Thomas D. Gatlin
General Manager, Nuclear Plant Operations
803.345.4342

SCE&G®
A SCANA COMPANY

November 22, 2005

Ms. Melanie H. Hindman
Water Quality Assessments and Enforcement Division
Bureau of Water
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201

Dear Ms. Hindman:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
MONTHLY DISCHARGE MONITORING REPORTS
NPDES PERMITS NO. SC0030856 & SC0038407

Enclosed are the Monthly Discharge Monitoring Reports (DMRs), with one (1) additional copy of each, submitted in accordance with the subject NPDES permits. These reports cover the period of October 1 through October 31, 2005. The DMRs contain all the parameter results of the outfalls as required by NPDES Permits No. SC0030856 and SC0038407.

All parameters were within specification during the reporting period with the exception of dissolved oxygen at Outfall 001, NPDES Permit No. SC0038407. A sample collected and analyzed on October 5, 2005, indicated a dissolved oxygen concentration below the limit of 1.0 ppm. The cause of the low dissolved oxygen is low flow into and out of the package plant at the Nuclear Training Center. The building is designed to house one hundred plus employees however, at this time the number of employees onsite is four to five. The future utilization of this building is currently being evaluated.

Should there be any questions, please contact Ms. Susan B. Reese at 345-4591.

Very truly yours,

Thomas D. Gatlin

SBR/TDG/sr
Enclosures

c:	R. J. White	(w/o enclosures)	NRC Resident Inspector	
	Central Midlands District Office	(w/o enclosures)	NSRC	
	J. W. Preston	(P05)	RTS	(L-99-0101, C-05-3801)
	M. B. Roberts	(P40)	File	(818.03-11, RR 4200)
	W. F. Bacon	(331)	DMS	(RC-05-0194)

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / SUMMER NUCLEAR TRAINING
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / SUMMER NUCLEAR TRAINING
LOCATION JUNCTION OF HWY 213 & CTY RD 16

SC0038407	001 1
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 03/01/2003 - 07/31/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00300 LAB ID: 20001 Dissolved Oxygen	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	0.7	********* *********	********* *********		1	01/30	GR
MLOC=1	PERMIT REQUIREMENT			***** *****	[illegible] INST MIN			MG/L		01/30	GR
00310 LAB ID: 40569 BOD - 5 Day (20 Degrees C)	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	6.0	6.0		0	01/30	24
MLOC=1	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	24
00400 LAB ID: 20001 pH Standard Units	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	7.8	********* *********	7.8		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		8.5 DAILY MX	SU		01/30	GR
00530 LAB ID: 20001 Total Suspended Solids (TSS)	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	8.0	8.0		0	01/30	24
MLOC=1	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	24
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant	SAMPLE MEASUREMENT	0.000200	0.000200		********* *********	********* *********	********* *********	***** *****	0	01/30	IN
MLOC=1	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
50060 LAB ID: 20001 Total Residual Chlorine	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
74055 LAB ID: 40569 Fecal Coliform General	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	<1	<1		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			***** *****		200 30DAVG GEO	400 DAILY MX	# PER 100ML		01/30	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

R [illegible] for
W. Frank Bacon
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	11	17
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
Low dissolved oxygen due to low or no flow to outfall.

Total Residual Chlorine, method SM4500 CLG, PQL 0.1 mg/L, number of times results less than PQL = one.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	001 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

Form Approved.
OMB No. 2040-00

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	102.1	106.0		0	99/99	CN
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	[illegible] DAILY MX	DEG. FAR.		99/99	CN
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=7	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	76.4	80.5		0	99/99	CN
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX	DEG. FAR.		99/99	CN
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=T	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	76.7	82.1		0	99/99	CN
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	REPORT DAILY MX	DEG. FAR.		99/99	CN
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	6.8	********* *********	6.8		0	01/30	GR
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		[illegible] MAXIMUM	SU		01/30	GR
01042 LAB ID: 32006 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX	MG/L		01/30	GR
01045 LAB ID: 32006 Iron, Total as Fe MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.545	0.545		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX	MG/L		01/30	GR
01055 LAB ID: 32006 Manganese, Total MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.039	0.039		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX	MG/L		01/30	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

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R. Hanulboff for
W. Frank Bacon

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	11	17
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

MLOC=1 -DISCHARGE TEMPERATURE SHALL BE MONITORED AT THE OUTLET CORRESPONDING TO AN INDIVIDUAL UNIT PRIOR TO MIXING WITH RECEIVING STREAM. MLOC=T - PLUME TEMPERATURE SHALL BE TAKEN AT THE INTAKE STRUCTURE. MLOC=7 - INTAKE TEMPERATURE SHALL BE MEASURED ON INLET SIDE OF THE MAIN CONDENSER.

Copper - method SW846, 6010B. PQL = 0.01 mg/L, number of times results less than PQL = one

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	001 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	738.7	738.7		********* *********	********* *********	********* *********	***** *****	0	99/99	ES
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		99/99	ES
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

R. [signature] for
W. Frank Baxon
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	11	17
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

MLOC=1 - DISCHARGE TEMPERATURE SHALL BE MONITORED AT THE OUTLET CORRESPONDING TO AN INDIVIDUAL UNIT PRIOR TO MIXING WITH RECEIVING STREAM. MLOC=T - PLUME TEMPERATURE SHALL BE TAKEN AT THE INTAKE STRUCTURE. MLOC=7 - INTAKE TEMPERATURE SHALL BE MEASURED ON INLET SIDE OF THE MAIN CONDENSER.

MLOC=T total of 21 hrs missing data
Short periods of bad data during the last week of the month due to an intermittent ground.
The probe was replaced during the month.

PERMITTEE [illegible] ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT [illegible] ARGE ELIMINATION SYSTEM *(NPDES)*
DISCHAR [illegible] MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-000[illegible]

SC0030856	003 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00400 LAB ID: 20001 pH	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	6.7	********* *********	7.7		0	01/OC	GR
Standard Units MLOC=1	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		9.0 MAXIMUM	SU		[illegible]	GR
00530 LAB ID: 20001 Total Suspended	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	02/30	GR
Solids (TSS) MLOC=S	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		01/OC	GR
00556 LAB ID: 20001 Oil & Grease Freon	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	02/30	GR
Extr-Grav Method MLOC=S	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		01/OC	GR
50050 LAB ID: 20001 Flow in Conduit or	SAMPLE MEASUREMENT	0.004200	0.004400		********* *********	********* *********	********* *********	***** *****	0	01/OC	ES
Thru Treatment Plant MLOC=S	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/OC	ES
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	R. [illegible] for W. Frank Bason	803	345-4214	05	11	17
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
MLOC=S - SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE OF DISCHARGE, BUT NEED NOT BE MORE THAN ONCE PER MONTH. NOTE: SAMPLES SHALL BE TAKEN AT THE FOLLOWING LOCATIONS - SEE PAGE 19, PARA. A. 2.
O&G Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = two. TSS Method SM 2540D, number of times results below PQL = two.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*	
NAME	SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS	P. O. Box 88
	Jenkinsville, SC 29065
FACILITY	SCE&G / V C SUMMER NUCLEAR STAT
LOCATION	HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	004 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

	MONITORING PERIOD					
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		01/OC	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr - Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		01/OC	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	No	Discharge		********* *********	********* *********	********* *********	***** *****			
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/OC	CN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	CERTIFICATION	SIGNATURE	TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	R. Donnelly Jr W. Frank Brown	803	345-4214	05	11	17
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE, BUT NEED NOT BE MORE THAN ONCE PER MONTH.
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATION - SEE PAGE 20, PARA. A.3.

PERMITTEE [redacted]E/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTAN[redacted]HARGE ELIMINATION SYSTEM *(NPDES)*
DISCH[redacted]MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-00[redacted]

SC0030856	005 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00310 LAB ID: 40569 BOD - 5 Day (20 Degrees C) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	6.0	6.0		0	01/30	24
	PERMIT REQUIREMENT			***** *****		30 MO AVG	45 DAILY MX	MG/L		01/30	24
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	11.0	11.0		0	01/30	24
	PERMIT REQUIREMENT			***** *****		30 MO AVG	45 DAILY MX	MG/L		01/30	24
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.003320	0.005100		********* *********	********* *********	********* *********	***** *****	0	05/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
74055 LAB ID: 40569 Fecal Coliform General MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	14.0	14.0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		200 30DAVGEO	400 DAILY MX	# PER 100ML		01/30	GR
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	R. Yasnuey for W. Frank Bacon	TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations			803	345-4214	05	11	17
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 21, PARA. A.4..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	06A 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			*****		30 MO AVG	100 DAILY MX	MG/L		01/30	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			*****		15 MO AVG	20 DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.163500	0.163500		*********	*********	*********	*****	0	01/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				*****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
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	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

R. Dancey for
W. Frank Bacon
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	11	17
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 22, A.5..
Total Suspended Solids Method SM2540D, PQL 1.0 mg/L, number of times result less than PQL = one.
Oil & Grease Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = one.

PERMITTEE [illegible]/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTAN[illegible]HARGE ELIMINATION SYSTEM *(NPDES)*
DISCHA[illegible]MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-00[illegible]

PERMIT NUMBER	DISCHARGE NUMBER
SC0030856	06B 1

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	24.5	24.5		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.012740	0.016500		********* *********	********* *********	********* *********	***** *****	0	05/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

R. [illegible] Jr
W. Frank [illegible]
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	11	17
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 23. PARA 6..

Oil & Grease Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = one.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	007 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD					
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	6.7	********* *********	7.8		0	01/DS	GR
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		[illegible] DAILY MX	SU		01/30	GR
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	2.0	2.0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		01/30	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.063333	0.070000		********* *********	********* *********	********* *********	***** *****	0	01/DS	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	R. [illegible] for W. Frank Baron	803	345-4214	05	11	17
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 24, PARA. A.7..

Oil & Grease Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = one

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	008 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		01/OC	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		01/OC	GR
01042 LAB ID: 20001 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		1.0 MO AVG	1.0 DAILY MX	MG/L		01/OC	GR
01045 LAB ID: 20001 Iron, Total as Fe MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		1.0 MO AVG	1.0 DAILY MX	MG/L		01/OC	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	NO	DISCHARGE		********* *********	********* *********	********* *********	***** *****			
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		[illegible]	[illegible]
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

R. [illegible] Jr
N. Frank Bacon
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	11	17
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE OF DISCHARGE. SHOULD THE DURATION OF DISCHARGE EXCEED ONE WEEK, THE DISCHARGE SHALL BE SAMPLED ONCE PER WEEK UNTIL THE END OF DISCHARGE. NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 25 - PARA. A.8. B..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	012 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	6.9	********* *********	6.9		0	01/30	GR
Standard Units MLOC=1	PERMIT REQUIREMENT	[illegible]	[illegible]	***** *****	6.0 MINIMUM		8.5 MAXIMUM	SU		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or	SAMPLE MEASUREMENT	0.008100	0.008100		********* *********	********* *********	********* *********	***** *****	0	01/30	IN
Thru Treatment Plant MLOC=1	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE	DATE
Jeffrey B. Archie V.P. Nuclear Operations TYPED OR PRINTED	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	R. [illegible] Jr W. Frank Baron	803 345-4214 NUMBER	05 / 11 / 17 YEAR MO DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 26. PARA A.9..

PERMITTEE N[illegible]DDRESS *(Include Facility Name/Location if Different)*

NATIONAL POLLUTANT D[illegible]RGE ELIMINATION SYSTEM *(NPDES)*
DISCHARG[illegible]NITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

PERMIT NUMBER	DISCHARGE NUMBER	
SC0030856	014 1	MAJOR

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	10	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH Standard Units MLOC=1 NNNYYYYYYYNN	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	7.3	********* *********	7.3		0	01/30	GR
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		9.0 MAXIMUM	SU		01/30	GR
00400 LAB ID: 20001 pH Standard Units MLOC=1 YYYNNNNNNNYY	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****		********* *********					
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		8.5 MAXIMUM	SU		01/30	GR
00610 LAB ID: 20001 Ammonia-Nitrogen Total as N MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
01042 LAB ID: 20001 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		0.028 MO AVG	0.039 DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.152072	0.720000		********* *********	********* *********	********* *********	***** *****	0	99/99	CN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		99/99	CN
50060 LAB ID: 20001 Total Residual Chlorine MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	R. [illegible] for W. Frank Barron	803	345-4214	05	11	17
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
Ammonia - method SM4500-NH3, lowest calibration standard = 0.100 ppm, detection limit = 0.100 ppm, # times results reported as 0 = one.
Copper - method SM3111B, lowest calibration standard = 0.015 mg/l, detection limit = 0.010 mg/l, # times results reported as 0 = one
Residual Chlorine - method SM4500CLD, lowest calibration standard = 0.05 mg/l, detection limit = 0.05 mg/l, # times results reported as 0 = one

Thomas D. Gatlin
General Manager, Nuclear Plant Operations
803.345.4342

SCE&G®
A SCANA COMPANY

December 21, 2005

Ms. Melanie H. Hindman
Water Quality Assessments and Enforcement Division
Bureau of Water
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201

Dear Ms. Hindman:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
MONTHLY DISCHARGE MONITORING REPORTS
NPDES PERMITS NO. SC0030856 & SC0038407

Enclosed are the Monthly Discharge Monitoring Reports (DMRs), with one (1) additional copy of each, submitted in accordance with the subject NPDES permits. These reports cover the period of November 1 through November 30, 2005. The DMRs contain all the parameter results of the outfalls as required by NPDES Permits No. SC0030856 and SC0038407.

All parameters were within specification during the reporting period with the exception of pH and dissolved oxygen at Outfall 001, NPDES Permit No. SC0038407. Samples collected and analyzed on November 2, 2005, indicated a dissolved oxygen concentration below the limit of 1.0 ppm and a pH of 5.91 S.U which is below the permit limit of 6.0 S.U. The cause of the low dissolved oxygen and low pH is low flow into and out of the package plant at the Nuclear Training Center. The building is designed to house one hundred plus employees however, at this time the number of employees onsite is four to five. The future utilization of this building is currently being evaluated.

Should there be any questions, please contact Ms. Susan B. Reese at 345-4591.

Very truly yours,

Shawn Zarlandi For Thomas D. Gatlin

Thomas D. Gatlin

SBR/TDG/sr
Enclosures

c:	R. J. White	(w/o enclosures)	NRC Resident Inspector	
	Central Midlands District Office	(w/o enclosures)	NSRC	
	J. W. Preston	(P05)	RTS	(L-99-0101, C-05-4099)
	M. B. Roberts	(P40)	File	(818.03-11, RR 4200)
	W. F. Bacon	(331)	DMS	(RC-05-0208)

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / SUMMER NUCLEAR TRAINING
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / SUMMER NUCLEAR TRAINING
LOCATION JUNCTION OF HWY 213 & CTY RD 16

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0038407	001 1
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 03/01/2003 - 07/31/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00300 LAB ID: 20001 Dissolved Oxygen	SAMPLE MEASUREMENT	*********	*********	*****	0.6	*********	*********		1	02/30	GR
MLOC=1	PERMIT REQUIREMENT			*****	1.0 INST MIN			MG/L		01/30	GR
00310 LAB ID: 40569 BOD - 5 Day (20 Degrees C)	SAMPLE MEASUREMENT	*********	*********	*****	*********	12.0	12.0		0	01/30	24
MLOC=1	PERMIT REQUIREMENT			*****		30 MO AVG	45 DAILY MX	MG/L		01/30	24
00400 LAB ID: 20001 pH Standard Units	SAMPLE MEASUREMENT	*********	*********	*****	5.9	*********	7.0		2	03/30	GR
MLOC=1	PERMIT REQUIREMENT			*****	6.0 MINIMUM		8.5 DAILY MX	SU		01/30	GR
00530 LAB ID: 20001 Total Suspended Solids (TSS)	SAMPLE MEASUREMENT	*********	*********	*****	*********	8.1	8.1		0	01/30	24
MLOC=1	PERMIT REQUIREMENT			*****		30 MO AVG	45 DAILY MX	MG/L		01/30	24
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant	SAMPLE MEASUREMENT	0.000200	0.000200		*********	*********	*********	*****	0	01/30	IN
MLOC=1	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				*****		01/30	IN
50060 LAB ID: 20001 Total Residual Chlorine	SAMPLE MEASUREMENT	*********	*********	*****	*********	0	0		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			*****		0.5 MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
74055 LAB ID: 40569 Fecal Coliform General	SAMPLE MEASUREMENT	*********	*********	*****	*********	<1	<1		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			*****		200 30DAVGEO	400 DAILY MX	# PER 100ML		01/30	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	[signature]	803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

pH and DO below permit limits at the beginning of the month. Low flow is believed to be problem. The aeration time was increased on the outfall to correct the problems. All parameters were within permit limits by Nov. 3.
Total F[illegible]ual Chlorine, method SM4500 CLG, PQL 0.1 mg/L, number of times results less than PQL = one.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	001 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	92.1	96.1	DEG. FAR.	0	99/99	CN
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	[illegible] DAILY MX			99/99	CN
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=7	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	66.3	70.1	DEG. FAR.	0	99/99	CN
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX			99/99	CN
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=T	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	68.1	76.2	DEG. FAR.	0	99/99	CN
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	REPORT DAILY MX			99/99	CN
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	7.4	********* *********	7.4	SU	0	01/30	GR
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		8.5 MAXIMUM			01/30	GR
01042 LAB ID: 32006 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.016	0.016	MG/L	0	01/30	GR
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX			01/30	GR
01045 LAB ID: 32006 Iron, Total as Fe MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.325	0.325	MG/L	0	01/30	GR
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX			01/30	GR
01055 LAB ID: 32006 Manganese, Total MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.027	0.027	MG/L	0	01/30	GR
	PERMIT REQUIREMENT			***** *****		REPORT MO AVG	REPORT DAILY MX			01/30	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	W. [signature]	803	345-4214	05	12	23
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

MLOC=1 -DISCHARGE TEMPERATURE SHALL BE MONITORED AT THE OUTLET CORRESPONDING TO AN INDIVIDUAL UNIT PRIOR TO MIXING WITH RECEIVING STREAM. MLOC=T - PLUME TEMPERATURE SHALL BE TAKEN AT THE INTAKE STRUC[illegible] MLOC=7 - INTAKE TEMPERATURE SHALL BE MEASURED ON [illegible]T SIDE OF THE MAIN CONDENSER.

MLOC=T 58 hours of missing data due to equipment failure. Permit limits are not likely to be exceeded in N[illegible]mber.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	001 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	738.7	738.7		********* *********	********* *********	********* *********	***** *****	0	99/99	ES
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		99/99	ES
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.		803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

MLOC=1 - DISCHARGE TEMPERATURE SHALL BE MONITORED AT THE OUTLET CORRESPONDING TO AN INDIVIDUAL UNIT PRIOR TO MIXING WITH RECEIVING STREAM. MLOC=T - PLUME TEMPERATURE SHALL BE TAKEN AT THE INTAKE STRUC RE. MLOC=7 - INTAKE TEMPERATURE SHALL BE MEASURED ON INLET SIDE OF THE MAIN CONDENSER.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	003 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	6.3	********* *********	7.4		0	01/OC	GR
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		9.0 MAXIMUM	SU		01/30	GR
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=S	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.0	0.0		0	02/30	GR
	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		01/OC	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=S	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	02/30	GR
	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		01/OC	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=S	SAMPLE MEASUREMENT	0.004286	0.004350		********* *********	********* *********	********* *********	***** *****	0	01/OC	ES
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/OC	ES
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	D. Frank [signature]	803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

MLOC=S - SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE OF DISCHARGE, BUT NEED NOT BE MORE THAN ONCE PER MONTH. NOTE: SAMPLES SHALL BE TAKEN AT THE FOLLOWING LOCATIONS - SEE PAGE 19, PARA. A. 2.
O&G Meth SM-5520B, PQL 5.0 mg/L, number of times results below PQL = two. S Method SM 2540D, number of times results below PQL = two.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

PERMIT NUMBER	DISCHARGE NUMBER
SC0030856	004 1

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0	0		0	01/OC	GR
	PERMIT REQUIREMENT			*****		10 MO AVG	100 DAILY MX	MG/L		01/OC	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr - Grav Method MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0	0		0	01/OC	GR
	PERMIT REQUIREMENT			*****		15 MO AVG	20 DAILY MX	MG/L		01/OC	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.001860	0.001860		*********	*********	*********	*****	0	01/OC	CN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				*****		01/OC	CN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	12	20
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE, BUT NEED NOT BE MORE THAN ONCE PER MONTH.
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATION - SEE PAGE 20, PARA. A.3.
O&G M[illegible]d SM-5520B, PQL 5.0 mg/L, number of times results below PQL = one. TSS Method SM 2540D, number of times results below PQL = one.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	005 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00310 LAB ID: 40569 BOD - 5 Day (20 Degrees C) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	12.0	12.0		0	01/30	24
	PERMIT REQUIREMENT			***** *****		10 MO AVG	15 DAILY MX	MG/L		01/30	24
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	11.8	11.8		0	01/30	24
	PERMIT REQUIREMENT			***** *****		30 MO AVG	45 DAILY MX	MG/L		01/30	24
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.003450	0.005100		********* *********	********* *********	********* *********	***** *****	0	04/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
74055 LAB ID: 40569 Fecal Coliform General MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	<1	<1		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		200 30DAVGEO	400 DAILY MX	# PER 100ML		01/30	GR
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.		803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 21, PARA. A.4..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	06A 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	100 DAILY MX	MG/L		01/30	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		15 MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.036700	0.036700		********* *********	********* *********	********* *********	***** *****	0	01/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
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TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 22. A.5..
Total Suspended Solids Method SM2540D, PQL 1.0 mg/L, number of times result less than PQL = one.
Oil & Gr[illegible]e Method SM-5520B, PQL 5.0 mg/L, number of times results below PQ[illegible] = one.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	06B 1
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

Form Approved.
OMB No. 2040-0004

MAJOR

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	5.5	5.5		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	98 DAILY MX	MG/L		01/30	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.008375	0.011800		********* *********	********* *********	********* *********	***** *****	0	04/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	W. Frank Baxter	803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 23, PARA 6..

