installation costs by 79 percent when compared to the long-span design but reduces the magnetic field from 9 mG to 3 mG (about 67 percent) at the edge of the 100-foot-wide right of way as shown on Chart III.

4. **Reverse phase new or rebuilt double-circuit transmission lines for all voltage levels.**

- Reverse phasing was adopted by PPL EU in March 1991 for double-circuit 138/69 kV transmission lines and in April 1992 for all other double circuit transmission lines. Reverse phasing is shown in Chart VII. Reverse phasing will reduce the magnetic fields when the current flow on both circuits is in the same direction. Calculated values contained here are based on balanced and equal phase currents on both circuits.

- Reverse phasing reduces the magnetic field of a double circuit 138 kV single pole transmission line from 29 mG to 9 mG (about 69 percent) at the edge of the 100-foot-wide right of way as shown on Chart III.
- Reverse phasing reduces the magnetic field of a double circuit 230 kV single pole transmission line from 49 mG to 16 mG (about 67 percent) at the edge of the 150-foot-wide right of way as shown on Chart VIII.
- Reverse phasing reduces the magnetic field of a double-circuit 500 kV single pole transmission line from 37 mG to 21 mG (about 43 percent) at the edge of the 200-foot-wide right of way as shown on Chart IX.

- When new or rebuilt double-circuit lines require tapping existing double-circuit lines, PPL EU will review the existing lines to determine if reverse phasing can be provided at low cost.
- Computer modeling is required to develop the optimum phasing and overall conductor arrangements for lines added to, or rebuilt in, multiple-line corridors.
  - Merely adding a reverse-phase double-circuit line to an existing transmission line corridor or reverse phasing a rebuilt line in the multiple-line corridor will not necessarily produce lower magnetic field levels at the edge of the corridor right of way.
  - The corridor must be computer modeled with all the lines, existing phase conductor locations and currents. Then, magnetic field calculations must be made varying the phase arrangements of the new or reconstructed line to determine the appropriate phasing arrangement.
  - Current flow direction on a line also must be considered. For example, a reverse-phased line should have the current flowing in the same direction on both circuits. If the current flow is in the opposite direction for one circuit, reverse phasing will not produce the lowest magnetic field and another phase arrangement that produces lower fields may need to be utilized.

5. **Increase the minimum ground clearance for all new transmission lines.**

138/69 kV Transmission Lines

- Increasing the minimum line design ground clearance from 25 feet to 30 feet may add up to about 5 percent to the installed cost of a new double-circuit single pole 138/69 kV line. For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. With long-span reverse-phase design, the, magnetic field is reduced from 9 mG to 7 mG (about 22 percent) at the edge of a 100-foot-wide right of way as shown in Chart X.
  - In the actual design of transmission lines to include higher minimum ground clearances, there may be limited segments (such as highway crossings, severe slopes and transmission line crossing locations) where National Electrical Safety Code (NESC) minimum ground clearances may need to be used. The NESC minimum ground clearances are less than the increased ground clearance discussed previously.

230 kV Transmission Lines

- Increasing the minimum line design ground clearances from 27 feet to 32 feet may add up to about 5 percent to the cost of a single-circuit single-pole line (current standard). For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. By increasing the clearances, the magnetic field is reduced from 30 mG to 28 mG (about 7 percent) at the edge of a 150-foot-wide right of way.
- Increasing clearances from 27 feet to 32 feet could theoretically add up to about 2.8 percent to the cost of a double-circuit single-pole line (current standard) and reduce the magnetic field of a reverse-phase line from 16 mG to 15 mG (about 6 percent) at the edge of a 150-foot-wide right of way. Chart XI is a summary of this data.
- Studies are required for each new 230 kV line to determine optimum structure types, ground clearances, configurations and designs to reduce field levels. Such

studies could include analysis of reduction measures such as additional minimum ground clearances, increasing conductor tensions, using reduced phase spacing (a "Delta" configuration on a single-circuit line), installing the second circuit initially, and/or adding a second set of conductors that are reverse phased and operated in parallel with the first set (bundled/split phase).