Oil & Gr[illegible] Method SM-5520B, PQL 5.0 mg/L, number of times results below P[illegible] one.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS: P. O. Box 88
Jenkinsville, SC 29065

FACILITY: SCE&G / V C SUMMER NUCLEAR STAT
LOCATION: HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	007 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	6.9	********* *********	7.2		0	01/DS	GR
Standard Units MLOC=1	PERMIT REQUIREMENT			***** *****	(6.0) MINIMUM		9.0 DAILY MX	SU		01/30	GR
00530 LAB ID: 20001 Total Suspended	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	2.4	2.4		0	01/30	GR
Solids (TSS) MLOC=1	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		01/30	GR
00556 LAB ID: 20001 Oil & Grease Freon	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
Extr-Grav Method MLOC=1	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or	SAMPLE MEASUREMENT	0.070567	0.102500		********* *********	********* *********	********* *********	***** *****	0	01/DS	IN
Thru Treatment Plant MLOC=1	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	05	12	20
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 24, PARA. A.7..

Oil & G[illegible]se Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = one

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	008 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		01/OC	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		01/OC	GR
01042 LAB ID: 20001 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/OC	GR
01045 LAB ID: 20001 Iron, Total as Fe MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/OC	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	NO	DISCHARGE		********* *********	********* *********	********* *********	***** *****			
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/01	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.		803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE OF DISCHARGE. SHOULD THE DURATION OF DISCHARGE EXCEED ONE WEEK, THE DISCHARGE SHALL BE SAMPLED ONCE PER WEEK UNTIL THE END OF DISCHARGE. NOTE: SAMP[illegible]ALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 25 - PA[illegible].8. B..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	012 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	7.8	********* *********	7.8		0	01/30	GR
Standard Units MLOC=1	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		8.5 MAXIMUM	SU		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or	SAMPLE MEASUREMENT	0.008000	0.008000		********* *********	********* *********	********* *********	***** *****	0	01/30	IN
Thru Treatment Plant MLOC=1	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.		803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 26. PARA A.9..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	014 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD					
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	11	01	TO	05	11	30

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH Standard Units	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****		********* *********					
MLOC=1 NNNYYYYYYYNN	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		9.0 MAXIMUM	SU		01/30	GR
00400 LAB ID: 20001 pH Standard Units	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	7.7	********* *********	7.7		0	01/30	GR
MLOC=1 YYYNNNNNNNYY	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		8.5 MAXIMUM	SU		01/30	GR
00610 LAB ID: 20001 Ammonia-Nitrogen Total as N	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.2	0.2		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
01042 LAB ID: 20001 Copper, Total as Cu	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant	SAMPLE MEASUREMENT	0.107021	0.260000		********* *********	********* *********	********* *********	***** *****	0	99/99	CN
MLOC=1	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		99/99	CN
50060 LAB ID: 20001 Total Residual Chlorine	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
MLOC=1	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		01/30	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	W. [illegible]	803	345-4214	05	12	20
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

Copper - method SM3111B, lowest calibration standard = 0.015 mg/l, detection limit = 0.010 mg/l, # times results reported as 0 = one
Residua' [illegible]ine - method SM4500CLD, lowest calibration standard = 0.05 mg/l, detectio[illegible] = 0.05 mg/l, # times results reported as 0 = one

Thomas D. Gatlin
General Manager, Nuclear Plant Operations
803.345.4342

SCE&G®
A SCANA COMPANY

January 24, 2006

Ms. Melanie H. Hindman
Water Quality Assessments and Enforcement Division
Bureau of Water
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201

Dear Ms. Hindman:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
MONTHLY DISCHARGE MONITORING REPORTS
NPDES PERMITS NO. SC0030856 & SC0038407

Enclosed are the Monthly Discharge Monitoring Reports (DMRs), with one (1) additional copy of each, submitted in accordance with the subject NPDES permits. These reports cover the period of December 1 through December 31, 2005. The DMRs contain all the parameter results of the outfalls as required by NPDES Permits No. SC0030856 and SC0038407. All parameters were within specification during the reporting period.

Should there be any questions, please contact Ms. Susan B. Reese at (803) 345-4591.

Very truly yours,

Thomas D. Gatlin

SBR/TDG/sr
Enclosures

c: R. J. White (w/o enclosures)
Central Midlands District Office (w/o enclosures)
J. W. Preston (P05)
J. A. Orr (P40)
W. F. Bacon (331)
NSRC
RTS (L-99-0101)
File (818.03-11, RR 4200)
DMS (RC-06-0019)

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / SUMMER NUCLEAR TRAINING
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY LOCATION SCE&G / SUMMER NUCLEAR TRAINING
JUNCTION OF HWY 213 & CTY RD 16

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0038407	001 1
PERMIT NUMBER	DISCHARGE NUMBER

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 03/01/2003 - 07/31/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00300 LAB ID: 20001 Dissolved Oxygen MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****		********* *********	********* *********				
	PERMIT REQUIREMENT			***** *****	[illegible] INST MIN			MG/L		[illegible]	[illegible]
00310 LAB ID: 40569 BOD - 5 Day (20 Degrees C) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****		********* *********					
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		8.5 DAILY MX	SU		[illegible]	[illegible]
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	NO	FLOW		********* *********	********* *********	********* *********	***** *****			
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		[illegible]	[illegible]
50060 LAB ID: 20001 Total Residual Chlorine MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
74055 LAB ID: 40569 Fecal Coliform General MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		200 30DAVG	400 DAILY MX	# PER 100ML		[illegible]	[illegible]

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE: 803 345-4214 (NUMBER)
DATE: 06 / 01 / 23 (YEAR / MO / DAY)

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

There was no effluent flow from this outfall in December.

PERMITTEE N[illegible]DDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT D[illegible]RGE ELIMINATION SYSTEM *(NPDES)*
DISCHARG[illegible]NITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	001 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

	MONITORING PERIOD					
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	80.3	87.0	DEG. FAR.	0	99/99	CN
	PERMIT REQUIREMENT			*****		REPORT MO AVG	[illegible] DAILY MX			99/99	CN
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=7	SAMPLE MEASUREMENT	*********	*********	*****	*********	54.3	61.0	DEG. FAR.	0	99/99	CN
	PERMIT REQUIREMENT			*****		REPORT MO AVG	REPORT DAILY MX			99/99	CN
00011 LAB ID: 20001 Water Temperature (Fahrenheit) MLOC=T	SAMPLE MEASUREMENT	*********	*********	*****	*********	53.7	65.0	DEG. FAR.	0	99/99	CN
	PERMIT REQUIREMENT			*****		90 MO AVG	REPORT DAILY MX			99/99	CN
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	6.8	*********	6.8	SU	0	01/30	GR
	PERMIT REQUIREMENT			*****	6.0 MINIMUM		8.5 MAXIMUM			01/30	GR
01042 LAB ID: 32006 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0	0	MG/L	0	01/30	GR
	PERMIT REQUIREMENT			*****		REPORT MO AVG	REPORT DAILY MX			01/30	GR
01045 LAB ID: 32006 Iron, Total as Fe MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0.473	0.473	MG/L	0	01/30	GR
	PERMIT REQUIREMENT			*****		REPORT MO AVG	REPORT DAILY MX			01/30	GR
01055 LAB ID: 32006 Manganese, Total MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0.016	0.016	MG/L	0	01/30	GR
	PERMIT REQUIREMENT			*****		REPORT MO AVG	REPORT DAILY MX			01/30	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
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TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

MLOC=1 -DISCHARGE TEMPERATURE SHALL BE MONITORED AT THE OUTLET CORRESPONDING TO AN INDIVIDUAL UNIT PRIOR TO MIXING WITH RECEIVING STREAM. MLOC=T - PLUME TEMPERATURE SHALL BE TAKEN AT THE INTAKE STRUCTURE. MLOC=7 - INTAKE TEMPERATURE SHALL BE MEASURED ON INLET SIDE OF THE MAIN CONDENSER.

Copper - method SW846, 6010B. PQL = 0.01 mg/L, number of times results less than PQL = one

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

SC0030856 — PERMIT NUMBER

001 1 — DISCHARGE NUMBER

MAJOR

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

	YEAR	MO	DAY		YEAR	MO	DAY
MONITORING PERIOD FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	AVERAGE	MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	738.7	738.7		********* *********	********* *********	********* *********	***** *****	0	99/99 *	ES
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		99/99	ES
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
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NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
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V.P. Nuclear Operations
TYPED OR PRINTED

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TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

MLOC=1 - DISCHARGE TEMPERATURE SHALL BE MONITORED AT THE OUTLET CORRESPONDING TO AN INDIVIDUAL UNIT PRIOR TO MIXING WITH RECEIVING STREAM. MLOC=T - PLUME TEMPERATURE SHALL BE TAKEN AT THE INTAKE STRUCTURE. MLOC=7 - INTAKE TEMPERATURE SHALL BE MEASURED ON INLET SIDE OF THE MAIN CONDENSER.

* 45 hours of missing data due to system malfunctions. System has been repaired and calibrated.

PERMITTEE NA[illegible]DDRESS *(Include Facility Name/Location if Different)*

NATIONAL POLLUTANT D[illegible]GE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE [illegible]NITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

SC0030856	001 2
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
TCP3B LAB ID: 36001 %Effect Statre 7Day Chr Ceriodaphnia MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/90	GR
	PERMIT REQUIREMENT			***** *****		25 QRTR AVG	40 DAILY MX	PER-CENT		01/90	GR
TJP3B LAB ID: 36001 %Mortality 7Day Chr Ceriodaphnia MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/90	GR
	PERMIT REQUIREMENT			***** *****		REPORT QRTR AVG	REPORT MAXIMUM	PER-CENT		01/90	GR
TVP3B LAB ID: 36001 % Repro Reduc Statre 7d Chr Ceriodaphnia MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/90	GR
	PERMIT REQUIREMENT			***** *****		REPORT QRTR AVG	REPORT MAXIMUM	PER-CENT		01/90	GR
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.		803	345-4214	06	01	23
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS ***(Reference all attachments here)***

Chronic toxicity CTC=100.00% effluent.

DMR Attachment for Multi-Concentration Toxicity Test Results. Bureau of Water **01/10/2003**

SCE&G/V C SUMMER NUCLEAR STAT Permit number SC0030856 Discharge number 0012
Final Limits 02/01/2003-04/30/2007 Parameter Code **TCP3B** MLOC=1 CTC=100.00% effluent

Monitoring period	Year	Month	Day		Year	Month	Day
From	05	10	01	To	05	12	31

Date 10/17/05

Lab ID 36001

Group	All tests: # Adults	All tests: # Dead	Chronic tests only: Group Average	Chronic tests only: Group Variance
0.0000	10	0	18	4
50.0000	10	0	18	5
60.0000	10	0	17	9
71.0000	10	0	16	2
84.0000	10	0	16	13
100.0000	10	0	16	6
0.0000				
0.0000				
0.0000				
0.0000				

Survival Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control survival = Predicted % Survival Effect at CTC=
Reproduct Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control Reproduct= Predicted % Reproduct Effect at CTC=

Date

Lab ID

Group	All tests: # Adults	All tests: # Dead	Chronic tests only: Group Average	Chronic tests only: Group Variance
0.0000				
50.0000				
60.0000				
71.0000				
84.0000				
100.0000				
0.0000				
0.0000				
0.0000				
0.0000				

Survival Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control survival = Predicted % Survival Effect at CTC=
Reproduct Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control Reproduct= Predicted % Reproduct Effect at CTC=

Signature of Principal Executive Officer or Authorized Agent [signature]

Name/Title of Principal Executive Officer *(typed or printed)* Jeffrey B. Archie 01/23/06
VP Nuclear Operations (Date today)

DHEC 3710 (6/00) Rev 1.0 (10/02)

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	003 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	6.1	********* *********	6.9		0	01/OC	GR
	PERMIT REQUIREMENT			***** *****	MINIMUM		MAXIMUM	SU		[illegible]	[illegible]
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=S	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	02/30	GR
	PERMIT REQUIREMENT			***** *****		MO AVG	DAILY MX	MG/L		[illegible]	[illegible]
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=S	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	02/30	GR
	PERMIT REQUIREMENT			***** *****		MO AVG	DAILY MX	MG/L		[illegible]	[illegible]
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=S	SAMPLE MEASUREMENT	0.004281	0.004500		********* *********	********* *********	********* *********	***** *****	0	01/OC	ES
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		[illegible]	[illegible]
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

[signature]
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
MLOC=S - SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE OF DISCHARGE, BUT NEED NOT BE MORE THAN ONCE PER MONTH. NOTE: SAMPLES SHALL BE TAKEN AT THE FOLLOWING LOCATIONS - SEE PAGE 19, PARA. A. 2.
O&G Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = two. TSS Method SM 2540D, number of times results below PQL = two.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	004 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		30 MO AVG	100 DAILY MX	MG/L		[illegible]	[illegible]
00556 LAB ID: 20001 Oil & Grease Freon Extr - Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		15 MO AVG	20 DAILY MX	MG/L		[illegible]	[illegible]
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	No	Discharge		********* *********	********* *********	********* *********	***** *****			
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		[illegible]	[illegible]
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE. BUT NEED NOT BE MORE THAN ONCE PER MONTH.
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATION - SEE PAGE 20, PARA. A.3.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	005 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00310 LAB ID: 40569 BOD - 5 Day (20 Degrees C) MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	16.0	16.0		0	01/30	24
	PERMIT REQUIREMENT			*****		MO AVG	DAILY MX	MG/L			
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	10.7	10.7		0	01/30	24
	PERMIT REQUIREMENT			*****		MO AVG	DAILY MX	MG/L			
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.002633	0.002900		*********	*********	*********	*****	0	06/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				*****			
74055 LAB ID: 40569 Fecal Coliform General MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	<1	<1		0	01/30	GR
	PERMIT REQUIREMENT			*****		MO AVG	DAILY MX	# PER 100ML			
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 21, PARA. A.4..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location If Different)*

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

SC0030856	06A 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	2.3	2.3		0	01/30	GR
	PERMIT REQUIREMENT			***** *****				MG/L			
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****				MG/L			
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.108900	0.108900		********* *********	********* *********	********* *********	***** *****	0	01/30	IN
	PERMIT REQUIREMENT			MGD				***** *****			
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 22. A.5..

Oil & Grease Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL

PERMITTEE NAM[illegible]DRESS *(Include Facility Name/Location if Different)*

NATIONAL POLLUTANT DISC[illegible]E ELIMINATION SYSTEM *(NPDES)*
DISCHARGE M[illegible]ITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

SC0030856	06B 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	6.5	6.5		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.0	0.0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.012917	0.022200		********* *********	********* *********	********* *********	***** *****	0	06/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		[illegible]	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 23. PARA 6..

Oil & Grease Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL

EPA Form 3320 - 1 (REV 3/99) Previous editions may be used. 02/12/2003

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	007 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	6.6	*********	7.1		0	01/DS	GR
	PERMIT REQUIREMENT			*****	[illegible] MINIMUM		[illegible] DAILY MX	SU		[illegible]	[illegible]
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	4.8	4.8		0	01/30	GR
	PERMIT REQUIREMENT			*****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	GR
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			*****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.073000	0.095000		*********	*********	*********	*****	0	01/DS	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				*****		[illegible]	[illegible]
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Jeffrey B. Archie
V.P. Nuclear Operations

TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 24. PARA. A.7..

Oil & Grease Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = one

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	008 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	100 DAILY MX	MG/L		[illegible]	[illegible]
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	20 DAILY MX	MG/L		[illegible]	[illegible]
01042 LAB ID: 20001 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
01045 LAB ID: 20001 Iron, Total as Fe MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********						
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	NO	DISCHARGE		********* *********	********* *********	********* *********	***** *****			
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		[illegible]	[illegible]
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant *penalties for submitting false information*, including the possibility of fine and imprisonment for knowing violations.	[signature]	803	345-4214	06	01	23
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

SAMPLES SHALL BE TAKEN AT LEAST ONCE PER OCCURRENCE OF DISCHARGE. SHOULD THE DURATION OF DISCHARGE EXCEED ONE WEEK, THE DISCHARGE SHALL BE SAMPLED ONCE PER WEEK UNTIL THE END OF DISCHARGE. NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 25 - PARA. A.8. B..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	012 1	MAJOR
PERMIT NUMBER	DISCHARGE NUMBER	

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	7.8	********* *********	7.8		0	01/30	GR
	PERMIT REQUIREMENT			***** *****	6.0 MINIMUM		8.5 MAXIMUM	SU		01/30	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.011800	0.011800		********* *********	********* *********	********* *********	***** *****	0	01/30	IN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		01/30	IN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeffrey B. Archie
V.P. Nuclear Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 26, PARA A.9..

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

SC0030856	012 2
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	07	01	TO	05	12	31

Form Approved.
OMB No. 2040-0004

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	03/YR	GR
	PERMIT REQUIREMENT	[illegible]	[illegible]	***** *****	[illegible]	[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
00556 LAB ID: 20001 Oil & Grease Freon Extr-Grav Method MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	03/YR	GR
	PERMIT REQUIREMENT	[illegible]	[illegible]	***** *****	[illegible]	[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	[illegible]
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
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	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
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TYPED OR PRINTED				NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 26. PARA.A.9..
Total Suspended Solids Method SM2540D, PQL 1.0 mg/L, number of times result less than PQL = two.
Oil & Grease Method SM-5520B, PQL 5.0 mg/L, number of times results below PQL = two.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	013 1
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	07	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
00400 LAB ID: 20001 pH Standard Units MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	6.2	*********	6.2		0	02/YR	GR
	PERMIT REQUIREMENT			*****	REPORT MINIMUM		REPORT MAXIMUM	SU		02/YR	GR
00530 LAB ID: 20001 Total Suspended Solids (TSS) MLOC=1	SAMPLE MEASUREMENT	*********	*********	*****	*********	0.0	1.4		0	03/YR	GR
	PERMIT REQUIREMENT			*****		REPORT MO AVG	REPORT DAILY MX	MG/L		02/YR	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.000500	0.000500		*********	*********	*********	*****	0	02/YR	ES
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				*****		02/YR	ES
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.		803	345-4214	06	01	23
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

Total Suspended Solids Method SM2540D, PQL 1.0 mg/L, number of times result less than PQL = one.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

PERMIT NUMBER	DISCHARGE NUMBER	
SC0030856	014 1	MAJOR

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	12	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
00400 LAB ID: 20001 pH Standard Units MLOC=1 NNNYYYYYYYNN	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****		********* *********					
	PERMIT REQUIREMENT			***** *****	[illegible] MINIMUM		[illegible] MAXIMUM	SU		[illegible]	GR
00400 LAB ID: 20001 pH Standard Units MLOC=1 YYYNNNNNNNYY	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	7.0	********* *********	7.0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****	[illegible] MINIMUM		[illegible] MAXIMUM	SU		01/30	GR
00610 LAB ID: 20001 Ammonia-Nitrogen Total as N MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.84	0.84		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	GR
01042 LAB ID: 20001 Copper, Total as Cu MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0.018	0.018		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	GR
50050 LAB ID: 20001 Flow in Conduit or Thru Treatment Plant MLOC=1	SAMPLE MEASUREMENT	0.053049	0.230000		********* *********	********* *********	********* *********	***** *****	0	99/99 *	CN
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD				***** *****		99/99	CN
50060 LAB ID: 20001 Total Residual Chlorine MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/30	GR
	PERMIT REQUIREMENT			***** *****		[illegible] MO AVG	[illegible] DAILY MX	MG/L		[illegible]	GR

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
Jeffrey B. Archie V.P. Nuclear Operations	I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	[signature]	803	345-4214	06	01	23
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS ***(Reference all attachments here)***
* 64 hours of missing data due to equipment failure..

Residual Chlorine - method SM4500CLD, lowest calibration standard = 0.05 mg/l, detection limit = 0.05 mg/l, # times results reported as 0 = one

PERMITTEE NA..._/ADDRESS *(Include Facility Name/Location if Different)*

NAME SCE&G / V C SUMMER NUCLEAR STAT
ADDRESS P. O. Box 88
Jenkinsville, SC 29065

FACILITY SCE&G / V C SUMMER NUCLEAR STAT
LOCATION HIGHWAY 215

NATIONAL POLLUTANT D... ARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. 2040-0004

SC0030856	014 2
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	05	10	01	TO	05	12	31

39 CM FINAL LIMITS
DMR VALID: 02/01/2003 - 04/30/2007
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
TCP3B LAB ID: 36001 %Effect Statre 7Day Chr Ceriodaphnia MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/90	GR
	PERMIT REQUIREMENT			***** *****		[illegible] QRTR AVG	40 DAILY MX	PER-CENT		01/90	GR
TJP3B LAB ID: 36001 %Mortality 7Day Chr Ceriodaphnia MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/90	GR
	PERMIT REQUIREMENT			***** *****		REPORT QRTR AVG	REPORT MAXIMUM	PER-CENT		01/90	GR
TVP3B LAB ID: 36001 % Repro Reduc Statre 7d Chr Ceriodaphnia MLOC=1	SAMPLE MEASUREMENT	********* *********	********* *********	***** *****	********* *********	0	0		0	01/90	GR
	PERMIT REQUIREMENT			***** *****		REPORT QRTR AVG	REPORT MAXIMUM	PER-CENT		01/90	GR
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
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	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Jeffrey B. Archie
V.P. Nuclear Operations

TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
803	345-4214	06	01	23
	NUMBER	YEAR	MO	DAY

COMMENT AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

NOTE: SAMPLES SHALL BE TAKEN AT FOLLOWING LOCATIONS - SEE PAGE 32. PARA B.4.A..

Chronic toxicity CTC=100.00% effluent.

DMR Attachment for Multi-Concentration Toxicity Test Results. Bureau of Water 01/10/2003

SCE&G/V C SUMMER NUCLEAR STAT Permit number SC0030856 Discharge number 0142
Final Limits 02/01/2003-04/30/2007 Parameter Code **TCP3B** MLOC=1 CTC=100.00% effluent

Monitoring period	Year	Month	Day		Year	Month	Day
From	05	10	01	To	05	12	31

Date 10/17/05

Lab ID 36001

Group	All tests # Adults	All tests # Dead	Chronic tests only Group Average	Chronic tests only Group Variance
0.0000	10	1	16	32
50.0000	10	0	19	3
60.0000	10	0	18	3
71.0000	10	0	18	5
84.0000	10	0	16	5
100.0000	10	0	17	15
0.0000				
0.0000				
0.0000				
0.0000				

Survival Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control survival = Predicted % Survival Effect at CTC=
Reproduct Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control Reproduct= Predicted % Reproduct Effect at CTC=

Date

Lab ID

Group	All tests # Adults	All tests # Dead	Chronic tests only Group Average	Chronic tests only Group Variance
0.0000				
50.0000				
60.0000				
71.0000				
84.0000				
100.0000				
0.0000				
0.0000				
0.0000				
0.0000				

Survival Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control survival = Predicted % Survival Effect at CTC=
Reproduct Model $\alpha=$ $\beta=$ $\gamma=$ $\delta=$ Predicted control Reproduct= Predicted % Reproduct Effect at CTC=

Signature of Principal Executive Officer or Authorized Agent [signature]

Name/Title of Principal Executive Officer *(typed or printed)* Jeffrey B. Archie
VP Nuclear Operations
01/23/06 (Date today)

DHEC 3710 (6/00) Rev 1.0 (10/02)

Section 5.5 References

1. SCE&G undated. *Solid Waste Management and Waste Minimization Plan for Virgil C. Summer Nuclear Station*, Rev. 1.

2. U.S. NRC 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volume 1, Office of Nuclear Regulatory Research, May. 1996.

Section 5.5
Ref 1

SOLID WASTE MANAGEMENT AND WASTE MINIMIZATION PLAN FOR VIRGIL C. SUMMER NUCLEAR STATION

PREPARED BY
SOUTH CAROLINA ELECTRIC
AND
GAS COMPANY

Revision 1

SCEG

APPROVALS

____
W. FRANK BACON
MANAGER,CHEMISTRY SERVICES

____
STEVE BYRNE
GENERAL MANAGER,NUCLEAR PLANT OPERATIONS

Date Issued________________

TABLE OF CONTENTS

SECTION	TITLE	PAGE

LISTS OF DRAWINGS

SECTION 1

INTRODUCTION

This solid waste management and minimization plan has been prepared per the requirements of the current NPDES Permit (SC0030856) and RCRA sections 3002(b) and 3005(h) for the Virgil C. Summer Nuclear Station. The purpose of the plan is to describe in detail how solid wastes produced at the facility will be handled and disposed. For the purpose of this plan, the term "solid waste" will refer to sludge, waste oil, and solid wastes whether hazardous or not. This plan will be used as a guide to ensure that all solid wastes are properly disposed of in accordance with the rules and regulations of the South Carolina Department of Health and Environmental Control's (DHEC) Bureau of Solid and Hazardous Waste Management.

This plan is divided into five sections: Introduction, Background, Solid Waste Management Practices, Management of Future Solid Wastes, and Waste Minimization. Section 3, Solid Waste Management Practices, describes in detail each existing solid waste produced at the plant. Subsections included in the description for each waste are: Identification, Collection and Storage, Transfer, Disposal and Waste Minimization. The plan also includes a map of the facility.

Once the plan is approved by SCDHEC, the plan will be kept on file at the facility. Modifications should be made as new or different solid wastes are produced or identified at the plant. All modifications should be submitted to DHEC for approval. This revision incorporates the RCRA Waste Minimization Plan requirements and adds new waste categories in Sections 3.22-3.26.

SECTION 2

BACKGROUND

The Virgil C. Summer Nuclear Station is located 26 miles northwest of Columbia, South Carolina near the community of Jenkinsville in Fairfield County. The plant is a joint project between South Carolina Electric and Gas Company, operator and two-thirds owner of the plant, and the South Carolina Public Service Authority (Santee Cooper), owner of the remaining one-third. The plant is a three loop pressurized water reactor that produces 930 Megawatts of electricity.

The plant's newest NPDES Permit, effective date of November 1, 1993, has the following condition:

> "All sludges, waste oil and solid and hazardous waste shall be properly disposed of in accordance with the rules and regulations of the Bureau of Solid and Hazardous Waste Management, including the intake screen backwash. Within ninety (90) days of the permit effective date, the permittee shall submit a plan which details the sludge and solids management and disposal practices including the chemical metal cleaning sludge at this facility for review and approval."

In addition, on May 28, 1993. EPA published, in Federal Register (58 FR 31114), interim final guidance on what EPA would consider to constitute a "program in place" for compliance with the certification requirements of RCRA sections 3002(b) and 3005(h). Section 3002(b) requires generators of hazardous waste to certify, on their hazardous waste manifests, that they have a waste minimization program in place to reduce the volume and quantity or toxicity of such waste to the degree determined by the generator to be economically practicable. Section 3005(h) requires that owners and operators of facilities that receive a permit for the treatment, storage, or disposal of hazardous waste on the premises where such waste was generated, to make the same certification no less often than annually. Virgil C. Summer Nuclear Station is both a generator of hazardous waste and an interim permitted storage facility, therefore sections 3002(b) and 3005(h) are applicable._

The issue of waste minimization was also addressed in the NRC's IEN94-0023. The NRC endorsed the Federal Register and recommended that the concepts of waste minimization were also applicable to radioactive waste._

To meet these requirements, SCE&G personnel developed this plan based on the existing operations at the plant.

SOLID WASTE MANAGEMENT PRACTICES

3.1 Oil Waste Absorbents

3.1.1 Identification

Oil waste absorbents consist of clean-up materials such as rags, oil-dry or other oil absorbents.

3.1.2 Collection and Storage

The oil waste absorbents are collected from various clean-up operations on site and stored in drums. Once the drums are filled, they are moved to a designated storage area, L-52, until a sufficient number of drums are collected to warrant disposal.

3.1.3 Transfer

The drums are transferred via an independent vendor.

3.1.4 Disposal

Disposal is handled by an independent vendor.

3.1.5 Waste minimization

The volume of waste absorbents is minimized by an aggressive maintenance program. Oil leaks are identified during plant walkdowns. Any oil leaks are identified, contained and maintenance work requests are initiated to repair the leak.

3.2 **Empty Oil Drums**

3.2.1 Identification

Empty oil drums are left from various equipment operations on site. The drums are emptied as much as possible through the used of the product. A small quantity of residue may be left in the drums. These drums are not classified as hazardous waste.

3.2.2 Collection and Storage

The empty oil drums are collected and stored on site at the designated storage are, L-52, until a sufficient number of drums are collected to warrant disposal.

3.2.3 Transfer

The drums are transferred via a independent vendor.

3.2.4 Disposal

Disposal is by metal recycling and is handled by an independent vendor if the drum cannot be re-used.

3.2.5 Waste minimization

Drums are rinsed and reused whenever possible, as a means of waste minimization. Drums that can not re-used are placed with scrap metal for recycling.

3.3 **Scrap Metal**

3.3.1 Identification

Scrap metal consists of unusable metals generated through various plant operations. These scrap metals are not classified as hazardous.

3.3.2 Collection and Storage

The scrap metal is collected from different areas of the site and stored in a roll-off container.

3.3.3 Transfer

The roll-off container itself is hauled using a container truck. Hauling is done by an independent service.

3.3.4 Disposal

The scrap metal is sent to a scrap metal dealer for recycling.

3.3.5 Waste Minimization

No attempt is made to minimize the volume of this waste. The waste is recycled.

3.4 **Plant Garbage**

3.4.1 Identification

This is general garbage collected on site. It consists of employee generated trash such as office and lunch room garbage. It is also includes operations generated trash such as material bags, cardboard boxes, and wood. This garbage is not hazardous.

3.4.2 Collection and Storage

The garbage is collected in various receptacles located on site. Recyclable white paper and green bar paper is separated and stored in tagged trash bags. Cardboard boxes are collected and stored in waste containers. Aluminum cans are collected in plastic receptacles and stored for recycling. The plant garbage is stored in large roll-off containers.

3.4.3 Transfer

The roll-off containers are hauled using a container truck. The white paper and green bar paper is transferred for recycling by an independent vendor. The cardboard boxes are transferred for recycling by an independent vendor. The aluminum cans are transferred to a recycling center.

3.4.4 Disposal

The plant garbage is hauled to a permitted municipal landfill for disposal. White paper, green bar paper, aluminum cans, and cardboard boxes are recycled.

3.4.5 Waste minimization

This waste source is minimized through recycling of paper, cardboard and aluminum. Personnel are encouraged to reduce other sources of waste whenever possible.

3.5 <u>Metal Working Wastes</u>

3.5.1 Identification

Metal working wastes are products (machine filings, slag, and welding rod butts) generated from various metal working operations. Machine filings are thin metal shavings generated in the preparatory or finishing process of metal objects prior to welding, assembly, etc. Slag is resolidified molten metal drippings generated when cutting steel with an acetylene gas torch. Welding rod butts are small metal rod remnants generated in the welding process due to the physical limitations that do not allow for complete consumption of the welding rods.

3.5.2 Collection and Storage

Machine filings and slag are collected from the floor by sweeping. The machine filings and slag are put into trash cans. The welding rod butts are collected in small cans or buckets by the welder. The small cans are emptied into trash cans. The trash cans are then emptied into a container provided by a private waste transporter.

3.5.3 Transfer

The container itself is hauled by an independent service.

3.5.4 Disposal

The container contents along with the plant garbage are hauled to a permitted municipal landfill for disposal.

3.5.5 Waste minimization

There is no attempt to minimize this source of waste.

3.6 **Waste Gaskets**

3.6.1 Identification

Waste Gaskets are unusable gaskets of various material (rubber, paper, teflon, etc.) generated during the repair or rebuilding of plant equipment. Asbestos containing gaskets are discussed in section 3.24.

3.6.2 Collection and Storage

The waste gaskets are collected and put into trash cans which are then emptied into a container provided by a private waste transporter. Gaskets that are contaminated with radioactive material are disposed of as radioactive waste.

3.6.3 Transfer

The container itself is hauled by an independent service.

3.6.4 Disposal

The container contents along with the plant garbage are hauled to a permitted municipal landfill for disposal. Asbestos containing gasket material is handled in accordance with the company asbestos disposal plan.

3.6.5 Waste minimization

The amount of gasket material waste generated is a function of the amount of work performed in the plant, therefore no attempt is made to minimize this volume of this waste.

3.7 **Waste Solvents**

3.7.1 Identification

Liquid solvent waste, used in the Oil Analysis Lab, is generated when solvent used in cleaning processes becomes saturated with oil or grease. Liquid solvents are also used in the various laboratories for certain analytical procedures.

3.7.2 Collection and Storage

The waste solvent is collected in drums at the satellite accumulation stations which are located in various places in the plant and labs.

3.7.3 Transfer

The collection drums are picked up and transported by a permitted independent vendor.

3.7.4 Disposal

The waste solvent will be recycled by an independent vendor or processed by an approved disposal facility.

3.7.5 Waste minimization

Waste solvents are recycled for reuse whenever possible. Chemistry personnel are trained to minimize the use of solvents for cleaning. Less toxic or non-hazardous wastes are used whenever possible.

3.8 Resins from Water Treatment Plant

3.8.1 Identification

Resins from the Water Treatment Plant are a styrene and divinylbenzene copolymer in the form of small spherical beads. The waste resin is removed from the demineralizer vessels in the water treatment plant. The beads are removed because they no longer produce demineralized water that meets quality standards.

3.8.2 Collection and Storage

The beads are collected and stored in suitable drums.

3.8.3 Transfer

The containers are transferred on trucks.

3.8.4 Disposal

After approval from DHEC is granted, the resin beads are sent to a landfill for burial.

3.8.5 Waste minimization

These resins typically last several years. They are routinely regenerated with acid and caustic to restore their ion exchange capacity. There are no additional steps taken to reduce this waste stream.

3.9 **Waste Paint Products**

3.9.1 Identification

Waste paint products (waste [dry & liquid] paint, paint thinner, brushes, buckets, etc.) are generated during structural painting.

3.9.2 Collection and Storage

Waste paint products are collected in drums and stored in the paint shop. The drums are collected and stored at lay down area, L-52. Waste paint products that are determined to be hazardous are disposed of as hazardous waste.

3.9.3 Transfer

Waste paint products are shipped via a independent vendor.

3.9.4 Disposal

Waste paint products are disposed of by an independent vendor. Non-hazardous products are disposed of as plant garbage. Hazardous paint products are disposed of as hazardous waste.

3.9.5 Waste minimization

The painters are instructed to withdraw only the amount of paint and thinner required to perform the task. Left-over paint that is reusable is recovered for future work. All paints used at the site are reviewed as part of the site Chemical Control Program. This program includes a review of the toxicity of each paint product. We try to select products with low toxicity when possible. The painters receive training on waste minimization.

3.10 **Wastewater Sludge**

3.10.1 Identification

Wastewater sludge is sludge collected from the on-site domestic wastewater treatment system. The system is a multicellular aerated lagoon and sand filter system. This waste stream is also referred to as NPDES Outfall 005.

3.10.2 Collection and Storage

The sludge will be collected within the wastewater system in one of the cells until it is necessary to remove it.

3.10.3 Transfer

The sludge will be transferred via a truck whenever it is necessary to remove the sludge.

3.10.4 Disposal

Based on sample analysis results and approval from SCDHEC, the sludge will be disposed of on site by land application. Chemistry Services will initiate all requests to SC DHEC for approval to dispose of this sludge.

3.10.5 Waste minimization

It is not practical to minimize this waste stream.

3.11 Water Treatment Sludge

3.11.1 Identification

The water treatment sludge consists of clarifier blowdown waste (floc), gravity filter backwash residue (dirt and carbon fines), activated carbon filter backwash residue (dirt and carbon fines), waste from the feeders supplying the clarifier (clay and Betz polymer 1190) and powdex resin from the condensate system polishers. These solids settle in the Alum Sludge Lagoon, NPDES Outfall 006A.

3.11.2 Collection and Storage

The solids are collected in the pond until it is necessary to remove the sludge.

3.11.3 Transfer

The sludge would be evacuated by a backhoe and transferred via truck to an on site disposal area.

3.11.4 Disposal

Based on sample analysis results and approval from SCDHEC, the sludge will be disposed of on site. Chemistry Services will initiate all requests to SC DHEC for approval to dispose of this sludge.

3.11.5 Waste minimization

Most of the waste in this outfall is from clarifier blowdown, which is mostly suspended solids from the lake. No attempt is made at minimizing this waste.

3.12 <u>Chemical Metal Cleaning Sludge</u>

3.12.1 Identification

Chemical metal cleaning sludge is sludge collected from the plant startup waste holding basin, NPDES Outfall 008. This sedimentation basin is for the retention of wastewater generated primarily by chemical cleaning of various equipment, piping, etc. within the plant.

3.12.2 Collection and Storage

The solids are collected in the pond. The use of the plant startup holding basin is very infrequent and has a very small sludge bed.

3.12.3 Transfer

If it is necessary to remove the sludge from the basin, the sludge would be evacuated using a backhoe and transferred via truck to an on-site disposal area.

3.12.4 Disposal

If it is necessary to remove the sludge from the basin, the sludge would be disposed of on-site based on sample analysis results and approval from SCDHEC. Chemistry Services will initiate all requests to SC DHEC for approval to dispose of this sludge.

3.12.5 Waste minimization

This waste stream is minimized by controlling the amount of waste allowed to enter the pond. Whenever possible, chemical cleaning contracts will specify that the vendor remove from site all wastes generated.

3.13 Plant Surge Basin Sludge

3.13.1 Identification

The plant surge basin (NPDES Outfall 006B) functions as a retention basin. Sources of wastewater to the plant surge basin consists primarily of wastewater from various plant sumps, storm water from transformer areas and fuel oil storage and handling areas. An oil skimmer removes oil which is collected in a holding tank. Sedimentation also occurs in the retention basin and reduces suspended solids content. The sludge, in the form of solids, is collected in the retention basin.

3.13.2 Collection and Storage

The solids are collected in the basin and stored until it is necessary to desludge the pond. Oil skimmed from the surface is collected in a holding tank.

3.13.3 Transfer

At which time it is necessary to remove the sludge, it will be excavated by a backhoe and transferred via truck to an on site disposal area. The skimmed oil is transferred to a tanker for recycling.

3.13.4 Disposal

Based on sample analysis results and approval from SCDHEC, the sludge will be disposed of on site. Chemistry Services will initiate all requests to SC DHEC for approval to dispose of this sludge. The skimmed oil is recycled by an approved vendor.

3.13.5 Waste minimization

No attempt is made to reduce the amount of sludge generated. The amount of waste oil is minimized by an aggressive maintenance program that repairs oil leaks within the plant. This minimizes the amount of oil that leaks into the various sumps.

3.14 Waste Oil

3.14.1 Identification

The waste oil is spent lubricating fluids from various pieces of equipment, machinery and vehicles used on site.

3.14.2 Collection and Storage

The waste oil is collected from the various locations in the plant and stored in drums and tanks. Once a drum is filled it is moved to the designated on site storage area, L-52. Waste oil from the turbine is stored in one 15,000 gallon underground storage tank or a 10,000 gallon tank located in the 412' elevation of the turbine building.

3.14.3 Transfer

The drums are transferred to a designated storage area, L-52. An independent vendor picks up and transfers the drum via a truck. The tanks are transferred to a tanker truck for recycling.

3.14.4 Disposal

The waste oil is recycled for energy recovery by an independent vendor.

3.14.5 Waste minimization

The amount of waste generated is considered small. The Oil Lab analyzes all in-use oil prior to change out to determine if change out is required. Those oils that meet specifications are reused. This in effect minimizes the amount of oily waste generated.

3.15 Sand Blast Material

3.15.1 Identification

Sand blast material is material which is used to prepare metals for painting. The sand blast material used is a diamond impregnated metal bond or more commonly called black diamond. When it is collected it can contain a small amount of paint and fine metal particles.

3.15.2 Collection and Storage

The sand blast material is collected in the sand blast area and reused.

3.15.3 Transfer and Disposal

The sand blast material is reused on site, therefore there is not a disposal plan for it.

3.15.4 Waste minimization

This waste is minimized by recycling as much of the sand blast material as possible.

3.16 **Used Oil Filters**

3.16.1 Identification

The used oil filters are collected from various pieces of equipment and machinery used on site.

3.16.2 Collection and Storage

The used oil filters from various pieces of equipment and machinery are collected, drained and placed in trash cans which are then emptied into a container provided by a private waste recycler.

3.16.3 Transfer

The accumulated filters are picked up by the waste recycler.

3.16.4 Disposal

The waste filters are compacted, by the waste contractor. The metal is then sent to a smelter to recover the metal. Oil obtained from the crushing operation is recovered by the vendor for energy recovery.

3.16.5 Waste minimization

The volume of waste is minimized by draining, then crushing the filters prior to disposal.

3.17 Waste Petroleum Naphtha (Mineral Spirits)

3.17.1 Identification

This waste stream was waste petroleum naphtha (mineral spirits) used in a parts cleaner. This solvent has been eliminated and replaced with a citrus-based cleaner.

3.18 Lead Waste

3.18.1 Identification

Lead waste comes from pure lead that is used for radiation penetration shielding throughout the radiation control area of the plant. This sealant is a lead impregnated rubber.

3.18.2 Collection and Storage

All lead waste generated on site will be collected by personnel sealing penetrations and placed in a drum. The drums will be stored in the Lead Shop (satellite accumulation) or at the lay down area, L-52.

3.18.3 Transfer

The drums will be transferred via a permitted vendor.

3.18.4 Disposal

The lead waste will be disposed of by a permitted vendor at a permitted disposal facility.

3.18.5 Waste minimization

There is only a small quantity of this waste generated. The individuals using the lead are encouraged to prepare only the necessary amount of the lead for the job at hand to minimize the waste generated.

3.19 <u>Chromated Waste</u>

3.19.1 Identification

Potassium Chromate/Potassium Dichromate are used as a corrosion inhibitor in the Component Cooling Water System at the plant. Small volumes of the chromated water are drained from components for maintenance or from leaks.

3.19.2 Collection and Storage

Small volumes of chromated water are collected in containers and labeled. Properly collected chromated water is not considered hazardous waste and is returned to the system for reuse. Chromated water that can not be returned to the system is treated as hazardous waste and handled accordingly. Large volumes of chromated waste are normally sent to the Component Cooling Water Drain Tank until it can be reused. If the small volume of chromated water contains radioactive material, it will be processed through the Radioactive Waste System.

3.19.3 Transfer

Any chromated waste for disposal is transferred via an independent vendor.

3.19.4 Disposal

Chromated waste is disposed of via an approved independent waste contractor.

3.19.5 Waste minimization

Waste chromated water is recovered for re-use in the plant systems when possible. Any unusable chromated waste will be treated as hazardous waste if it exceeds the regulatory limit for chrome. The station is pursuing the removal of chromates from station systems to preclude future generation of this waste.

3.20 **Activated Carbon**

3.20.1 Identification

Activated carbon is used as a filter media in the water treatment system. The waste is removed from the vessels when the media no longer meets quality standards.

3.20.2 Collection and Storage

The carbon media is collected and stored in suitable containers

3.20.3 Transfer

The collection containers are transferred via trucks.

3.20.4 Disposal

Based on sample analysis results and approval from SCDHEC, the activated carbon is sent to McMeekin Station for burning with coal..

3.20.5 Waste minimization

Since this waste is recycled and the quantity used is small, no attempt is made for minimization.

3.21 **Intake Screen Backwash**

3.21.1 Identification

The intake screen backwash consists primarily of aquatic plants removed from the main water intake screen. These plants are locally native plants that become uprooted and accumulate on the screens.

3.21.2 Collection and Storage

The intake screen is cleaned manually with a rake on an as needed basis. As the intake screen is cleaned, the materials are place in a truck.