500 kV Transmission Lines

- Increasing ground clearances from 33 feet to 53 feet may add up to about 4.5 percent to the cost of a single-circuit "H-frame" line (current standard). For a given project, such cost may be substantially less, however. In fact, PPL EU frequently uses higher-than-minimum ground clearances due to such features as road crossings, line crossings and site-specific terrain. By increasing the clearances, the magnetic field is reduced from 42 mG to 35 mG (about 17 percent) at the edge of a 200-foot-wide right of way.
- Increasing ground clearances from 33 feet to 53 feet could theoretically add up to 2.8 percent to the cost of a double-circuit "H-frame" line (current standard) and reduces the magnetic field of a reverse-phase line from 21 mG to 16 mG (about 24 percent) at the edge of a 200-foot-wide right of way. Chart XII is a summary of this data.
- Studies are required for each new 500 kV line to determine optimum structure types, ground clearances, configurations and designs to reduce field levels. Such studies could include analysis of reduction measures such as additional minimum ground clearances, increasing conductor tensions, using reduced-phase spacing (a "Delta" configuration on a single circuit line), installing the second circuit initially, and/or adding a second set of conductors that are reverse phased and operated in parallel with the first set (bundled/split phase).

RECONDUCTORING OR ADDING ADDITIONAL CIRCUITS TO EXISTING TRANSMISSION LINES

When reconductoring or adding additional circuits to existing transmission lines, PPL EU will evaluate low-cost or no-cost options for magnetic field management on a case-by-case basis.

When reconductoring existing transmission lines or adding additional circuits, low-cost alternatives may not exist; however, the following steps will be taken:

- For a single-circuit line, the use of a Delta arrangement or other modifications on the existing structure, with reduced-phase spacing, will be evaluated.
- For double-circuit lines, application of reverse phasing may reduce the magnetic field under the line and within the right of way and will be evaluated.
- For single- and double-circuit lines, evaluate using higher conductor tensions that can increase the minimum line design ground clearance.

DISTRIBUTION LINES

At the 12 kV distribution level, new main three-phase lines will continue to be constructed with five feet of additional ground clearance.

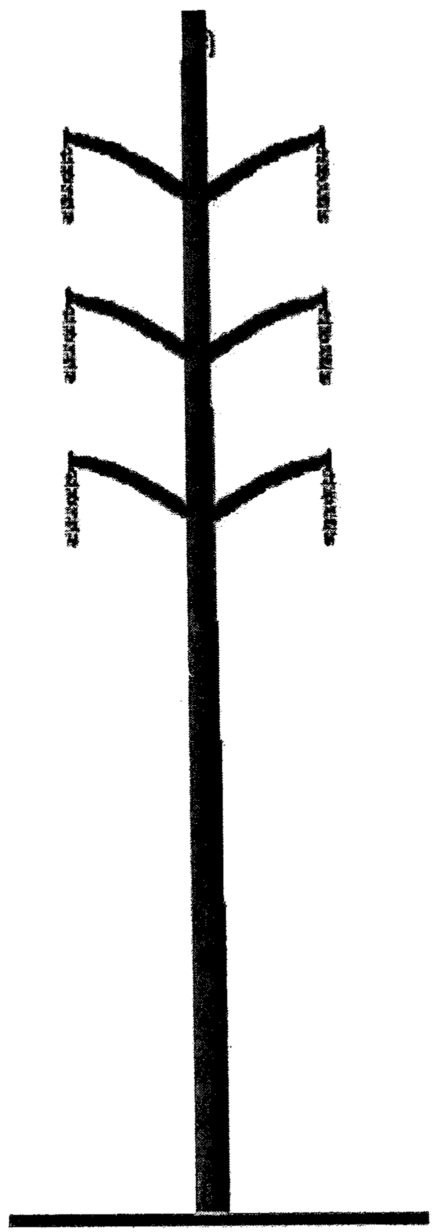
- Main lines are the most heavily loaded sections of a distribution line and therefore have the highest magnetic fields associated with them.
- Increasing the ground clearance by five feet reduces the magnetic field under the line from 14 mG to 11 mG using the standard eight-foot crossarm design. These values are based on increasing pole heights from 45 feet to 50 feet and a typical operating current of 300 amps per phase.
- Chart XIII is a summary of this data. Increasing ground clearance by five feet could theoretically add about 5 percent to the cost of a typical distribution line.

Underground Transmission Lines

Underground transmission lines are required due to environmental or land use factors or restrictions on available clearances, PPL EU will evaluate options for magnetic field management techniques on a case-by-case basis.

- The phase arrangement that produces the lowest field will be determined.
- The depth of burial of the line will be determined considering the cost of excavation and the location of other buried utilities in the area.
- The use of steel pipe ferromagnetic shielding that reduces magnetic fields will be evaluated.