3.21.3 Transfer

The material is transferred to a disposal area on site.

3.21.4 Disposal

The material is disposed of in an area on site.

3.21.5 Waste minimization

Their is no effort to reduce this waste stream, since it is highly dependent on the amount of floating debris in Lake Montecello.

3.22 <u>BATTERIES</u>

3.22.1 Identification

This waste stream stream include waste lead-acid batteries used at the station.

3.22.2 Collection and Storage

Used batteries are collected and stored in the warehouse for recycling.

3.22.3 Transfer

Used batteries are transferred by the independent vendor that recycles the batteries.

3.22.4 Disposal

The batteries are recycled to recover the metal by an approved vendor.

3.22.5 Waste minimization

This waste is minimized by recycling the batteries to an approved vendor.

3.23 PCB's, CAPACITORS

3.23.1 Identification

There are very few PCB containing components at the station. Capacitors that are not label as non-PCB, are treated as PCB waste.

3.23.2 Collection and Storage

Any material containing or suspected of containing PCB's is collected in drums. PCB waste may be collected and stored in drums for up to 30 days.

3.23.3 Transfer

Prior to the expiration of the 30 day temporary storage period, the capacitors must be transferred via truck to the storage area at Columbia Stores.

3.23.4 Disposal

All PCB containing components must be disposed of in an EPA approved incinerator.

3.23.5 Waste minimization

The volume of PCB containing material at the site is minimal. When they fail, PCB containing components are replaced with non-PCB components.

3.24 <u>Asbestos Waste</u>

3.24.1 Identification

Asbestos is a hydrated mineral silicate that is incombustible in air. It is found in heat insulating material, fireproofing material, block and pipe insulation, brake linings and gaskets. At this site the primary source of asbestos waste is gasket material. Gaskets are used at flanged surfaces in various plant systems. These gaskets are removed and replaced during maintenance activities.

3.24.2 Collection and Storage

Asbestos containing material will be collected in accordance with the company Asbestos Plan. It will be stored in 6 mil poly bags and labeled appropriately.

3.24.3 Transfer

Asbestos waste will be transported to Environmental Services for proper disposal.

3.24.4 Disposal

Asbestos waste may be disposed of at a SC DHEC approved county landfill.

3.24.5 Waste minimization

This waste stream will be minimized by selection of non-asbestos containing materials, whenever possible.

3.25 **LIGHT BULBS**

3.25.1 Identification

Used fluorescent lamps (including high-intensity discharge, or HID lamps) may be classified as hazardous waste. If the lamps exceed the TCLP test for the presence of heavy metals, then they are considered hazardous.

3.25.2 Collection and Storage

Used lamps are collected and stored for disposal. The unbroken used lamps should be stored in a manner to prevent breaking. Broken lamps should be stored in a sealable drum. All waste should be labeled as hazardous waste.

3.25.3 Transfer

This waste will be transferred to Environmental Services for disposal.

3.25.4 Disposal

These lamps are accumulated for recycling.

3.25.5 Waste minimization

This waste is recycled.

3.26 **Laboratory Waste**

3.26.1 Identification

V. C. Summer Station has 4 laboratories within the protected fence, one training lab and an environmental laboratory at the Nuclear Training Center. Each of these labs accumulate waste lab chemicals, mostly expired reagents.

3.26.2 Collection and Storage

These wastes are collected in each lab, then stored in a collection area for re-use or recycling. Hazardous wastes are accumulated in satellite accumulation points established in each lab.

3.26.3 Transfer

Re-usable or recyclable chemicals will be transported to the end user by company vehicles or picked up by the end user.

3.26.4 Disposal

Small quantities of lab chemicals used in analysis are allowed o be poured down lab sinks. Larger quantities will be disposed of as hazardous waste or accumulated for re-use or recycling.

3.26.5 Waste minimization

These wastes are routinely packaged in lab packs for disposal of as hazardous waste. To minimize this waste stream, other uses are being evaluated. Primarily, expired reagents will be collected for reuse in the training labs, where shelf-life is not critical. Additionally, these reagents will be donated to various high school or college labs. Lab wastes that can not be re-used or recycled will be disposed of as hazardous waste using an approved hazardous waste vendor.

Section 4

Management of Future Solid Wastes

This plan has described the handling, disposal and waste minimization of existing solid wastes produced at the facility. It is the intent of the plant to handle all solid wastes in accordance with S. C. Department of Health and Environmental Control regulations. In the event that new or different solid wastes are produced at the plant, this plan will be modified to indicate handling methods. Also, as new regulations evolve, handling practices will be evaluated and modified as required.

As a general guideline, the following is our plan:

1. If a waste is suspected of being hazardous, we will handle and dispose of it as such until proper testing proves otherwise.
2. Review the most current solid waste regulations yearly and modify this plan accordingly.
3. Submit all modifications of this plan to DHEC for approval.
4. Whenever possible, recycle wastes instead of landfilling or incinerating.

V. C. Summer Nuclear Station has a Chemical Use Permit program that controls the use of chemicals that are on site. V. C. Summer Nuclear Station is a generator of hazardous waste and therefore must be in compliance with the facility and generator requirements as specified in the South Carolina Hazardous Waste Management Regulations.

SECTION 5

WASTE (HAZARDOUS AND NON-HAZARDOUS) MINIMIZATION

5.1 POLICY

It shall be the policy of V. C. Summer Nuclear Station to minimize both the volume and toxicity of the waste generated at the station where practicable and economically justifiable. This policy receives the full endorsement of station management. Waste minimization is a process of continuous improvement. It is an integral part of the station's chemical control and waste program and as such should increase productivity and quality.

5.2 Goals

The following three goals are established for the generation of waste at the station:

1. To reduce the volume and toxicity of hazardous and non-hazardous waste streams.
2. To become a Small Quantity Generator of hazardous waste. This will require us to reduce the amount of hazardous waste generated to less than 2205 lbs (1000 kilo grams per month and to accumulate no more than 13,230 lbs (6000 kilograms) at any one time.
3. To rescind our Interim Part A storage permit for the of mixed waste(radioactive and hazardous) on-site. This will require us to ship all mixed waste within 90 days of the time it is generated for Large Quantity generator and 180 days for a Small Quantity generator.

The following are components of a sound waste minimization plan that should help meet the above goals:

1. Management Support

   Management has reviewed this plan. Their endorsement of the plan is shown by their signatures on the cover of the plan and their willingness to support any efforts to reduce costs and risk to the public, environment and plant staff..

2. Use of waste minimization audits and program implementation evaluations

   Periodic audits of the program will be performed by Chemistry Services, station Quality Assurance and SC DHEC. Recommendations identified through these assessments, and evaluations will be implemented when cost beneficial. Periodic (~annually) reviews of the program effectiveness will be performed. These reviews will provide feedback and identify potential areas for improvement.

   Waste assessments will identify opportunities at all points in the plant where materials can be prevented from becoming a waste and for waste minimization opportunities based on true costs associated with waste management and cleanup.

3. Waste cost tracking

   Annual costs for waste management will be tracked beginning in December 1995.

4. Encourage technology transfer

   We will continue to make use of any new technology that will help reduce the volume and toxicity of our waste. This will be done by contacting other utilities periodically, review of waste periodicals, and other sources.

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Final Report

U.S. Nuclear Regulatory Commission

Office of Nuclear Regulatory Research

socioeconomic impacts could be reduced in this fashion.

The operating impacts of a large solar thermal facility also would revolve around land resources dedicated to the plant. No other uses would be compatible since the solar thermal collectors would take up most of the space. Construction-initiated adverse aesthetic impacts and habitat losses and any accompanying risks to threatened and endangered species would continue. There should be few operating impacts to air quality, human health, solid waste, and cultural resources. Water quality should not be affected unless water were used as a cooling agent in an arid environment where it is in short supply or water runoff from the collectors were uncontrolled and sedimentation damaged water bodies. Socioeconomic benefits should be small compared with those going to host communities of large nonrenewable generating stations. Work forces and local purchases would be small. However, the likely high cost—and high assessed value—of solar thermal facilities could lead to substantial property tax revenues.

8.3.4 Hydropower

Currently, the largest electricity contribution from renewable resources is from hydropower. In 1990, conventional hydroelectric plants generated 28 billion kWh of electricity or 83 percent of electricity generated by renewable technologies and about 9.5 percent of electricity generated by all technologies. Hydropower makes up 10 percent of this country's generating capacity. This percentage is expected to decline because new hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and destruction of natural river courses. Hydropower has an average capacity factor of 46 percent, placing it in the middle of the range for renewable technologies (DOE/EIA-0561). Of all renewable and nonrenewable energy resources, hydropower has the fewest resources at 986 quads per year, of which 157 quads are accessible at some cost and 58 quads, or about 6 percent, constitute reserves that are recoverable at current costs (DOE/EIA-0561). Figure 8.3 shows both developed and undeveloped hydropower generating capacity as of January 1992, according to the Federal Energy Regulatory Commission (DOE/EIA-0561).

Impediments to the development of hydropower capacity include environmental concerns and licensing requirements. New dam safety criteria also have affected development. Although it is unlikely that many hydroelectric dams will be constructed in the future, some measures can be taken to increase electrical generation. Older turbines and generators can be upgraded and refurbished. New equipment—such as variable-speed, constant-frequency generators—is being developed which would allow turbines to operate at higher efficiencies (SERI/TP-260-3674).

Although the amount varies, large-scale hydroelectric plants of 1000 MW(e) or greater require an average of almost 400,000 ha (1 million acres). Additional land would be required for transmission, as technology can qualify as Public Utility Regulatory Policies Act of 1978 (PURPA) plants if they are no larger than 80 MW(e) and operate as cogenerators.

Most environmental impacts of constructing natural-gas–fired plants should be approximately the same for steam, gas-turbine and combined-cycle plants. These impacts, in turn, generally will be similar to those of other large central generating stations. Land-use requirements for gas-fired plants are small at 45 ha (110 acres) for a 1000-MW(e) plant; thus land-dependent ecological, aesthetic, erosion, and cultural impacts should be small unless site-specific factors should indicate a particular sensitivity for some environmental resource. Siting at a greenfield location would require new transmission lines and increased land-related impacts, whereas co-locating the gas-fired plant with the retired nuclear plant would help reduce land-related impacts. Socioeconomic impacts should not be very noticeable because the highest peak work force of 1200 for steam plants is small for a central generating technology, and gas-fired plants are not usually sited in remote areas where community impacts would be most adverse. Also, gas-fired plants, particularly combined cycle and gas turbine, take much less time to construct than other plants.

The environmental impacts of operating gas-fired plants are generally less than those of other fossil fuel technologies of equal capacity. Consumptive water use is about the same for steam plants as for other technologies. There are potential impacts to aquatic biota through impingement and entrainment and increased water temperatures in receiving water bodies. Water consumption is likely to be less for gas-turbine plants. Generally, air quality impacts for all natural gas technologies are less than for other fossil technologies because fewer pollutants are emitted and SO_2, a contributor to acid precipitation, is not emitted at all. Solid waste should be minimal. The work force of 150 workers would be the lowest of any nonrenewable technology, as would local purchases and local tax revenues. Approximately 1500 ha (3600 acres) of additional land would be required for wells, collection stations, and pipelines to bring the natural gas to the generating facility. Impacts would be typical of those associated with land clearance. Operational impacts should not be severe because most of the land would not be disturbed further once facilities were sited.

8.3.11 Oil

Oil-fired power production was 3.2 percent of the country's total net electricity generation in 1992 and is projected to decline to 2.3 percent by 2010 [DOE/EIA-0383(94)]. Domestic petroleum resources are estimated by the EIA at about 2,800 quads, of which about 1,100 quads are accessible at some price, and about 160 are recoverable at current costs (DOE/EIA-0561). In the 12-year period for which EIA has reported annual oil and gas reserves (1977 through 1988), year-end crude oil reserves decreased by 19.9 percent ([DOE/EIA-0216(88)].

The oil fuel cycle system involves exploration/extraction, processing, transportation, end use, and waste management. The production of electricity from oil combustion is accomplished by the same process used for coal and natural gas. Oil-fired plants provide peak, intermediate, and baseload capacity.

The economics, apart from fuel price, of oil-fired power generation are similar to those of natural gas-fired power generation. Distillate oil can be used to run gas turbines in a combined-cycle system; however, the cost of distillate oil usually makes this combined-cycle system much less competitive where gas is available. Oil-fired power generation has experienced a significant decline since the early 1970s. Increases in world oil prices have forced utilities to use less expensive fuels; however, oil-fired power generation is still important in certain regions of the United States.

Constructing a 1000-MW(e) oil-fired power plant would have the same environmental impacts as constructing other large central generating power stations. Relatively small land requirements of an estimated 50 ha (120 acres), however, would be expected to reduce other resource impacts that tend to follow land-use impacts: ecological, aesthetic, air quality, water quality, and cultural. As land-use requirements decrease, erosion, loss of habitat, and negative aesthetic impacts decrease as well, although very site-specific considerations occasionally enter the picture. Expected socioeconomic impacts should not be high because of the moderate size work force of 1700, and oil-fired plants typically are not sited in remote areas or otherwise away from larger communities that are on pipelines or near where the oil is refined, consumed, or imported. Transmission lines for a greenfield site likely would increase land-dependent impacts in approximate proportion to the transmission/generation acreage. Land-use related impacts could be reduced if the oil-fired plant were colocated with the retired nuclear plant.

Environmental impacts of operating oil-fired power plants are similar to those from comparably sized coal-fired plants. Since they typically use the same cooling systems, water use and related impacts to water quality and aquatic biota would be similar. Air emissions, too, would be typical of coal plants; regulated pollutants, CO_2, and small amounts of radionuclides would be emitted, although in lesser quantities than from an equivalent-size coal-fired plant. Moderate amounts of scrubber sludge would require disposal. Attendant impacts would include acid precipitation, global warming, and some increased risk of health problems, such as emphysema, cancer, and other illnesses associated with combustion of fossil fuels. Employment, tax revenues, and local purchases would be positive socioeconomic impacts for some local communities. Approximately 650 ha (1600 acres) of additional land would be needed for oil wells and support facilities that would provide the generating plant with fuel. Impacts would likely be similar to those of other land clearing activities. Operational impacts should not be severe because, as with gas, the land generally would not be disturbed once the wells were producing.

8.3.12 Advanced Light-Water Reactor

Section 2.1 describes a typical nuclear power plant and its operation. In 1992, nuclear power provided 22 percent of total United States net electric utility generation, a figure that is expected to decline to 18.8 percent by 2010. Nuclear power represented 14.3 percent of this country's 1992 electric utility generation capacity and is projected to decline to 12.2 percent by 2010 [DOE/EIA-0383(94)].

Current American research focuses on the advanced LWR as a viable replacement for existing nuclear plants. Advanced LWR technology differs from current LWR technologies primarily in component design, including passive safety features that reduce the probability of severe accidents (NUREG-1362). Advanced LWRs would require slightly more fuel than current designs, resulting in slight increases in spent fuel generation and lower overall plant

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Section 5.6
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NIEHS 1999

NIEHS The National Institute of Environmental Health Sciences

EMF RAPID Electric and Magnetic Fields Research and Public Information Dissemination Program

1999 NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields

NIEHS REPORT on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields

Prepared in Response to the 1992 Energy Policy Act

(PL 102-486, Section 2118)

NIEHS

National Institute of Environmental Health Sciences
National Institutes of Health

Dr. Kenneth Olden, Director

Prepared by the NIEHS EMF-RAPID Program Staff

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1999 NIEHS Report on Health Effects from Exposure to
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1999 NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and *Magnetic* Fields

Executive Summary

Introduction

Electrical energy has been used to great advantage for over 100 years. Associated with the generation, transmission, and use of electrical energy is the production of weak electric and magnetic fields (EMF). In the United States, electricity is usually delivered as alternating current that oscillates at 60 cycles per second (Hertz, Hz) putting fields generated by this electrical energy in the extremely low frequency (ELF) range.

Prior to 1979 there was limited awareness of any potential adverse effects from the use of electricity aside from possible electrocution associated with direct contact or fire from faulty wiring. Interest in this area was catalyzed with the report of a possible association between childhood cancer mortality and proximity of homes to power distribution lines. Over the next dozen years, the U.S. Department of Energy (DOE) and others conducted numerous studies on the effects of ELF-EMF on biological systems that helped to clarify the risks and provide increased understanding. Despite much study in this area, considerable debate remained over what, if any, health effects could be attributed to ELF-EMF exposure.

In 1992, the U.S. Congress authorized the Electric and Magnetic Fields Research and Public Information Dissemination Program (EMF-RAPID Program) in the Energy Policy Act (PL 102-486, Section 2118). The Congress instructed the National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health and the DOE to direct and manage a program of research and analysis aimed at providing scientific evidence to clarify the potential for health risks from exposure to ELF-EMF. The EMF-RAPID Program had three basic components: 1) a research program focusing on health effects research, 2) information compilation and public outreach and 3) a health assessment for evaluation of any potential hazards arising from exposure to ELF-EMF. The NIEHS was directed to oversee the health effects research and evaluation and the DOE was given the responsibility for overall administration of funding and engineering research aimed at characterizing and mitigating these fields. The Director of the NIEHS was mandated upon completion of the Program to provide a report outlining the possible human health risks associated with exposure to ELF-EMF. This document responds to this requirement of the law.

This five-year effort was signed into law in October 1992 and provisions of this Act were extended for one year in 1997. The Program ended December 31, 1998. The EMF-RAPID Program was funded jointly by Federal and matching private funds and has been an extremely successful Federal/private partnership with substantial financial support from the utility industry. The NIEHS received $30.1 million from this program for research, public outreach, administration and the health assessment evaluation of ELF-EMF. In addition to EMF-RAPID Program funds from the DOE, the NIEHS contributed $14.5 million for support of extramural and intramural research including long-term toxicity studies conducted by the National Toxicology Program.

NIEHS Conclusion

The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations obsewed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults. While the support from individual studies is weak, the epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattem of a small, increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia. In contrast, the mechanistic studies and the animal toxicology literature fail to demonstrate any consistent pattern across studies although sporadic findings of biological effects (including increased cancers in animals) have been reported. No indication of increased leukemias in experimental animals has been observed.

The lack of connection between the human data and the experimental data (animal and mechanistic) severely complicates the interpretation of these results. The human data are in the "right" species, are tied to "real-life" exposures and show some consistency that is difficult to ignore. This assessment is tempered by the observation that given the weak magnitude of these increased risks, some other factor or common source of error could explain these findings. However, no consistent explanation other than exposure to ELF-EMF has been identified.

Epidemiological studies have serious limitations in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF-EMF at environmental levels and changes in biological function or disease status. The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but it cannot completely discount the epidemiological findings.

The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concem. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concem.

The interaction of humans with ELF-EMF is complicated and will undoubtedly continue to be an area of public concern. The EMF-RAPID Program successfully contributed to the scientific knowledge on ELF-EMF through its support of high quality, hypothesis-based research. While some questions were answered, others remain. Building upon the knowledge base developed under the EMF-RAPID Program, meritorious research on ELF-EMF through carefully designed, hypothesis-driven studies should continue for areas warranting fundamental study including leukemia. Recent research in two areas, neurodegenerative diseases and cardiac diseases associated with heart rate variability, have identified some interesting and novel findings for which further study is ongoing.

Background

Program Oversight and Management

The 1992 Energy Policy Act created two committees to provide guidance and direction to this program. The first, the Interagency Committee (IAC), was established by the President of the United States and composed of representatives from the NIEHS, the DOE and seven other Federal agencies with responsibilities related to ELF-EMF. This group receives the report from the NIEHS Director and must prepare its own report for Congress. The IAC had responsibility for developing a strategic research agenda for the EMF-RAPID Program, facilitating interagency coordination of Federal research activities and communication to the public and monitoring and evaluating the Program.

The second committee, the National EMF Advisory Committee (NEMFAC), consisted of representatives from public interest groups, organized labor, state governments and industry. This group was involved in all aspects of the EMF-RAPID Program providing advice and critical review to the DOE and the NIEHS on the design and implementation of the EMF-RAPID Program's activities.

ELF-EMF Health Effects Research

The EMF-RAPID Program's health effects research initiative relied upon accepted principles of hazard identification and risk assessment to establish priorities. All studies supported by the NIEHS and the DOE under this program were selected for their potential to provide solid, scientific data on whether ELF-EMF exposure represents a human health hazard, and if so, whether risks are increased under exposure conditions in the general population. Research efforts did not focus on epidemiological studies (i.e. those in the human population) because of time constraints and the number of ongoing, well-conducted studies. The NIEHS health effects research program focused on mechanistic, cellular and laboratory studies in the areas of neurophysiology, behavior, reproduction, development, cellular research, genetic research, cancer and melatonin. Mechanistic, cellular and laboratory studies are part of the overall criteria used to determine causality in interpreting epidemiological studies. In this situation, the most cost-effective and efficient use of the EMF-RAPID Program's research funds was clearly for trying to clarify existing associations identified from population studies. The DOE research initiatives focused on assessment of exposure and techniques of mitigation.

The EMF-RAPID Program through the combined efforts of the NIEHS and the DOE radically changed and markedly improved the quality of ELF-EMF research. This was accomplished by providing biological and engineering expertise to investigators and emphasizing hypothesis-driven, peer-reviewed research. Four regional facilities were also set-up where state-of-the-art magnetic field exposure systems were available for in-house and outside investigators to conduct mechanistic research. The EMF-RAPID Program through rigorous review and use of multi-disciplinary research teams greatly enhanced the understanding of the interaction of biological systems with ELF-EMF.

Information Dissemination and Public Outreach

The EMF-RAPID Program provided the public, regulated industry and scientists with useful, targeted information that addressed the issue of uncertainty regarding ELF-EMF health effects. Two booklets, a question and answer booklet on ELF-EMF and a layman's booklet addressing ELF-EMF in the workplace, were published. A telephone information line for ELF-EMF was available where callers could request copies of ELF-EMF documents and receive answers to standard questions from operators. The NIEHS also developed a web-site for the EMF-RAPID Program where all of the Program's documents are on-line and links are available to other useful sites on ELF-EMF. Efforts were made to include the public in EMF-RAPID Program activities through sponsorship of scholarships to meetings; holding open, scientific workshops; and setting aside a two-month period for public comment and review on ELF-EMF and the workshop reports. In addition, the NIEHS sponsored attendance of NEMFAC members at relevant scientific meetings and at each of the public comment meetings.

Health Risk Assessment of ELF-EMF Exposure

In preparation of the NIEHS Director's Report, the NIEHS developed a process to evaluate the potential health hazards of ELF-EMF exposure that was designed to be open, transparent, objective, scholarly and timely under the mandate of the 1992 Energy Policy Act. The NIEHS used a three-tiered strategy for collection and evaluation of the scientific information on ELF-EMF that included: 1) three science review symposia for targeted ELF-EMF research areas, 2) a working group meeting and 3) a period of public review and comment. Each of the three symposia focused on a different, broad area of ELF-EMF research: mechanistic and cellular research (24-27 March 1997, Durham, NC), human population studies (12-14 January 1998, San Antonio, TX) and laboratory human and clinical work (6-9 April 1998, Phoenix, AZ). These meetings were aimed at including a broad spectrum of the researchcommunity and the public in the evaluation of ELF-EMF health hazards, identifying key research findings and providing opinion on the quality of this research. Discussion reports from small discussion groups held for specific topics were prepared for each meeting.

Following the symposia, a working group meeting (16-24 June 1998, Brooklyn Park, MN) was held where a scientific panel reviewed historical and novel evidence on ELF-EMF and determined the strength of the evidence for human health and biological effects. Stakeholders and the public attended this meeting and were given the opportunity to comment during the process. The Working Group conducted a formal, comprehensive review of the literature for research areas identified from the symposia as being important to the assessment of ELF-EMF-related biological or health effects. Separate draft documents covering areas of animal carcinogenicity, animal non-cancer findings, physiological effects, cellular effects, theories and human population studies (epidemiology studies) in children and adults for both occupational and residential ELF-EMF exposures were rewritten into a single book. The Working Group characterized the strength of the evidence for a causative link between ELF-EMF exposure and disease in each category of research using the criteria developed by the International Agency for Research on Cancer (IARC).

The IARC criteria fall into four basic categories: sufficient, limited, inadequate and evidence suggesting the lack of an effect. After critical review and discussion, members of the Working Group were asked to determine the categorization for each research area; the range of responses reflected the scientific uncertainty in each area. A majority of the Working Group members concluded that childhood leukemia and adult chronic lymphocytic leukemia from occupational exposure were areas of concern. For other cancers and for non-cancer health endpoints, the Working Group categorized the experimental data as providing much weaker evidence or no support for effects from exposure to ELF-EMF.

Following the Working Group Meeting, the NIEHS established a formal review period for solicitation of comments on the symposia and Working Group reports. The NIEHS hosted four public meetings (14-15 September 1998, Tucson, AZ; 28 September, Washington, DC; 1 October 1998, San Francisco, CA; and 5 October 1998, Chicago, IL) where individuals and groups could voice their opinions; the meetings were recorded and transcripts prepared. In addition, the NIEHS received 178 written comments that were also reviewed in preparation of this report. The remarks that NIEHS received covered many areas related to ELF-EMF and provided insight about areas of concern on behalf of the public, researchers, regulatory agencies and industry.

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Conclusions and Recommendations

Previous Panel Reviews

Since 1990, more than 60 reports and literature reviews written by various expert panels, individual researchers or governmental officials have examined the ELF-EMF scientific evidence worldwide. While most of these documents are one-time assessments, some U.S. states (including Connecticut, Maryland, Virginia) have recognized public concern for this topic and monitored this issue on a yearly or periodic basis *(310)*. A number of national reviews of ELF-EMF research have also been prepared.

The most recent panel reviews*(19, 311-316)* used a variety of evaluation criteria and differing types of information to evaluate potential health effects from ELF-EMF exposures. Several groups concluded that the epidemiological evidence for childhood and adult cancers was inconsistent and inconclusive and was insufficient to address risks*(19, 311, 312, 315, 316)*. Several noted that there existed some associations between exposures and cancers, but without mechanistic and animal evidence to support the effect, concluded it was still basically a hypothesis to be studied *further (19, 313-315)*. For all of these reviews, the conduct of additional research was suggested.

NIEHS Conclusion

As part of the EMF-RAPID Program's assessment of ELF-EMF-related health effects, an international panel of 30 scientists met in June 1998 to review and evaluate the weight of the ELF-EMF scientific evidence *(12)*. Using criteria developed by the International Agency for Research on Cancer, none of the Working Group considered the evidence strong enough to label ELF-EMF exposure as a "known human carcinogen" or "probable human carcinogen," However, a majority of the members of this Working Group (19128 voting members) concluded that exposure to power-line frequency ELF-EMF is a "possible" human carcinogen, This decision was based largely on "limited evidence of an increased risk for childhood leukemias with residential exposure and an increased occurrence of CLL (chronic lymphocytic leukemia) associated with occupational exposure." For other cancers and for non-cancer health endpoints, the Working Group categorized the experimental data as providing much weaker evidence or no support for effects from exposure to ELF-EMF.

The NIEHS agrees that the associations reported for childhood leukemia and adult chronic lymphocytic leukemia cannot be dismissed easily as random or negative findings. The lack of positive findings in animals or in mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but cannot completely discount the finding. The NIEHS also agrees with the conclusion that no other cancers or non-cancer health outcomes provide sufficient evidence of a risk to warrant concern.

The ultimate goal of any risk assessment is to estimate the probability of disease in an exposed population. In general, this involves the combination of three basic pieces of information: the probability that the agent causes the disease, the response as a function of exposure given that the exposure does cause disease and the distribution of exposures in the population being studied. The NIEHS believes that the probability that ELF-EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm.

The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

Several groups have attempted to determine the risk of childhood leukemia in the general population under the unproven assumption that ELF-EMF is truly causing this disease *(317-319)*. If this assumption were correct, these calculations generally suggest, on average, that between 5% and 15% of childhood leukemias could be caused by exposures to ELF-EMF with confidence intervals including 0%. Based upon this assumption, our own evaluations using the most current data and several different methods of analysis do not disagree with these percentages. The risk of getting leukemia prior to age 15 in the United States is about 0.05% (5/10,000 people) *(320)*. This would make the lifetime risk of childhood leukemia attributable to ELF-EMF (again, conditional on the risk being real) between 2.5 to 7.5 per 100,000 people. On a yearly basis, this conditional risk is approximately 15 times less than the lifetime risk or 2 to 6 additional cases per million children per year.

The National Toxicology Program routinely examines environmental exposures to determine the degree to which they constitute a human cancer risk and produces the "Report on Carcinogens" listing agents that are "known human carcinogens" or "reasonably anticipated to be human carcinogens." It is our opinion that based on evidence to date, ELF-EMF exposure would not be listed in the \'Reporton Carcinogens" as an agent "reasonably anticipated to be a human carcinogen." This is based on the limited epidemiological evidence and the findings from the EMF-RAPID Program that did not indicate an effect of ELF-EMF exposure in experimental animals or a mechanistic basis for carcinogenicity.

Recommended Actions

Regulatory action on any environmental exposure can be multifaceted and proceed by any of a number of options. In general, if regulatory action is to be taken, the types of controls can be broken down into restrictions placed on the production of the hazard and those placed on individuals who might come in contact with the hazard. In the case of ELF-EMF, there are several issues that complicate any regulatory action. First, there is only marginal, scientific support that exposure to ELF-EMF is a health hazard. Second, it is unclear what aspect of the exposure, if any, may be the active component of the field resulting in the increased cancer risk. While the association observed is with average magnetic field measures, controls resulting in reductions in these field levels may not alleviate the risk. Third, it is impossible to remove all ELF-EMF exposure and remain a modern, technologically advanced society. Finally, considering the weak degree of evidence involved, it is critical that the potential risks from any alternatives to our current methods of using electricity be carefully evaluated.

Regulatory actions prompted by this review of ELF-EMF are not the purview of the NIEHS. The

Interagency Committee (IAC, described earlier) has been involved in all aspects of both our research program and the process of reviewing these data. The agencies that compose the IAC employ experts who have greater experience and knowledge concerning mitigation of ELF-EMF exposure than the NIEHS. However, it is important that the strength of the evidence reported here be placed in a context that is clear to the regulatory authorities. Therefore, the NIEHS is providing the following suggestions that are intended to give scope for future regulatory actions.

The NIEHS suggests that the level and strength of evidence supporting ELF-EMF exposure as a human health hazard are insufficient to warrant aggressive regulatory actions; thus, we do not recommend actions such as stringent standards on electric appliances and a national program to bury all transmission and distribution lines. Instead, the evidence suggests passive measures such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. NIEWS suggests that the power industry continue its current practice of siting power lines to reduce exposures and continue to explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating new hazards. We also encourage technologies that lower exposures from neighborhood distribution lines provided that they do not increase other risks, such as those from accidental electrocution or fire.

Exposures in individual residences are linked to certain characteristics. Their chief causes are improper grounding and improper wiring, which if addressed by properly following current electrical codes, can be mitigated and exposures reduced. Older homes may also have higher ambient exposures, but these must be assessed on a case-by-case basis. Many of the U.S. electric utility companies will measure fields in their customers' homes and help them to identify sources of high fields; we encourage continuation of this practice. Finally, the NIEHS would encourage the manufacturers of household and office appliances to consider alternatives that reduce magnetic fields at a minimal cost. We feel that the risks do not warrant major and expensive redesign of modern electrical appliances, but inexpensive modifications should be sought to reduce exposures.

Certain occupations result in high field exposures. The NIEHS encourages the National Institute for Occupational Safety and Health and the Occupational Safety and Health Administration to review these findings and carefully evaluate if current occupational exposure standards are adequate.

In summary, the NIEHS believes that there is weak evidence for possible health effects from ELF-EMF exposures, and until stronger evidence changes this opinion, inexpensive and safe reductions in exposure should be encouraged.

Future Research

The NIEHS is committed to the support of hypothesis-driven research on any environmental exposure that is of concern for human beings. Exposure to ELF-EMF is no different. These exposures warrant continued monitoring because ELF-EMF exposure is ubiquitous and the use of electromagnetic technology is growing in our society.

The characteristics of ELF-EMF and their possible interactions with biological systems have been investigated for several decades. The EMF-RAPID Program successfully contributed to the scientific knowledge on ELF-EMF through its support of high quality, hypothesis-based research, While some questions were answered, others remain. Building upon the knowledge base developed under the EMF-RAPID Program, meritorious research on ELF-EMF through carefully designed, hypothesis-driven studies should continue for areas warranting fundamental study including leukemia. The NIEHS will continue to support research in this area. Certain areas of research, however, warrant noting.

There are several epidemiological studies of ELF-EMF exposures and childhood leukemia underway that may help clarify this issue. Any new epidemiological studies of ELF-EMF exposure are not warranted unless, in some unique manner, the studies differ from existing ones and can test new hypotheses. Very little is known about the mechanisms and causes of childhood leukemias and chronic lymphocytic leukemia in adults. Many agencies, including the National Institutes of Health, have ongoing programs in these areas aimed at improving our understanding of these diseases. As risk factors are identified, we strongly recommend re-analysis of the existing ELF-EMF epidemiology data to determine if these risk factors reduce or strengthen the reported findings of concern expressed in this document. Where currently available studies cannot adequately address newly discovered risk factors, the NIEHS encourages new studies.

Several non-cancer health areas including neurodegenerative and cardiovascular diseases have been identified as being of national concern, but for which there are few, high quality studies to evaluate adequately whether ELF-EMF exposure might have effects. Preliminary work suggests that ELF-EMF exposure may be linked to cardiovascular deaths resulting from arrhythmia and acute myocardial infarction. The mechanism for such an effect, if true, is not known, but possibly occurs through exposure-related effects on autonomic nervous system control of cardiac function. Also, several exploratory studies have suggested possible associations between occupational ELF-EMF exposure and neurodegenerative diseases specifically amyotrophic lateral sclerosis and Alzheimer's disease. The data on these end-points are inadequate for interpreting the possibility of an association. Research in these areas should cover all aspects of scientific investigation including epidemiology, laboratory and mechanistic studies.

Preliminary studies in transformed breast cancer cells suggest that ELF-EMF exposures can overcome effects of melatonin and tamoxifen in regulating cell growth. This effect of ELF-EMF appears to occur at magnetic field exposures that may be encountered in the environment. Several other laboratories have presented similar, unpublished findings at national meetings. The importance of this finding for human health is unclear, but considering the magnitude of the incidence of breast cancer, this area warrants further investigation.

There is a continued need for more biologically realistic mathematical models to evaluate the biophysics of ELF-EMF and for biological systems specifically developed to evaluate the validity and utility of these mathematical models. While it is clearly established that certain animals can sense weak magnetic fields for navigation and homing, the physical basis for these processes is unknown. More remains to be learned about the physics of magnetic field interactions with biological systems.

The interaction of humans with ELF-EMF is complicated and will undoubtedly continue to be an area of public concern. The World Health Organization through its own international program on ELF-EMF will review this field in the year 2003. The NIEHS is a partner in this process.

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Santee Cooper 1996. Transmission Line Location, Engineering Survey, and Right-of-Way Activities, Transmission Line Standards Reference Manual, Section 3, June. 1996.

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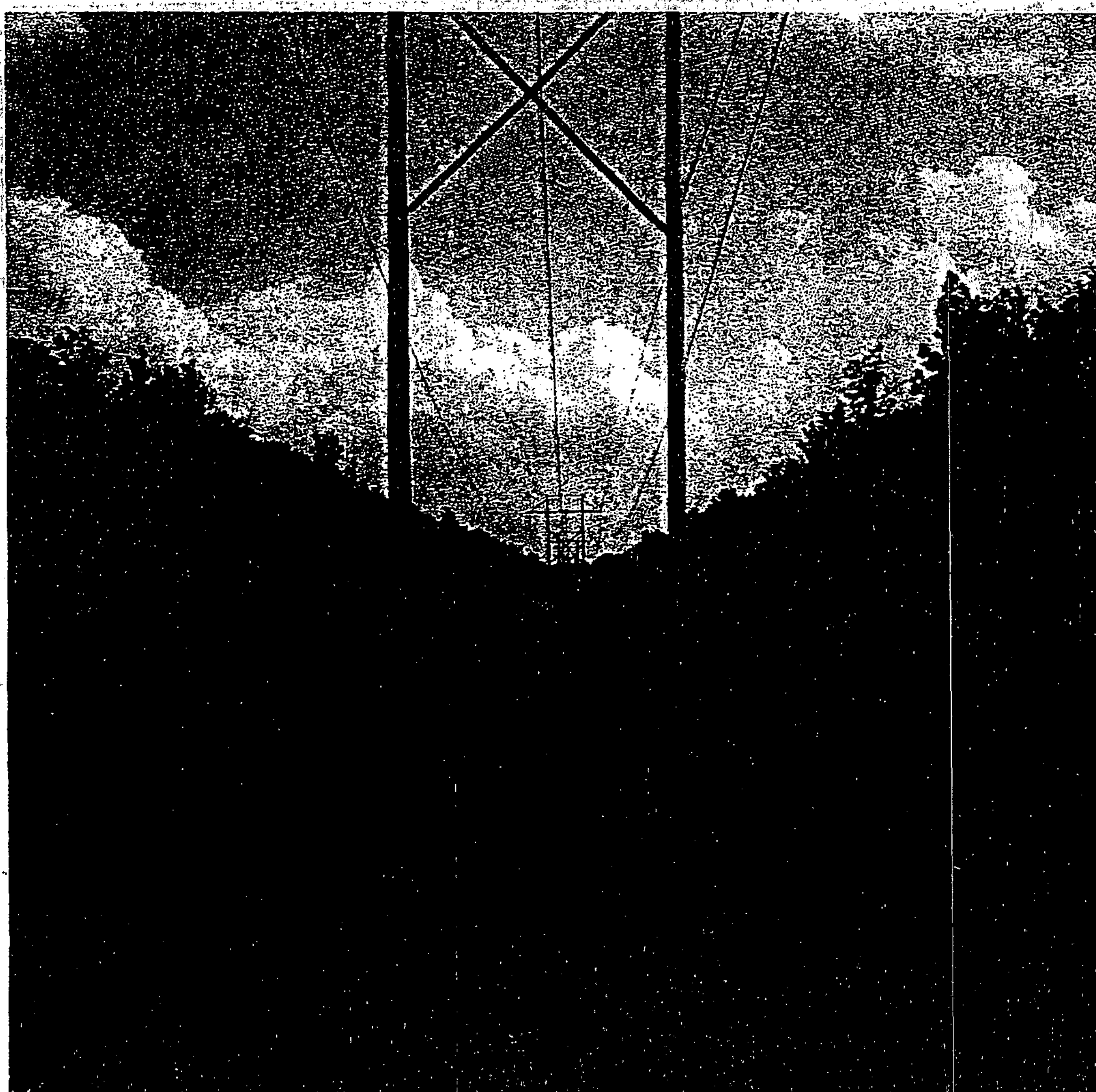
SANTEE COOPER
TRANSMISSION VEGETATION MANAGEMENT PROGRAM



Prepared by: Kenneth R. Sott
Date: February 17, 2006

Objectives

To provide an integrated Transmission Vegetation Maintenance Program (TVMP) that protects transmission system availability, provides safety to the public, promotes a positive public image, and complies with NERC Standard FAC-003-1.

To insure that the following key components that make up Santee Cooper's Transmission Vegetation Management Program are systematically reviewed and implemented appropriately.

- Consistent vegetation maintenance cycles
- Routine rights-of-way vegetation inspections
- Effective maintenance reporting tools
- Scheduling flexibility
- Utilization of best management vegetation practices
- Respect for individual property rights

Introduction

Santee Cooper is responsible for maintaining approximately 35,000 brush acres and trees on the periphery of the right-of-way on over 3,900 miles of transmission rights-of-way. The Santee Cooper transmission system is located throughout the state, except in the extreme northwest section, which creates a number of vegetation maintenance problems due to the differing topography, soil types and climates found throughout the state. In order to maintain an effective vegetation maintenance program, it is important to consider these problems and provide an integrated, proactive approach that is cyclic in nature.

Currently, the transmission system (figure 1) is divided into three (3) transmission areas (Southern Transmission Area – Green, Central Transmission Area – Peach, and the Northern Transmission Area – Purple) from a line maintenance perspective. From a vegetation management view point, this is very important since line personnel are very knowledgeable of the changing vegetation conditions in their respective areas. Their routine right-of-way inspections and associated feedback provide a quality check that ensures established vegetation maintenance cycles continue to be effective. Further, they routinely recognize and report critical vegetation problems (e.g., dead & leaning trees) that were not present during scheduled vegetation maintenance activities.

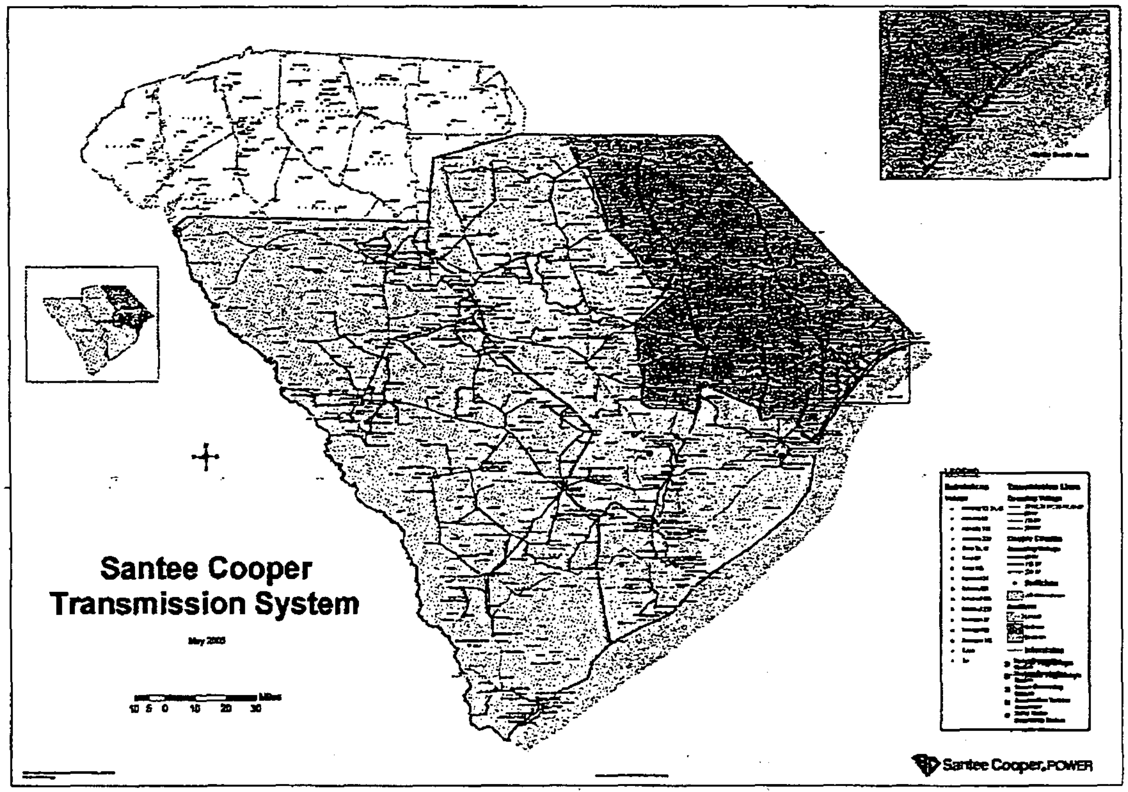


Figure 1

Organization

The *Right-of-Way Management* section (see Appendix A) is responsible for the scheduling and completion of all vegetation related issues located within and along transmission rights-of-way. This section is divided into three units which are responsible for a variety of right-of-way vegetation maintenance activities. Each unit is supported by individuals with varying degrees of professional work experience (e.g., clearing equipment operation, rights-of-way management, contract service administration, herbicide application, etc.) & educational backgrounds/certifications (forestry, arboriculture, wetland delineation, biology, etc.).