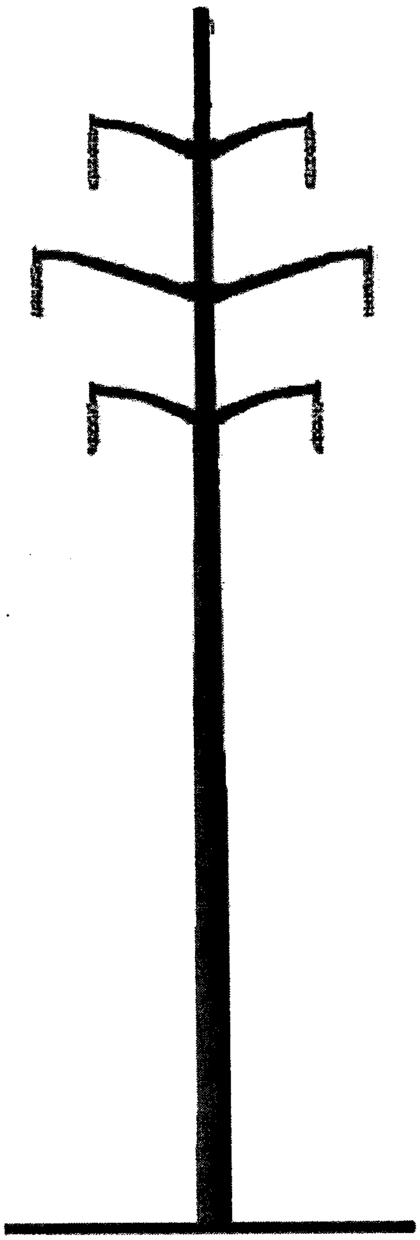
Short-Span Construction



- **More compact design**
- **Should not be used solely to reduce magnetic fields**
- **Typical conductor data:**

1 3/8" HS steel overhead ground wire - 7.3 feet sag
6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 10.0 feet sag
Average span - 400 feet

Long-Span Construction Remains PPL EU 138 kV Standard



- Lower cost alternative
- Reduces magnetic fields due to higher structures
- Typical conductor data:

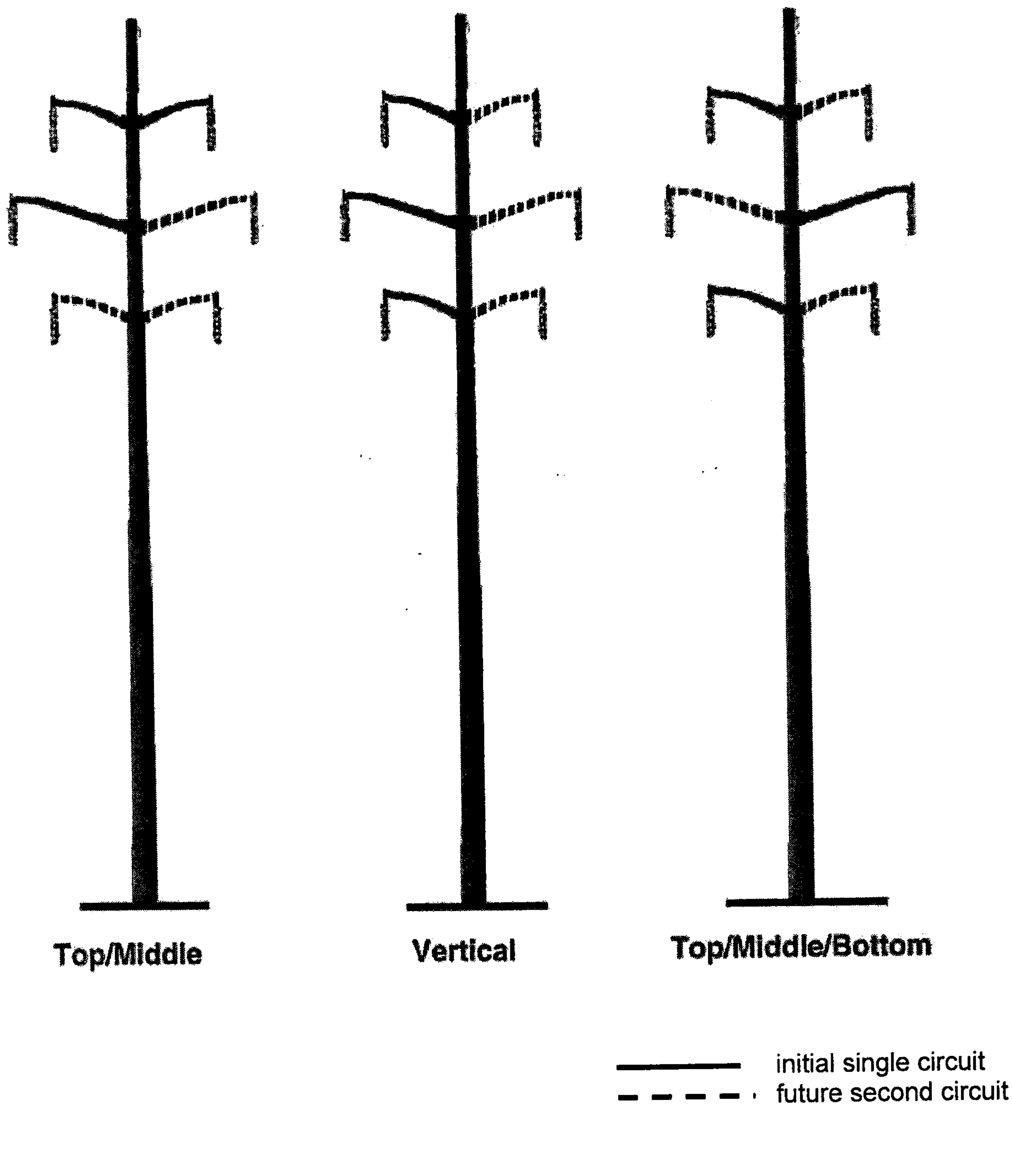
  1 3/8" HS steel overhead ground wire - 17.3 feet sag
  6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 23.0 feet sag
  Average span - 600 feet

138/69 kV REVERSE-PHASE TRANSMISSION LINES CALCULATED MAGNETIC FIELDS AT 400 AMPERES

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SHORT SPAN (CHART I)	30
SHORT SPAN (REVERSE PHASE)	8
LONG SPAN (CHART II)	29
LONG SPAN (REVERSE PHASE)	9
COMPACT (CHART VI)	14
COMPACT (REVERSE PHASE)	3

The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 25 feet.
LONG SPAN, SHORT SPAN and COMPACT are double-circuit lines.

Typical Single-Circuit Structure Designs

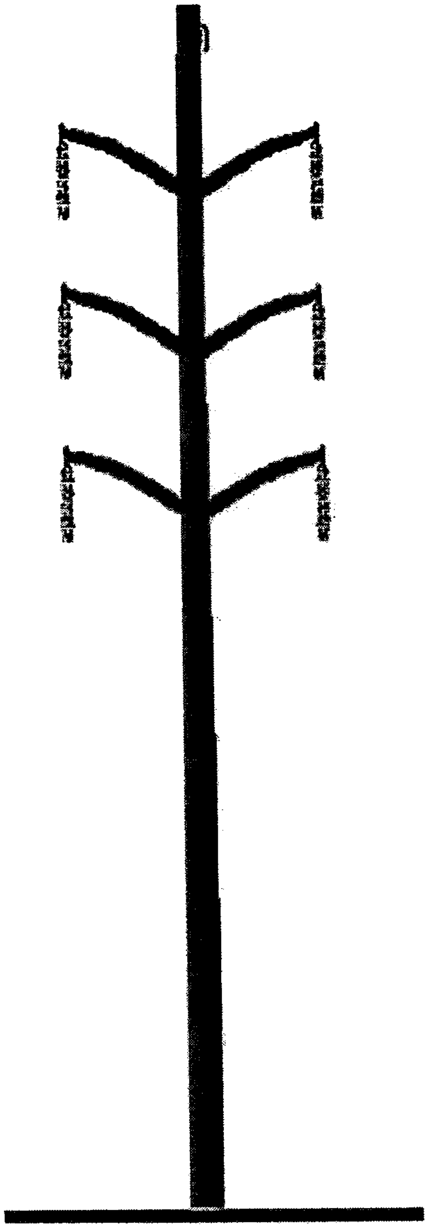


138/69 kV SINGLE CIRCUIT TRANSMISSION LINES CALCULATED MAGNETIC FIELDS AT 400 AMPERES

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
TOP/MIDDLE/BOTTOM	20
VERTICAL	17
TOP/MIDDLE	12

The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 25 feet.