Mechanical Reclearing is the largest of the three units with respect to the number of company personnel and is responsible for the mechanical reclearing of selected transmission rights-of-way. This unit is made up of a Supervisor, two (2) crew leaders, and ten (10) equipment operators. A second unit, *Vegetation Management* is responsible for all herbicide related vegetation maintenance, scheduling of reported vegetation maintenance problems, and administering a wildlife habitat enhancement program that complements other vegetation management activities. This unit is made up of a Supervisor, Vegetation Management, Sr. Right-of-Way Specialist, Technical Assistant, Administrative Associate, and one (1) Equipment Operator. A third unit, *Contract Services*, is responsible for all tree related maintenance throughout the transmission system. This unit is made up of a Supervisor, Contract Services and a Right-of-Way Forester.

The overall supervision and direction of this section is the responsibility of the - Superintendent, Right-of-Way Management.

Right-of-Way Vegetation Maintenance Standards

Ground Floor Maintenance

1) Right-of-way vegetation maintenance is scheduled, on average, every 3 years to effectively maintain the different vegetation species and associated growth potentials found throughout the transmission system. Mechanical reclearing equipment and/or herbicides are the primary tools that are used to achieve effective maintenance.

   a. Exceptions: Rights-of-way that have low site quality and/or treated with herbicides may produce a slow growing woody vegetation component as well as a herbaceous plant community that competes with new woody plants. In this situation, maintenance cycles can be extended in order to accommodate higher priority vegetation maintenance items and/or inclement weather situations where scheduled maintenance activities may damage (e.g., rutting) rights-of-way.

2) Easements, GIS data base, and Plan & Profiles are reviewed prior to maintenance activities to understand right-of-way widths and maintenance restrictions/provisions. Any atypical restrictions/provisions are provided to the appropriate maintenance personnel prior to beginning vegetation maintenance work.

3) All woody vegetation, capable of growing into transmission conductors and growing within the bounds of the right-of-way, will be maintained by the appropriate maintenance personnel. To ensure this, maintenance personnel routinely measure and flag the edges of the right-of-way to delineate the boundaries of the right-of-way.

   a. Exceptions: large diameter trees that can not be safely maintained by reclearing personnel will be maintained by professional tree maintenance personnel. Where easement restrictions/provisions exclude tree removals, maintenance personnel insure that sufficient clearances are gained through sound trimming practices (ANSI 300A) so reliability is not compromised prior to the next maintenance cycle.

4) Post maintenance clearances will vary depending on the design (i.e., the established-height of the conductor in relation to the ground) of the line. However, a minimum of 15' clearance (Clearance 1 - R1.2.1 of Standard FAC-003-1) will be established between the conductor and remaining ground floor vegetation. Prior to the next scheduled maintenance cycle, no ground floor vegetation will be allowed to grow closer to conductors than the minimum clearances (Clearance 2 - R1.2.2 of Standard FAC-003-1) set forth in the Institute of Electrical and Electronics Engineering (IEEE) Standard 516-2003, section 4.2.2.3.

   a. Exceptions: Landowner conflicts may require certain maintenance items (e.g., removal/trimming of established trees) to be scheduled at a later date. In this event, minimal clearances (IEEE Standard 516-2003) will be established until the conflict is resolved. To ensure the follow-up maintenance is not over looked, a work request will be generated and assigned to the appropriate maintenance unit.

   b. Exceptions: Landscape and ornamental plantings (e.g., wax myrtle, crape myrtles, etc.) that have a maximum height growth potential that will bring them no closer that 15' from the conductor and/or slow growing species that can be effectively pruned to 15' from conductor and will not violate IEEE Standard 516-2003 prior to the next maintenance cycle may be left.

5) Daily progress sheets will be completed by the appropriate maintenance unit detailing when and where maintenance took place. This will include the current line name, location (structure/pole numbers) where maintenance was completed, and any atypical maintenance items that could not be completed and require alternative maintenance scheduling. Copies of the progress sheets will be forwarded to the Right-of-Way Management secretary so vegetation

maintenance information can be inputted into a GIS data base and hard copy progress sheets filed in a central location. Also, the Right-of-Way Management planner is to be notified of completed work, via e-mail, so work requests can be closed out.

6) Vegetation maintenance items that could not be completed by ground floor maintenance personnel will be forwarded to the planner via work request creation information forms so a work requests can be created for the appropriate maintenance activity. This may include the use of tree professionals and aerial reach devices where maintenance items are out of reach for normal ground maintenance personnel.

7) Maintenance production (e.g., acreage and brush miles) is reconciled annually for existing rights-of-way while new rights-of-way acreage is added to the total. This information is used to support future maintenance resources and insure that the three (3) year maintenance cycle is not compromised by new responsibilities.

Periphery of Right-of-Way

1) Contract services are used exclusively to maintain trees and tree limbs growing along the 3,900 miles of forested areas growing adjacent to transmission rights-of-way. Typically, a three (3) year maintenance contract is awarded to an established tree maintenance care company to ensure that scheduled tree maintenance work is completed within established time frames. Also, an annual aerial side trimming contract is also awarded to help supplement other long term contract services.

2) Established maintenance cycles are in place to deal with tree limbs that extend into rights-of-way. These maintenance cycles vary in length between 1 – 7 years depending on the width of the right-of-way and location & design of the transmission line within the right-of-way.

3) Easements are researched for maintenance restrictions/provisions and landowners contacted prior to tree maintenance activities, if necessary.

    a. Exception: Majority of landowner contacts are made when live trees are maintained outside of the right-of-way and/or growing in a maintained area within the right-of-way. Trimming of tree limbs along the along the right-of-way does not normally merit a landowner contact.

4) Maintenance reports, generated from the work management system, are run every Monday to ensure that new tree maintenance items are provided to the appropriate tree maintenance personnel to be completed. Typically, these are items (e.g., dead tree, leaning tree, etc.) generated from line patrols and/or during normal ground floor maintenance activities. To ensure that these items are completed per the vegetation maintenance template time frames, a dedicated patrol crew(s) is assigned solely to this task.

5) Daily progress information is recorded and then forwarded to an Administrative Associate who has the responsibility of inputting this information into a GIS data base as well as filing of the hard copy information in a central location. Also, completed work request information is forwarded to the Right-of-Way Management planner so they can be closed out in the work management system.

6) Post maintenance clearances will vary depending on the location of the outside conductor in relation to the edge of the right-of-way with a minimum clearance (Clearance 1 - R1.2.1 of Standard FAC-003-1) not less than 15'. Prior to the next scheduled maintenance cycle, limbs will be allowed to grow no closer to conductors than the minimum clearances (Clearance 2 - R1.2.2 of Standard FAC-003-1) set forth in IEEE Standard 516-2003.

   a. Exceptions: Landowner conflicts may require certain maintenance items (e.g., removal/trimming of established trees) to be scheduled at a later date. In this event, minimum clearances set forth in IEEE Standard 516-2003 will be established until the conflict is resolved.

   b. Exceptions: Lines designed to be off-set and/or stacked on rights-of-way may not allow maintenance personnel to achieve a 15' minimum clearance. In this case, limbs will be removed to the edge of the right-of-way with the clearance not being less than the minimum clearances set forth in IEEE Standard 516-2003.

Rights-of-Way Inspection

Electrical line personnel routinely inspect all transmission rights-of-way twice a year (spring & fall) by air patrol and once a year by ground. Along with electrical facility inspections, line personnel incorporate a right-of-way vegetation inspection that produces records of any vegetation related problems that could compromise system reliability. To aid in the identification and prioritization of found vegetation related problems, line personnel utilize a vegetation maintenance template (i.e., a working template that describes various vegetation condition categories along with a recommended maintenance completion time frame – Appendix B). Additionally, right-of-way vegetation maintenance personnel utilize the same template to report items outside of their respective maintenance capabilities that are found during their scheduled maintenance activities. This provides an additional inspection source that has the potential of identifying new maintenance problems that developed after lineman have completed their patrols.

Vegetation Maintenance Reporting & Scheduling

Vegetation maintenance problems identified by linemen and vegetation maintenance personnel are recorded onto a patrol or daily progress sheet that represents a specific line section. Information included on these sheets include a description (e.g., dead tree) of the problem, location of the problem with respect to transmission structure/pole numbers, and a priority code that sets a recommended time frame in which the problem is to be mitigated. Completed sheets are then forwarded to the appropriate transmission planner who will in turn create individual maintenance work requests using a work management system.

Once the individual work requests have been created in the work management system, a Right-of-Way Maintenance planner utilizes the work request information to schedule the work as well as assign the work to the appropriate vegetation maintenance unit. Maintenance personnel are then able to access maintenance reports that provide a specific work request number, description of the maintenance problem, and a recommended completion date. After maintenance is completed, maintenance personnel provide a completion date so the planner can close out the work request.

Schedules for normal rotational vegetation maintenance (e.g., mowing, spraying, side trimming, etc.) are developed by the respective maintenance units in Right-of-Way Management. Work requests are then generated from these schedules and are available via a company reporting system (Brio).

In the event a maintenance problem (e.g., leaning tree close to conductor) is considered an immediate threat to the line, personnel will contact the Right-of-Way Maintenance planner, by phone, upon identifying the problem. In turn, the appropriate maintenance personnel will be dispatched to mitigate the problem. If required, line personnel will be contacted to obtain the proper line clearance(s) (e.g., hot line tag) to ensure the safety of maintenance personnel.

Annual Work Plan

Based on established vegetation maintenance cycles, selected rights-of-way are placed on an annual maintenance schedule that is developed in late December for the upcoming year. Schedules will be available no later than January 15th and can be viewed on the Right-of-Way Management web site (access instructions below) and/or as an attachment (see Appendix C) to this document. Maintenance completion dates for specific line sections will be available on the Right-of-Way Management web site and will updated on a monthly basis.

Electronic Access to Right-of-Way Maintenance Schedules

- Using iPort, select "Departments" Tab
- Select "Transmission Operations" under the "Operations" listing
- Select the "Right-of-Way" Tab
- Under the "Right-of-Way Schedule Yr" list, select the maintenance operation you require a schedule for

Referenced in Section 4.1

Santee Cooper 2006. Santee Cooper Transmission Vegetation Management Program, February 17, 2006.

Section 5.6 Ref 4

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South Carolina Rare, Threatened, & Endangered Species Inventory County Selection From List

Please click on a county of interest to view its species data, or click here to list all species found in South Carolina.

Counties A - C	Counties D - L	Counties M - Y
Abbeville	Darlington	Lexington
Aiken	Dillion	Marion
Allendale	Dorchester	Malboro
Anderson	Edgefield	McCormick
Bamberg	Fairfield	Newberry
Barnwell	Florence	Oconee
Beaufort	Georgetown	Orangeburg
Berkeley	Greenville	Pickens
Calhoun	Greenwood	Richland
Charleston	Hampton	Saluda
Chereokee	Horry	Spartanburg
Chester	Jasper	Sumter
Chesterfield	Kershaw	Union
Clarendon	Lancaster	Williamsburg
Colleton	Laurens	York
	Lee	

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South Carolina Rare, Threatened, & Endangered Species Inventory KEY

Return to species data...

STATUS - legal status:

FE -
Federal Endangered

FT -
Federal Threatened

PE -
Proposed for Federal listing as Endangered

PT -
Proposed for Federal listing as Threatened

C -
Candidate for Federal listing

NC -
Of Concern, National (unofficial - plants only)

RC -
Of Concern, Regional (unofficial - plants only)

SE -
State Endangered (official state list - animals only)

ST -
State Threatened (official state list - animals only)

SC -
Of Concern, State

SX -
State Extirpated

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Aiken County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
ACIPENSER BREVIROSTRUM	SHORTNOSE STURGEON	G3	S3	FE/SE
AESCULUS PARVIFLORA	SMALL-FLOWERED BUCKEYE	G2G3	S1	RC
AGALINIS LINIFOLIA	FLAX LEAF FALSE-FOXGLOVE	G4?	S?	SC
ALLIUM CUTHBERTII	STRIPED GARLIC	G3	S?	S[illegible]
AMBYSTOMA TIGRINUM TIGRINUM	EASTERN TIGER SALAMANDER	G5T5	S2S3	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTRAGALUS VILLOSUS	A MILK-VETCH	G4	S?	SC
ATRYTONE AROGOS	AROGOS SKIPPER	G3G4	S?	SC
BOTRYCHIUM LUNARIOIDES	WINTER GRAPE-FERN	G4?	S?	SC
CALAMOVILFA BREVIPILIS	PINE-BARRENS REED-GRASS	G4	S?	NC
CAREX CHEROKEENSIS	CHEROKEE SEDGE	G4G5	SR	SC
CAREX COLLINSII	COLLINS' SEDGE	G4	S1	SC
CAREX ELLIOTTII	ELLIOTT'S SEDGE	G4?	S?	SC
CAREX FOLLICULATA	LONG SEDGE	G4G5	S1	SC
CAREX SOCIALIS	SOCIAL SEDGE	G4	S?	SC
CAROLINA BAY		G?	S?	SC
CLADRASTIS KENTUKEA	YELLOWWOOD	G4	S1	RC
CLEMMYS GUTTATA	SPOTTED TURTLE	G5	S5	ST
COLONIAL WATERBIRD		G?	S?	SC
CONDYLURA CRISTATA	STAR-NOSED MOLE	G5	S3?	SC
COREOPSIS ROSEA	ROSE COREOPSIS	G3	S2	[illegible]
CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT	G3G4	S2?	SE
CROTON ELLIOTTII	ELLIOTT'S CROTON	G2G3	S?	SC
CYSTOPTERIS PROTRUSA	LOWLAND BRITTLE FERN	G5	S?	SC
DELPHINIUM CAROLINIANUM	CAROLINA LARKSPUR	G5	S?	SC

DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
ECHINACEA LAEVIGATA	SMOOTH CONEFLOWER	G2	S1	FE/SE
ECHINODORUS PARVULUS	DWARF BURHEAD	G3Q	S2	SC
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ENEMION BITERNATUM	FALSE RUE-ANEMONE	G5	S1	RC
EUONYMUS ATROPURPUREUS	WAHOO	G5	S1	SC
FORESTIERA LIGUSTRINA	UPLAND SWAMP PRIVET	G4G5	S1	SC
GAURA BIENNIS	BIENNIAL GAURA	G5	S?	SC
GOPHERUS POLYPHEMUS	GOPHER TORTOISE	G3	S1	SE
HALESIA PARVIFLORA	SMALL-FLOWERED SILVERBELL-TREE	G?	S?	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	SC
HYLA AVIVOCA	BIRD-VOICED TREEFROG	G5	S5	SC
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
ILEX AMELANCHIER	SARVIS HOLLY	G4	S3	SC
IPOMOPSIS RUBRA	RED STANDING-CYPRESS	G4G5	S?	SC
JUNIPERUS COMMUNIS	GROUND JUNIPER	G5	S?	SC
KALMIA CUNEATA	WHITE-WICKY	G3	S1	NC
LASIURUS CINEREUS	HOARY BAT	G5	S?	SC
LINDERA SUBCORIACEA	BOG SPICEBUSH	G2	S?	RC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	SC
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	SC
MAGNOLIA CORDATA	PIEDMONT CUCUMBER TREE	G?Q	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MICRURUS FULVIUS	EASTERN CORAL SNAKE	G5	S2	SC
MYRIOPHYLLUM LAXUM	PIEDMONT WATER-MILFOIL	G3	S2	RC
NEOTOMA FLORIDANA	EASTERN WOODRAT	G5	S3S4	SC
NEOTOMA FLORIDANA FLORIDANA	EASTERN WOODRAT	G5T5	S3S4	SC
NERODIA FLORIDANA	FLORIDA GREEN WATER SNAKE	G5	S2	SC
NESTRONIA UMBELLULA	NESTRONIA	G4	S2	SC
NOLINA GEORGIANA	GEORGIA BEARGRASS	G3G5	S?	SC
PARONYCHIA AMERICANA	AMERICAN NAILWORT	G3?	S?	SC
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	G3	S2	FE/SI
PITUOPHIS MELANOLEUCUS	PINE OR GOPHER SNAKE	G4	S3S4	SC
PITYOPSIS PINIFOLIA	PINE-LEAVED GOLDEN ASTER	G4	S?	SC
PLATANTHERA LACERA	GREEN-FRINGE ORCHIS	G5	S1	SC
PTILIMNIUM NODOSUM	HARPERELLA	G2	S1	FE/S
RANA CAPITO	GOPHER FROG	G3	S1	SE
RHODODENDRON FLAMMEUM	PIEDMONT AZALEA	G3	S2	SC
RHYNCHOSPORA INUNDATA	DROWNED HORNEDRUSH	G3G4	S?	SC
RORIPPA SESSILIFLORA	STALKLESS YELLOWCRESS	G5	S?	SC

RUELLIA CAROLINIENSIS SSP CILIOSA	A PETUNIA	G5T3T4	S?	SC
SAGITTARIA ISOETIFORMIS	SLENDER ARROW-HEAD	G4?	S2	SC
SARRACENIA RUBRA	SWEET PITCHER-PLANT	G3	S4	SC
SCIRPUS ETUBERCULATUS	CANBY BULRUSH	G3G4	S?	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SEMINATRIX PYGAEA	BLACK SWAMP SNAKE	G5	S?	SC
SOLIDAGO AURICULATA	EARED GOLDENROD	G4	S?	SC
SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
SPOROBOLUS PINETORUM	CAROLINA DROPSEED	G3	SR	SC
STYLISMA PICKERINGII VAR PICKERINGII	PICKERING'S MORNING-GLORY	G4T2T3	S1	SC
SYNGONANTHUS FLAVIDULUS	YELLOW PIPEWORT	G5	S1	RC
TREPOCARPUS AETHUSAE	AETHUSA-LIKE TREPOCARPUS	G4G5	S?	SC
TRILLIUM DISCOLOR	FADED TRILLIUM	G3	S?	SC
TRILLIUM LANCIFOLIUM	NARROW-LEAVED TRILLIUM	G3	S1	NC
TRILLIUM PUSILLUM VAR PUSILLUM	LEAST TRILLIUM	G3T2	S1	NC
TRILLIUM RELIQUUM	RELICT TRILLIUM	G2	S1	FE/SE
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
XYRIS BREVIFOLIA	SHORT-LEAVED YELLOW-EYED GRASS	G4G5	S?	S

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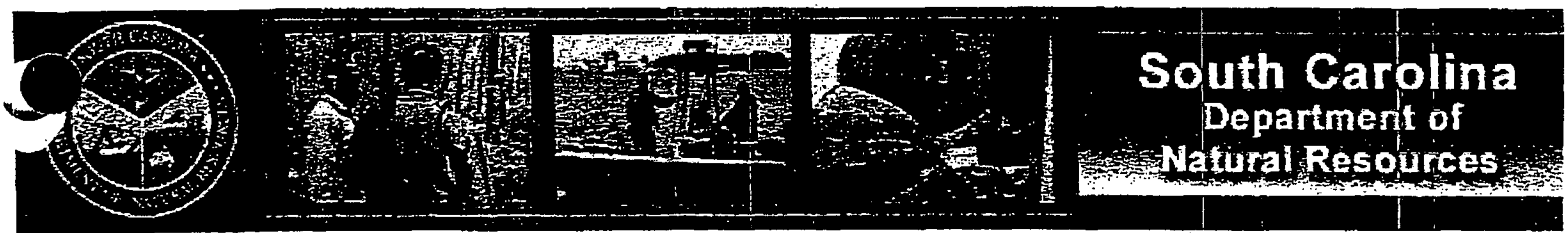

South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Edgefield County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
ACCIPITER COOPERII	COOPER'S HAWK	G5	S3?	SC
ALASMIDONTA VARICOSA	BROOK FLOATER	G3	S?	SC
AMORPHA GLABRA	SMOOTH INDIGOBUSH	G4?	S?	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	SC
CAREX AMPHIBOLA	NARROWLEAF SEDGE	G5	S?	SC
CAREX GRACILESCENS	SLENDER SEDGE	G5?	S?	SC
COREOPSIS ROSEA	ROSE COREOPSIS	G3	S2	RC
DELPHINIUM CAROLINIANUM	CAROLINA LARKSPUR	G5	S?	SC
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
ETHEOSTOMA HOPKINSI	CHRISTMAS DARTER	G4G5	S4	SC
FORESTIERA LIGUSTRINA	UPLAND SWAMP PRIVET	G4G5	S1	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
JUGLANS CINEREA	BUTTERNUT	G3G4	S?	SC
LAMPSILIS CARIOSA	YELLOW LAMPMUSSEL	G3G4	S?	SC
LASMIGONA DECORATA	CAROLINA HEELSPLITTER	G1	S1	FE/SE
LITHOSPERMUM TUBEROSUM	TUBEROUS GROMWELL	G4	S1	SC
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OENOTHERA LINIFOLIA	THREAD-LEAF SUNDROPS	G5	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OUTCROP		G?	S?	SC

PANAX QUINQUEFOLIUS	AMERICAN GINSENG	G3G4	S2S3	RC
PARONYCHIA AMERICANA	AMERICAN NAILWORT	G3?	S?	SC
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
PLETHODON WEBSTERI	WEBSTER'S SALAMANDER	G3	S2	SE
PYGANODON CATARACTA	EASTERN FLOATER	G5	S?	SC
QUERCUS OGLETHORPENSIS	OGLETHORPE'S OAK	G3	S3	SC
QUERCUS SINUATA	DURAND'S WHITE OAK	G5	S1	SC
SCHOENOLIRION CROCEUM	YELLOW SUNNYBELL	G4	S1	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	SC
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
SOLIDAGO AURICULATA	EARED GOLDENROD	G4	S?	SC
SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
SYLVILAGUS AQUATICUS	SWAMP RABBIT	G5	S2S3	SC
TRILLIUM DISCOLOR	FADED TRILLIUM	G3	S?	SC
TRILLIUM LANCIFOLIUM	NARROW-LEAVED TRILLIUM	G3	S1	NC
TRILLIUM RELIQUUM	RELICT TRILLIUM	G2	S1	FE/SE
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
VILLOSA VIBEX	SOUTHERN RAINBOW	G4Q	S?	SC

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Fairfield County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	SC
CAREX OLIGOCARPA	EASTERN FEW-FRUIT SEDGE	G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DODECATHEON MEADIA	SHOOTING-STAR	G5	S?	SC
ETHEOSTOMA COLLIS	CAROLINA DARTER	G3	S?	SC
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY	G5	S?	SC
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
PYGANODON CATARACTA	EASTERN FLOATER	G5	S?	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	SC
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC

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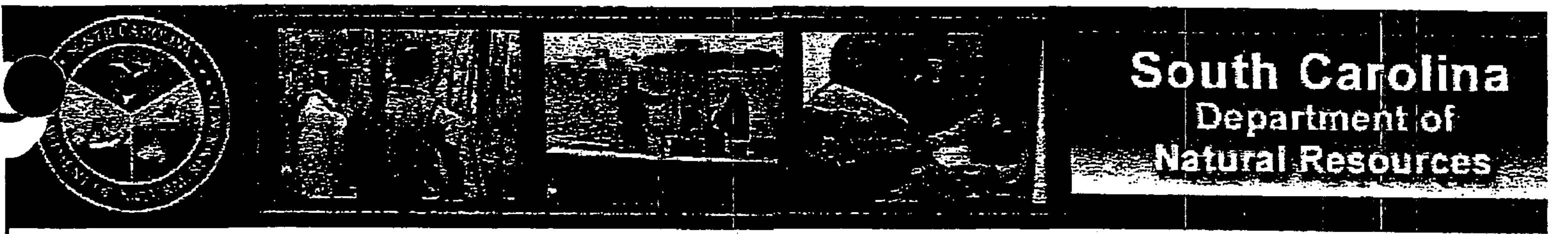

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Newberry County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DISTOCAMBARUS YOUNGINERI	A CRAYFISH	G1	S1	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
EUPATORIUM FISTULOSUM	HOLLOW JOE-PYE WEED	G5?	S?	SC
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERANTHERA RENIFORMIS	KIDNEYLEAF MUD-PLANTAIN	G5	S?	SC
JUGLANS CINEREA	BUTTERNUT	G3G4	S?	SC
LIPARIS LILIIFOLIA	LARGE TWAYBLADE	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MONOTROPSIS ODORATA	SWEET PINESAP	G3	S1	RC
MYCTERIA AMERICANA	WOOD STORK	G4	S1S2	FE/SE
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET	G5T5	S?	SC

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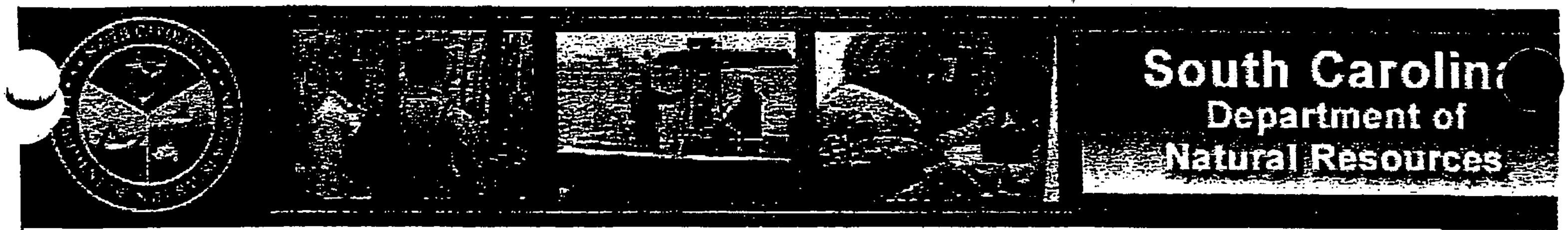

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Saluda County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
AMPHIANTHUS PUSILLUS	POOL SPRITE	G2	S1	FT/ST
ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	SC
CAROLINA BAY		G?	S?	SC
COREOPSIS ROSEA	ROSE COREOPSIS	G3	S2	RC
CUSCUTA CEPHALANTHI	DODDER; LOVE-VINE	G5	S?	[illegible]
DODECATHEON MEADIA	SHOOTING-STAR	G5	S?	SC
ECHINODORUS PARVULUS	DWARF BURHEAD	G3Q	S2	SC
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
ETHEOSTOMA HOPKINSI	CHRISTMAS DARTER	G4G5	S4	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	SC
HYPERICUM ADPRESSUM	CREEPING ST. JOHN'S-WORT	G2G3	S1	RC
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
LAMPSILIS SPLENDIDA	RAYED PINK FATMUCKET	G3	S?	SC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OENOTHERA LINIFOLIA	THREAD-LEAF SUNDROPS	G5	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY	G5	S?	SC
OUTCROP		G?	S?	[illegible]
PLATANTHERA LACERA	GREEN-FRINGE ORCHIS	G5	S1	SC
PLETHODON WEBSTERI	WEBSTER'S SALAMANDER	G3	S2	SE
PTILIMNIUM NODOSUM	HARPERELLA	G2	S1	FE/
PYGANODON CATARACTA	EASTERN FLOATER	G5	S?	S

QUERCUS OGLETHORPENSIS	OGLETHORPE'S OAK	G3	S3	SC
SAGITTARIA ISOETIFORMIS	SLENDER ARROW-HEAD	G4?	S2	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	SC
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
TOXOLASMA PULLUS	SAVANNAH LILLIPUT	G2	S1S3	SC
UTTERBACKIA IMBECILLIS	PAPER PONDSHELL	G5	S?	SC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET	G5T5	S?	SC

For detailed location information about rare & endangered species, please contact Julie Holling .

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Richland County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAI STATU
AGALINIS TENELLA		G4Q	S?	SC
ANDROPOGON PERANGUSTATUS	NARROW LEAVED BLUESTEM	G5T3T4	S1	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTER ELLIOTTII	ELLIOTT'S ASTER	G3G4	S?	
ASTRAGALUS MICHAUXII	SANDHILLS MILKVETCH	G3	S?	SC
BALDUINA ATROPURPUREA	PURPLE BALDUINA	G2G3	S?	SC
BOTRYCHIUM LUNARIOIDES	WINTER GRAPE-FERN	G4?	S?	SC
CALAMOVILFA BREVIPILIS	PINE-BARRENS REED-GRASS	G4	S?	NC
CAREX CHEROKEENSIS	CHEROKEE SEDGE	G4G5	SR	SC
CAREX COLLINSII	COLLINS' SEDGE	G4	S1	SC
CAREX CRUS-CORVI	RAVENFOOT SEDGE	G5	S?	SC
CAREX ELLIOTTII	ELLIOTT'S SEDGE	G4?	S?	SC
CAREX SOCIALIS	SOCIAL SEDGE	G4	S?	SC
CAROLINA BAY		G?	S?	SC
CAYAPONIA BOYKINII	CAYAPONIA	G4	S?	SC
COLLINSONIA SEROTINA	SOUTHERN HORSE-BALM	G3G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
CONDYLURA CRISTATA	STAR-NOSED MOLE	G5	S3?	SC
COREOPSIS GLADIATA	SOUTHEASTERN TICKSEED	G3G5	S?	SC
CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT	G3G4	S2?	S
DRYOPTERIS CARTHUSIANA	SPINULOSE SHIELD FERN	G5	S?	
ECHINACEA LAEVIGATA	SMOOTH CONEFLOWER	G2	S1	FE/
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	S
ELIMIA CATENARIA	GRAVEL ELIMIA	G4	S?	S
ETHEOSTOMA COLLIS	CAROLINA DARTER	G3	S?	S

FUNDULUS DIAPHANUS	BANDED KILLIFISH	G5	S1	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	SC
HYLA ANDERSONII	PINE BARRENS TREEFROG	G4	S2S3	ST
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
HYPERICUM ADPRESSUM	CREEPING ST. JOHN'S-WORT	G2G3	S1	RC
HYPERICUM NITIDUM	CAROLINA ST. JOHN'S-WORT	G4	S?	SC
ILEX AMELANCHIER	SARVIS HOLLY	G4	S3	SC
IPOMOPSIS RUBRA	RED STANDING-CYPRESS	G4G5	S?	SC
JUNCUS ABORTIVUS	PINEBARREN RUSH	G4G5	S?	SC
LECHEA TORREYI	PIEDMONT PINWEED	G4G5	S?	SC
LIATRIS MICROCEPHALA	SMALL-HEAD GAYFEATHER	G3G4	S?	SC
LINDERA SUBCORIACEA	BOG SPICEBUSH	G2	S?	RC
LOBELIA SP 1	LOBELIA	G?	S?	SC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	SC
LYCOPUS COKERI	CAROLINA BUGLEWEED	G3	S?	SC
LYSIMACHIA ASPERULIFOLIA	ROUGH-LEAVED LOOSESTRIFE	G3	S1	FE/SE
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	SC
MAGNOLIA MACROPHYLLA	BIGLEAF MAGNOLIA	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MYRIOPHYLLUM LAXUM	PIEDMONT WATER-MILFOIL	G3	S2	RC
NESTRONIA UMBELLULA	NESTRONIA	G4	S2	SC
NOTROPIS CHILITICUS	REDLIP SHINER	G4	S1?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OXYPOLIS CANBYI	CANBY'S DROPWORT	G2	S1	FE/S
PASPALUM BIFIDUM	BEAD-GRASS	G5	S?	SC
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	G3	S2	FE/S
PITYOPSIS PINIFOLIA	PINE-LEAVED GOLDEN ASTER	G4	S?	SC
PLAGIOCHILA SULLIVANTII		G2	S?	SC
POTAMOGETON CONFERVOIDES	ALGAE-LIKE PONDWEED	G4	S1	SC
PRUNUS ALABAMENSIS	ALABAMA BLACK CHERRY	G4	S?	SC
PSILOTUM NUDUM	WHISK FERN	G5	S1S2	SC
PTEROGLOSSASPIS ECRISTATA	CRESTLESS PLUME ORCHID	G2	S2	SC
RHEXIA ARISTOSA	AWNED MEADOWBEAUTY	G3	S2	SC
RHINICHTHYS ATRATULUS	BLACKNOSE DACE	G5	S1	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
RHYNCHOSPORA INUNDATA	DROWNED HORNEDRUSH	G3G4	S?	SC
RHYNCHOSPORA MACRA	BEAK RUSH	G3	S?	SC

RHYNCHOSPORA OLIGANTHA	FEW-FLOWERED BEAKED-RUSH	G4	S?	SC
RHYNCHOSPORA PALLIDA	PALE BEAKRUSH	G3	S?	SC
RHYNCHOSPORA STENOPHYLLA	CHAPMAN BEAKRUSH	G4	S?	SC
SARRACENIA RUBRA	SWEET PITCHER-PLANT	G3	S4	SC
SCIRPUS ETUBERCULATUS	CANBY BULRUSH	G3G4	S?	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
SYLVILAGUS AQUATICUS	SWAMP RABBIT	G5	S2S3	SC
TOFIELDIA GLABRA	WHITE FALSE-ASPHODEL	G3	S?	SC
TREPOCARPUS AETHUSAE	AETHUSA-LIKE TREPOCARPUS	G4G5	S?	SC
TRIDENS CHAPMANII	CHAPMAN'S REDTOP	G?	S?	SC
TYTO ALBA	BARN-OWL	G5	S4	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
URTICA CHAMAEDRYOIDES	WEAK NETTLE	G4G5	S?	SC
VACCINIUM CRASSIFOLIUM SSP SEMPERVIRENS	RAYNER'S BLUEBERRY	G4G5T1	S1	NC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
WAREA CUNEIFOLIA	NUTTALL WAREA	G4	S?	SC

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Fairfield County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	SC
CAREX OLIGOCARPA	EASTERN FEW-FRUIT SEDGE	G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DODECATHEON MEADIA	SHOOTING-STAR	G5	S?	SC
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY	G5	S?	SC
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	SC
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

For detailed location information about rare & endangered species, please contact Julie Holling .

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Newberry County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DISTOCAMBARUS YOUNGINERI	A CRAYFISH	G1	S1	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
EUPATORIUM FISTULOSUM	HOLLOW JOE-PYE WEED	G5?	S?	SC
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERANTHERA RENIFORMIS	KIDNEYLEAF MUD-PLANTAIN	G5	S?	SC
JUGLANS CINEREA	BUTTERNUT	G3G4	S?	SC
LIPARIS LILIIFOLIA	LARGE TWAYBLADE	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MONOTROPSIS ODORATA	SWEET PINESAP	G3	S1	RC
MYCTERIA AMERICANA	WOOD STORK	G4	S1S2	FE/SE
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET	G5T5	S?	SC

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Richland County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
AGALINIS TENELLA		G4Q	S?	SC
ANDROPOGON PERANGUSTATUS	NARROW LEAVED BLUESTEM	G5T3T4	S1	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTER ELLIOTTII	ELLIOTT'S ASTER	G3G4	S?	SC
ASTRAGALUS MICHAUXII	SANDHILLS MILKVETCH	G3	S?	SC
BALDUINA ATROPURPUREA	PURPLE BALDUINA	G2G3	S?	SC
BOTRYCHIUM LUNARIOIDES	WINTER GRAPE-FERN	G4?	S?	SC
CALAMOVILFA BREVIPILIS	PINE-BARRENS REED-GRASS	G4	S?	NC
CAREX CHEROKEENSIS	CHEROKEE SEDGE	G4G5	SR	SC
CAREX COLLINSII	COLLINS' SEDGE	G4	S1	SC
CAREX CRUS-CORVI	RAVENFOOT SEDGE	G5	S?	SC
CAREX ELLIOTTII	ELLIOTT'S SEDGE	G4?	S?	SC
CAREX SOCIALIS	SOCIAL SEDGE	G4	S?	SC
CAROLINA BAY		G?	S?	SC
CAYAPONIA BOYKINII	CAYAPONIA	G4	S?	SC
COLLINSONIA SEROTINA	SOUTHERN HORSE-BALM	G3G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
CONDYLURA CRISTATA	STAR-NOSED MOLE	G5	S3?	SC
COREOPSIS GLADIATA	SOUTHEASTERN TICKSEED	G3G5	S?	SC
CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT	G3G4	S2?	SE
DRYOPTERIS CARTHUSIANA	SPINULOSE SHIELD FERN	G5	S?	SC
ECHINACEA [redacted]				
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ELIMIA CATENARIA	GRAVEL ELIMIA	G4	S?	SC
ETHEOSTOMA COLLIS	CAROLINA DARTER	G3	S?	SC
FUNDULUS DIAPHANUS	BANDED KILLIFISH	G5	S1	SC
HALI[redacted]				
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	SC

HYLA ANDERSONII	PINE BARRENS TREEFROG	G4	S2S3	ST
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
HYPERICUM ADPRESSUM	CREEPING ST. JOHN'S-WORT	G2G3	S1	RC
HYPERICUM NITIDUM	CAROLINA ST. JOHN'S-WORT	G4	S?	SC
ILEX AMELANCHIER	SARVIS HOLLY	G4	S3	SC
IPOMOPSIS RUBRA	RED STANDING-CYPRESS	G4G5	S?	SC
JUNCUS ABORTIVUS	PINEBARREN RUSH	G4G5	S?	SC
LECHEA TORREYI	PIEDMONT PINWEED	G4G5	S?	SC
LIATRIS MICROCEPHALA	SMALL-HEAD GAYFEATHER	G3G4	S?	SC
LINDERA SUBCORIACEA	BOG SPICEBUSH	G2	S?	RC
LOBELIA SP 1	LOBELIA	G?	S?	SC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	SC
LYCOPUS COKERI	CAROLINA BUGLEWEED	G3	S?	SC
[redacted]				
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	SC
MAGNOLIA MACROPHYLLA	BIGLEAF MAGNOLIA	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MYRIOPHYLLUM LAXUM	PIEDMONT WATER-MILFOIL	G3	S2	RC
NESTRONIA UMBELLULA	NESTRONIA	G4	S2	SC
NOTROPIS CHILITICUS	REDLIP SHINER	G4	S1?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
[redacted]				
PASPALUM BIFIDUM	BEAD-GRASS	G5	S?	SC
PICOIDES BOREALIS	[redacted]			
[redacted]	PINE-LEAVED GOLDEN ASTER	G4	S?	SC
PLAGIOCHILA SULLIVANTII		G2	S?	SC
POTAMOGETON CONFERVOIDES	ALGAE-LIKE PONDWEED	G4	S1	SC
PRUNUS ALABAMENSIS	ALABAMA BLACK CHERRY	G4	S?	SC
PSILOTUM NUDUM	WHISK FERN	G5	S1S2	SC
PTEROGLOSSASPIS ECRISTATA	CRESTLESS PLUME ORCHID	G2	S2	SC
RHEXIA ARISTOSA	AWNED MEADOWBEAUTY	G3	S2	SC
RHINICHTHYS ATRATULUS	BLACKNOSE DACE	G5	S1	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
RHYNCHOSPORA INUNDATA	DROWNED HORNEDRUSH	G3G4	S?	SC
RHYNCHOSPORA MACRA	BEAK RUSH	G3	S?	SC
RHYNCHOSPORA OLIGANTHA	FEW-FLOWERED BEAKED-RUSH	G4	S?	SC
RHYNCHOSPORA PALLIDA	PALE BEAKRUSH	G3	S?	SC
RHYNCHOSPORA STENOPHYLLA	CHAPMAN BEAKRUSH	G4	S?	SC
SARRACENIA RUBRA	SWEET PITCHER-PLANT	G3	S4	SC
SCIRPUS ETUBERCULATUS	CANBY BULRUSH	G3G4	S?	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC

SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
SYLVILAGUS AQUATICUS	SWAMP RABBIT	G5	S2S3	SC
TOFIELDIA GLABRA	WHITE FALSE-ASPHODEL	G3	S?	SC
TREPOCARPUS AETHUSAE	AETHUSA-LIKE TREPOCARPUS	G4G5	S?	SC
TRIDENS CHAPMANII	CHAPMAN'S REDTOP	G?	S?	SC
TYTO ALBA	BARN-OWL	G5	S4	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
URTICA CHAMAEDRYOIDES	WEAK NETTLE	G4G5	S?	SC
VACCINIUM CRASSIFOLIUM SSP SEMPERVIRENS	RAYNER'S BLUEBERRY	G4G5T1	S1	NC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
WAREA CUNEIFOLIA	NUTTALL WAREA	G4	S?	SC

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Section 5.6
Ref 5

SOUTH CAROLINA ELECTRIC & GAS COMPANY

COLUMBIA, SC

TRANSMISSION LINE AND SUBSTATION SITING PROCESSES:

A DISCUSSION OF THE SCOPE OF WORK ASSOCIATED WITH EACH STEP IN THE PROCESSES

January 2000

1.0 SCE&G LINE SITING PROCESS

SITING PHASE I: Alternate Route Development

Step 1 Project Scoping / Team Member Responsibility Assignments

Held at a location agreed to by SCE&G, this meeting will include the Contractor project manager and key Contractor team members. It will be beneficial and productive to have all key project personnel for SCE&G available at this meeting. The goals of the meeting will be:

- Introduce Contractor team members to SCE&G's contact personnel;
- Discuss and refine siting process and schedule milestones for the project;
- Address significant project issues (if known) and discuss approaches;
- Clarify and agree on data and information to be provided by SCE&G; and,
- Define key communication channels among the Contractor team members and SCE&G's contacts.

Step 2 Substation Site Selection

On projects requiring the siting and acquisition of substation sites, SCE&G's comprehensive substation siting process will be fully executed at this stage in Siting Phase I. The continuation Siting Phase I will be suspended until a site for the substation has been placed under an option to purchase.

Step 3 Delineation of Routing Study Area

During the scoping meeting, the project ***study area*** will be delineated. Generally, the boundary of the study area is set broadly enough to include all practical routing opportunities. For example, a compelling case could be made that routing a line beyond the study area would lead to a clear increase in overall impacts due to increased length. In some cases, geographic features or political boundaries (where there are obvious restrictions to routing) can serve to define study area boundaries that are easily defensible.

Step 4 Schedule Development

The Contractor will develop a schedule showing all activities that lead up to having the right-of-way purchased and ready for construction. The schedule will include all key siting steps, permitting/licensing activity, surveying, and real estate acquisition.

Step 5 Agency Notification / Initial Data Gathering

Federal, state and local agencies will be contacted by the Contractor to gain information about the study area. This agency contact will be to determine significant constraints and opportunities for siting this transmission line. Land use and zoning information will be obtained from the local planning agency. Current aerial photography and/or satellite imagery obtained at the inception of the siting study will be used during this phase.

Step 6 Regional, Environmental, Land Use and Community Data Collection and Entry

Data collection will be dictated by the character of the study area. Unless determined not to be needed, the following data layers will be compiled in a Geographic Information System to fully characterize factors in the study area that will influence siting decisions:

Land Cover: Depending on the study area, land cover will be developed from aerial photography or satellite imagery. These data will be classified to an appropriate level (woodland types, agricultural lands, grasslands, etc.) using Remote Sensing software augmented by field reconnaissance.

Land Use: Agencies (county planning, county engineering, economic development, etc.) will be solicited for information about present and future land uses in the study area that may affect siting decisions. A field study will be conducted during which existing land uses (subdivisions, churches, schools, commercial properties, federal properties, state properties, etc.) that might affect the routing of a transmission line will be noted. All of this information will be compiled with county tax parcel information throughout the study area. The Contractor will collect sufficient information to precisely determine classes and boundaries of ownership (private, federal, state, municipal, and other).

Roads and existing utilities will be mapped using Global Positioning System (GPS) technology. Railroad locations will be taken from aerial photography and United States Geological Survey (USGS) 7.5' Quadrangle Sheets. Appropriate buffers will be applied to the locations to indicate rights-of-way.