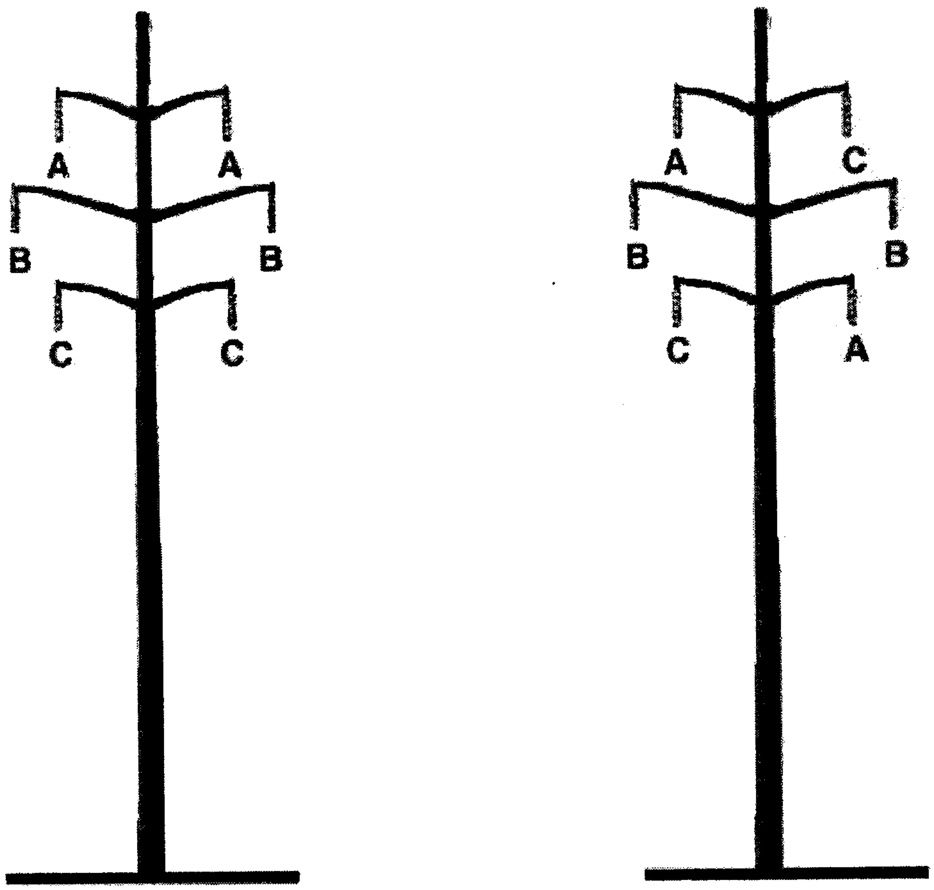
Compact Design Structure



- **Minimize magnetic fields due to compact design**
- **Not a low-cost alternative**
- **Typical conductor data:**

1 3/8" HS steel overhead ground wire - 9.0 feet sag
6-556.5 KCMIL 24/7 ACSR power conductors - (PARAKEET) 9.0 feet sag
Average span - 300 feet

Reverse Phasing of Double-Circuit Transmission Lines



From: ⟶ ⟶ ⟶ ⟶ To:

Reverse phasing also can be one of the following phase arrangements:

A	B		B	A		B	C		C	A		C	B
C	C	or	C	C	or	A	A	or	B	B	or	A	A
B	A		A	B		C	B		A	C		B	C

CHART VIII

230 kV REVERSE-PHASE TRANSMISSION LINES CALCULATED MAGNETIC FIELDS AT 800 AMPERES

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
DOUBLE CIRCUIT POLE	49
DOUBLE CIRCUIT POLE (REVERSE-PHASE)	16

The edge of right of way is 75 feet from the line centerline.
The 800 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 27 feet.

CHART IX

500 kV REVERSE-PHASE TRANSMISSION LINES CALCULATED MAGNETIC FIELDS AT 1100 AMPERES

TYPE CONSTRUCTION	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
DOUBLE CIRCUIT POLE	37
DOUBLE CIRCUIT POLE (REVERSE PHASE)	21

The edge of right of way is 100 feet from the line centerline.
The 1,100 ampere phase current is balanced between phases.
Calculations are based on a minimum ground clearance of 33 feet.

INCREASED 138/69 kV MINIMUM GROUND CLEARANCE CALCULATED MAGNETIC FIELDS AT 400 AMPERES

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT TOP/MIDDLE	25	12
SINGLE CIRCUIT TOP/MIDDLE	30	10
LONG SPAN	25	29
LONG SPAN	30	26
LONG SPAN (REVERSE PHASE)	25	9
LONG SPAN (REVERSE PHASE)	30	7

The edge of right of way is 50 feet from the line centerline.
The 400 ampere phase current is balanced between phases.

INCREASED 230 kV MINIMUM GROUND CLEARANCE CALCULATED MAGNETIC FIELDS AT 800 AMPERES

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT TOP/MIDDLE	27	30
SINGLE CIRCUIT TOP/MIDDLE	32	28
DOUBLE CIRCUIT POLE	27	49
DOUBLE CIRCUIT POLE	32	46
DOUBLE CIRCUIT POLE (REVERSE PHASE)	27	16
DOUBLE CIRCUIT POLE (REVERSE PHASE)	32	15

The edge of right of way is 75 feet from the line centerline.
The 800 ampere phase current is balanced between phases.

INCREASED 500 kV MINIMUM GROUND CLEARANCE CALCULATED MAGNETIC FIELDS AT 1,100 AMPERES

TYPE CONSTRUCTION	MINIMUM GROUND CLEARANCE FEET	MAGNETIC FIELD IN MILLIGAUSS AT THE EDGE OF THE RIGHT OF WAY
SINGLE CIRCUIT "H" STRUCTURE	33	42
SINGLE CIRCUIT "H" STRUCTURE	53	35
DOUBLE CIRCUIT POLE	33	37
DOUBLE CIRCUIT POLE	53	31
DOUBLE CIRCUIT POLE (REVERSE PHASE)	33	21
DOUBLE CIRCUIT POLE (REVERSE PHASE)	53	16

The edge of right of way is 100 feet from the line centerline.
The 1,100 ampere phase current is balanced between phases.

12 kV DISTRIBUTION LINES
CALCULATED MAGNETIC FIELDS AT 300 AMPERES

TYPE CONSTRUCTION	POLE HEIGHT FEET	MAGNETIC FIELD IN MILLIGAUSS*	
		AT CENTERLINE	AT 30 FEET FROM CENTERLINE
STANDARD CROSSARM	45	14	7
STANDARD CROSSARM	50	11	6

* Field level under the line at mid-span based on 300 amps, balanced loading, one meter above ground level.

Siting/Magnetic Field Management.doc/mlt

APPENDIX C

LIST OF PROPERTY OWNERS WITHIN THE PROPOSED RIGHT-OF-WAY

Property Owner/Address	Parcel Number
Headlands Realty Corporation C/O AMB Property Corporation Mr. Bo Farkas Vice President, Investments One Meadowlands Plaza Suite 100 East Rutherford, NJ 07073	1
Mr. Alexander G. Tamerler 5300 Crackersport Road Allentown, PA 18104	2
Ms. Althea M. Walbert P. O. Box 33 Alburtis, PA 18011	3

APPENDIX D

LIST OF INVOLVED GOVERNMENTAL AGENCIES, MUNICIPALITIES AND OTHER PUBLIC ENTITIES RECEIVING APPLICATIONS

1. Pennsylvania Historical and Museum Commission
   Bureau for Historic Preservation
   Commonwealth Keystone Building, Second Floor
   400 North Street
   Harrisburg, Pennsylvania 17120-0053
   Attn: Mr. Douglas C. McLearen, Chief

2. Pennsylvania Department of Transportation
   Commonwealth Keystone Building
   400 North Street, 8th Floor
   Harrisburg, Pennsylvania 17120
   Attn: The Honorable Allen D. Biehler, P.E., Secretary

3. Department of Environmental Protection
   P.O. Box 2063
   Market Street State Office Building
   Harrisburg, Pennsylvania 17105-2063
   Attn: Office of Field Operations

4. Lehigh County
   17 South 7th Street
   Allentown, PA 18101
   Attn: The Honorable Donald T. Cunningham, Jr., Executive

5. Lehigh Valley Planning Commission
   961 Marcon Blvd., Suite 310
   Allentown, PA 18103
   Attn: Mr. Michael N. Kaiser, AICP, Executive Director

6. Lower Macungie Township
   3450 Brookside Road
   Macungie, PA 18062-1427
   Attn: Mr. Bruce Fosselman, Manager

7. Lower Macungie Township Planning Commission
   3450 Brookside Road
   Macungie, PA 18062-1427
   Attn: Mr. Maury Robert, Chair