Radio towers will be located. If needed, the Contractor will check background radio levels and map areas of possible interference.

Occupied Building Locations: Using aerial photography for base mapping, building locations will be field verified and their locations mapped. These locations will be buffered at an appropriate level to indicate the building and surrounding property that would come under the building's influence.

Public Visibility: A combination of field reconnaissance and computer models will be used to predict those areas from which a line will be visible to the public. (This may be from public roads, key viewpoints, etc.) These data will be combined with other factors (distance to structures, vegetative screening conditions, landscape context, etc.) to establish visual impact values throughout the study area as a result of the proposed line.

Hydrography: The locations of waters of the US will be obtained from aerial photography, USGS 7.5' Quads, or USGS DLG's (digital line graphs). These data will be buffered to indicate areas of constraint to transmission line siting.

Wetlands: Wetlands will be entered from USFWS National Wetlands Inventory Maps if they are available. If they are not, wetland locations will be derived by the Contractor's environmental scientist from a combination of USGS 7.5' Quads, aerial photography interpretation, and field reconnaissance. These data will be classified, and buffered to indicate surrounding areas of constraint to transmission line siting.

Cultural Resources: State and local records will be researched and augmented by field reconnaissance to indicate areas of cultural significance. In particular, historic architectural resources will be identified. If areas of high potential exist, the Contractor will develop a model to predict areas most likely to contain significant archeological resources.

Natural Resources: State and federal protected species and significant natural community records will be researched and interpreted by the Contractor's staff biologist to delineate areas of constraint to line routing. Buffers and topological models will be applied as needed.

All data will be mapped to a level appropriate for the source and data type. GPS data will be corrected to five-meter accuracy. All data will be rectified to the same coordinate system, UTM, NAD27, used for the Siting Study allowing it to be integrated, if so desired.

Step 7 Community Workshops / Agency Comments / Analysis of Comments

The Contractor's project team, in close collaboration with the SCE&G project team, will organize and facilitate a community workshop. The Contractor will invite all property owners and residents within the project study area to the workshop by a direct mailing. The direct-mail invitation will include a map of the study area and a community survey that will allow public comments regarding the project to be mailed directly to the Contractor for a specified period of time ("Comment Period"). The community survey will be carefully designed to gain substantive information that should be considered while siting the line and to gain insight into community values and priorities. During the workshop, project need will be fully explained, the study area location will be communicated, and the siting approach will be discussed. Attendees will be encouraged to share information they deem relevant to the siting study.

The workshop will follow an informal format to give attendees an opportunity to arrive at their convenience, spend as little or as much time as they wish, and focus on specific areas that may interest them. For example, subject matter experts from the project team will be available at individual information stations to discuss EMF, project need, real estate acquisition, visual issues (including line structure and substation considerations), environmental issues, the siting process, etc. The team has a proven track record of working with the public to communicate and build consensus for controversial projects.

The key objectives of the workshop will be:

- To give the affected community an opportunity to participate in the planning process;
- To gather information that should be considered when developing, evaluating, and comparing alternative routes;
- To gain insight into community priorities;
- To identify issues that need on-going attention so that crisis management can be avoided later in the siting process; and,
- To instill a sense of confidence and trust in the siting process and SCE&G.

The structure of the meeting, i.e., decentralized presentations/discussions at subject matter information stations as individuals and small groups move from one information station to another, provides significant benefits. First, it is conducive to personalized communications with project decision-makers who can "drill down" into issues or concerns raised and provide explanations tailored to individual expectations.

Second, this format minimizes the possibility that the concerns of one person will feed off similar concerns of another. And finally, it is an effective method of understanding and documenting public concerns, listening to ideas, and giving appropriate consideration to each.

Federal, state and local agencies and other organizations with an interest in the project will be contacted and invited to a VIP session just prior to the public community workshop. They will be provided a map showing the study area as well as an explanation of how the routes were identified. Their comments will be incorporated in the evaluation.

Following the close of the public Comment Period, the information received at the workshop and from the community surveys will be analyzed and a Public Involvement Report will be issued that fully describes all information received from the public that will be considered in the siting process.

Step 8 Analyze Data / Determine Areas of Constraint and Opportunity

After all the data have been collected and compiled in the GIS, each individual data factor will be assigned a "constraint weight" by the Contractor and SCE&G siting team, based on team experience, legislative guidelines, agency comments, community priorities (as communicated in the community surveys), and sensitivity to the planned action. The weighted data will be compiled in the GIS to display the overlaying cumulative effect of all the data. The product will be a single map of the study area, color-coded to display the areas with highest constraint to routing, the areas with lowest constraint, and the full range of conditions between the two extremes.

Step 9 Identify Alternate Routes

Using the constraint opportunity mapping developed during Step 6, and working with SCE&G transmission line engineers, the Contractor's team will identify all practical transmission line route corridors. Once identified, each alternate route corridor will be closely field checked to confirm that no factors have been overlooked that could influence the viability of the route.

SITING PHASE II: Alternate Route Evaluation and Comparison

Step 1 Community Workshops / Agency Comments

The Contractor's project team, in close collaboration with SCE&G, will organize and facilitate a second community workshop. Again, all property owners and residents within the project study area will be invited by a direct mailing. This invitation will include a map showing the alternate route corridors developed during Phase I. During this workshop, the alternative routes will be displayed and how they were developed will be discussed at the siting workstation. As in the first workshop, the 2nd one will include workstations that will address project need, EMF, real estate considerations, construction and environmental concerns, and visual issues. Attendees will again be encouraged to share information they deem relevant to the siting study and any of the alternate routes.

As before, the workshop will follow an informal format to give attendees an opportunity to arrive at their convenience, spend as little or as much time as they wish, and focus on specific areas that may interest them.

The key objectives of this workshop are the same as the first. Allow the public a chance to participate in the process, instill confidence in SCE&G and their decisions, gather information relevant to the routing of the line, and identify issues that may affect the project.

Step 2 Field Review of Alternate Routes and Adjustments (if needed)

If comments are received during the community meeting about factors that were overlooked that might affect a route's viability, the Contractor's siting team will follow up and determine their validity. If needed, minor alignment adjustments will be made during this step.

Step 3 Develop Alternate Route Evaluation Criteria

Using data gathered during Siting Phase I, both community workshops, and meeting with regulatory agencies, the Contractor and SCE&G project team will have a basis to establish specific factors by which a quantifiable comparison of the alternate routes can be conducted. Typically, these factors include acres of woodland, pasture, etc., in the right-of-way; number of houses within 100' of the line,100'-200' etc; acres of right-of-way within 100', 100'-200', etc., of streams; the number of recorded archaeological sites within 100 feet of the line, etc.

Step 4 Alternate Route Evaluation and Ranking

The evaluation factors developed in Step 3 will be grouped into major categories, assigned weights (from 1-10) to reflect their relative importance within each category, and then applied to each alternate route. For example, a residence within 100' of the proposed line would be given a weight of 10; a residence within 200' of the line might be given a weight of 7 or 8 to reflect the lessened impact of the line to the residence due to the increased distance. Next, factor weights will be multiplied by their quantity (12 residences within 100' of route A = 120; 15 within 100' of route B = 150, etc.).

The routes will then be scored *in each category* by adding the individual factor totals. The total category score for each route will be normalized on a scale of 0-10 to give each category equal influence on the final route evaluation scoring and decision. The route with the highest category score will be given a normalized score of 10; routes with lower scores will be calculated based on their percentage of the highest score. The normalized route scores for each category and route will be carried forward to a Route Evaluation Score Summary sheet where the normalized category scores for each route will be totaled. Routes with lowest scores will be those with lowest impacts when measured against the evaluation criteria within the major evaluation categories.

Step 5 Cost and Engineering Evaluation

The Contractor's siting team will work closely with SCE&G engineers to evaluate each alternate route in terms of its engineering feasibility and constructability using approved structures and design parameters. This evaluation will include preliminary structure selection based on a careful field inspection of the alternate routes under consideration. The Contractor – SCE&G team will prepare a cost estimate for each route. Each estimate will include costs of real estate acquisition, right-of-way preparation, line engineering, line materials costs and line construction. The cost estimate will be a significant factor in the final route selection decision. If, for example, the two top-ranked routes (see Step 4) were practically equal in terms of overall environmental and land use effects, but the top-ranked route's total cost was significantly higher than the second-ranked route's, then SCE&G would probably have defensible reasons to select the lower cost, 2nd ranked route.

For each route on which cost estimates are prepared, a full listing of environmental studies associated with permitting and licensing will be prepared.

Step 6 Route Selection and Development of Ownership List

Upon SCE&G's final selection of a preferred route, the Contractor's Siting Team will prepare and deliver an ownership map (showing the selected route and a listing of property ownership within 500' of the selected route) to SCE&G. The ownership list can be used to conduct survey notification. A copy of this map will be delivered to SCE&G within three working days of the final route selection. The Contractor will be available to conduct the survey notification on behalf of SCE&G, and will submit a proposal to do so, if directed.

SITING PHASE III: Study Documentation and Agency Approval of the Preferred Route

Step 1 Agency Contact / Survey Notification / Community Notification

The Contractor assumes that property owners who will be crossed by the selected route will be notified by SCE&G in a manner that fulfills statutory requirements regarding survey notification. If SCE&G desires, the Contractor will be available to issue survey notification on their behalf to all property owners who will likely be crossed by the selected route.

Following the issuance of survey notification to directly affected property owners, a general notification regarding the selected route will be issued by the Contractor to everyone who was invited to the community workshop. This notification will be in the form of personal letters and will include a map showing the selected route.

Agencies and organizations with whom ongoing contact has been maintained regarding the project will be notified by methods deemed appropriate at the time.

Step 2 Additional Studies if Required by Agencies

This step often includes only the necessary field studies, which follow right-of-entry waivers or survey permission. Site-specific studies are performed as indicated from agency responses. This may include cultural resources, protected species, and wetland inventories and delineation to address individual property owner or agency concerns not resolved in earlier components of the siting study and analysis. Occasionally, two or more routes will be included in this step; however, it is common for only one route, the preferred route, to be examined in this detail. Features such as vegetation, archaeological resources, wetlands, geological hazards, or protected species will be mapped using GPS, if a high degree of point data accuracy is required prior to the physical survey.

Step 3 Develop Mitigation Measures

The Contractor's siting team will focus on the selected route and consider mitigation and construction practices that may lessen overall impacts within acceptable cost parameters. The siting team will consider issues such as right-of-way access, use of right-of-way clearing technique, erosion control design, and structure type and then make recommendations to SCE&G.

The Contractor, if requested by SCE&G, will conduct a comprehensive visual-impact analysis. As part of this step, three-dimensional computer-generated terrain models will be developed to show what might be seen from selected points along the line. If needed, visual analysis experts will use 7.5' U.S. Geological Survey digital elevation models (DEMs) or hand-digitized topography to determine ground elevations and develop the models. These terrain models will show post-construction conditions from major viewpoints (e.g., road locations, residences, scenic overlooks, schools, churches, etc.) with the proposed line's supporting structures added, based on preliminary engineering. The Contractor's siting team will determine the relative level of visual impact from each viewpoint, using a formula that considers landscape content, distance from the viewpoint to the structures, vegetative modification, and numbers of structures seen against background and/or skyline. This analysis process has been extremely effective in completing visual implication studies associated with gaining special use permits for transmission lines across U.S. Forest Service lands, addressing concerns associated with historic resources, etc.

Step 4 Produce A Siting Report That Fully Documents The Siting Process And The Project's Environmental Effects

The Contractor will produce a Siting Report that that fully documents the siting process. The report will clearly describe existing environmental and land use characteristics and conditions and will quantify any effects of a transmission line over the selected route. This report, which will include a full discussion relating to project need, will serve as the "centerpiece" of all project permit applications.

The format of the report will follow National Environmental Policy Act guidelines and will include the following sections:

- Executive Summary
- Chapter 1 - Facility Description
- Chapter 2 - Need for the Project
- Chapter 3 - Alternatives to the Project (Including the Proposed Action)
- Chapter 4 - The Affected Environment
- Chapter 5 - Environmental Consequences
- Chapter 6 - Mitigation and Monitoring Measures
- Chapter 7 - Correspondence and Other Project Coordination / Agencies Consulted
- Chapter 8 - Newspaper Advertisement and Legal Notices (if any)
- Chapter 9 - Community / Public Outreach (in applicable)
- Bibliography
- Tables and Figures

Step 5 Submit to Review Agencies / Licensing Authorities

Applications for all required permits and licenses will be prepared by the Contractor's project team on a time-and-materials basis, as directed by SCE&G.

SCE&G
Distribution Substation Siting Process

Step 1

SCE&G will designate a siting contractor ("Contractor") that will facilitate the substation site selection process through participation with Electric Transmission, Electric Distribution, and Real Estate project team representatives. The Contractor will meet local distribution planners to review each future project in their respective planning regions. The Contractor and planners will inspect the areas where substations are needed (e.g., the load center) and preliminarily identify sites that appear suitable. This preliminary site identification effort will be heavily weighted on distribution circuitry requirements, the apparent availability of undeveloped acreage of sufficient size, and observations regarding site development factors.

Step 2

The Contractor will acquire tax mapping and ownership records for the area that encompasses the alternate sites and conduct the following investigations for each:

1. Overlay the property with available topographical data acquired from various sources (U.S. Geodetic Survey data or topography available from local planning agencies);
2. Add the future substation's "footprint" onto the topographical mapping and prepare a preliminary grading plan for the purpose of determining if the subject lot is large enough to accommodate the future station. In cases where the acreage tracts are involved, the mapping will be used to determine what size lot would be needed from the acreage tract;
3. Determine the implications of zoning requirements, if any;
4. Preliminarily assess the ability to reach the site with a transmission line;
5. Determine if the site contains documented archaeological resources, natural heritage sites (Rare, Threatened, or Endangered Species), or sensitive resources such as wetlands;
6. Review the Environmental Protection Agency records to determine if the site is known to contaminated;
7. Assess the ability to gain department of transportation permits for the future access drive; and,
8. Estimate the cost to prepare the site for substation construction.

Step 3

The Contractor will review each alternate site with the real estate professional that will be responsible for acquisition. The real estate professional will be requested to estimate the cost to purchase each alternate site. (For schedule efficiency, it is anticipated that local real estate firms having extensive knowledge and data regarding sales in the local area will be engaged to provide this information).

Step 4

The Contractor will prepare a brief management summary report for each alternate site that will contain all relevant information needed to characterize the site, including a map showing the site with the topography and substation added.

Step 5

The Contractor will notify SCE&G's project manager that alternate sites for the future substation have been identified and evaluated. The project manager will be requested to arrange a meeting with key project team members from SCE&G, Electric Distribution (including the district manager), and Real Estate Services. During this meeting, the distribution planner and Contractor will present detailed information about each alternate site, and the project team will be asked to participate in a process to rank the sites from the most desirable to the least. It should be noted that the ranking process is relative and comparative among the sites. It is the intent of the substation siting process to present only alternate sites that will be suitable for the future substation.

Step 6

It is assumed that the real estate professional responsible for acquisition will be instructed by a representative from Electric Distribution to pursue the execution of an **Option to Purchase** on the selected site at the conclusion of the meeting described in Step 5. If it is ultimately determined that the selected site cannot be acquired, it is assumed that an inquiry will proceed regarding availability of the 2nd most desirable site, etc. If it is determined that none of the acceptable, evaluated sites are available from willing sellers based on the fair market value of the property needed, SCE&G will be well-positioned to return to the first-choice site and pursue acquisition through an eminent domain process if all other reasonable means of acquiring are first exhausted.

Step 7

Once SCE&G takes possession of the site through an Option to Purchase or by other means, the Contractor and Real Estate Services will cooperate to conduct a thorough due diligence investigation (title investigation, Phase I Environmental Assessment, topographic survey, pre-final grading plan, zoning approvals, etc.).

Step 8

If no problems are revealed during the due diligence investigation, the real estate professional will be authorized by Electric Distribution to order a final boundary survey and acquire the property.

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TRANSMISSION LINE SITING PROCESS

PHASE I
Alternate Route Development

1. Project Scoping / Team Member Responsibility Assignments
2. Delineation of Routing Study Area and Initial Data Collection
3. Community Workshop(s) / Agency Contact
4. Final Regional, Environmental, Land Use and Community Data Collection and Entry
5. Analyze Data / Determine Areas of Constraint and Opportunity
6. Identify Alternate Routes

Product → Identification of Alternate Routes

PHASE II
Alternate Route Evaluation and Comparison

1. Community Workshop(s) / Agency Comments
2. Compile and Analyze Community Comments and Information
3. Field Review of Alternate Routes and Adjustments (if needed)
4. Develop Alternate Route Evaluation Criteria
5. Alternate Route Evaluation and Ranking
6. Cost and Engineering Evaluation; Schedule Development

Product → Preferred Route

PHASE III
[illegible]

1. Agency Contact / Community Notification
2. Additional Studies (If Required By Agencies)
3. Develop Mitigation Measures
4. Produce Environmental Report or Other Routing Study Documentation
5. Submit to Review Agencies / Licensing Authorities As Needed

Product → Approved Route

Section 5.6
Ref
SCE&G 2002

SCE&G
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Appendix E
Applicant's Environmental Report
Operating License Renewal Stage
Virgil C. Summer Nuclear Station

South Carolina Electric & Gas Company

Docket No. 50-395

License No. NPF-12

August 2002

2.0 SITE AND ENVIRONMENTAL INTERFACES

2.1 Location and Features

Virgil C. Summer Nuclear Station (VCSNS) is located in Fairfield County, South Carolina, approximately 15 miles west of the county seat of Winnsboro and 26 miles northwest of Columbia, the state capital (Figure 2-1). The site is in a sparsely-populated, largely rural area, with forests and small farms comprising the dominant land use. The Broad River flows in a northwest-to-southeast direction approximately one mile west of the site and serves as the boundary between Fairfield County (to the east) and Newberry County (to the west).

This reach of the Broad River, impounded for a small, run-of-the-river hydroelectric plant (Parr Hydro) in 1914, is known as Parr Reservoir (Figure 2-2). Originally 1,850 acres, Parr Reservoir was enlarged to approximately 4,400 acres in 1977 by raising the level of the dam by 9 feet (SCE&G 1978, pg. 2.1-16). This modification was necessary to support the development of the Fairfield Pumped Storage Facility (FPSF) (Figure 2-2), which was built on Frees Creek, a small tributary of the Broad River. In addition, Monticello Reservoir, a 6,500-acre impoundment, was built in the Frees Creek valley to serve as the upper pool for FPSF and the cooling water source for VCSNS. Parr Reservoir, which had historically been the source of water for Parr Hydro, assumed a dual function, providing water for both Parr Hydro and FPSF.

The VCSNS powerblock area (generating facilities and switchyard) is located on the south shore of Monticello Reservoir (Figure 2-3). A nuclear exclusion zone, defined as the area within approximately one mile of the reactor building, is posted and access to land portions of this area is controlled. The nuclear exclusion zone is not a perfect circle; its western axis is slightly longer (5,850 feet, or 1.11 mile) than its eastern axis (5,350 feet, or 1.01 mile) (SCE&G 1978, pg. 2.1-2). The boundary of the exclusion zone also represents the site boundary. The VCSNS property, thus defined, covers approximately 2,245 acres, and includes the southern portion of Monticello Reservoir and parts of the FPSF (Figure 2-3).

Section 3.1 describes key features of the station, including reactor and containment systems, cooling and auxiliary water systems, and transmission facilities.

2.2 Aquatic and Riparian Ecological Communities

Aquatic and riparian communities in the vicinity of VCSNS are influenced by the hydrology and water quality of the Broad River and movement of water between the Broad River/Parr Reservoir and Monticello Reservoir. This section characterizes both the hydrology and water quality of these waterbodies and the distribution and abundance of organisms within them.

Broad River and Parr Reservoir Hydrology and Water Quality

The Broad River originates on the eastern slope of the Blue Ridge Mountains near Lake Lure, North Carolina, and flows 220 miles southeast into South Carolina before joining the Saluda River at Columbia, South Carolina, to form the Congaree River. In South Carolina, the Broad River basin encompasses an approximately 4,500-square-mile watershed drained by 4,719 miles of streams (SCDHEC 1998, pg. 21). Major tributaries include the Pacolet, Tyger, and Enoree Rivers, all of which enter the Broad River from the west (Figure 2-1). The Broad River Basin in South Carolina is entirely within the Piedmont region, which is an area of gently rolling to hilly terrain with relatively broad stream valleys; elevations range from 376 to 1,000 feet above mean sea level (SCDHEC 1998, pg. 22). For most of its length in South Carolina, the Broad River flows through agricultural and forested land, including the Sumter National Forest, which bounds the river for some 30 miles above Parr Reservoir.

The 1998 South Carolina Department of Health and Environmental Control (SCDHEC) report contains additional information on land use in the Broad River Basin, its sub-basins (upper Broad, Pacolet, Tyger, and Enoree), and watersheds within these sub-basins. In addition, it provides details on stream classifications and water quality of all major streams in the region, and describes potential threats to water quality (point sources and non-point sources). The SCDHEC report notes that water quality in the Broad River from the Tyger River to the Parr Shoals dam is suitable for a range of aquatic life, but is experiencing "a significantly increasing trend" in total phosphorous concentrations (SCDHEC 1998, pg. 113) from upstream (agricultural and municipal) sources. In addition, fecal coliform bacteria levels are occasionally elevated in this stretch of the river.

The U.S. Geological Survey (USGS) operates and maintains gauging stations on the Broad River upstream and downstream of Parr Reservoir. Mean daily flow at the Carlisle gauging station (approximately 20 miles upstream of Parr Reservoir) over the 1939-2000 period ranged from 44 to 114,000 cubic feet per second (cfs) and averaged 3,933 cfs (Cooney et al. 2001, pg. 179). At the Alston gauging station, 1.2 miles downstream of Parr Shoals Dam, flows over the period of record (1896-1907; 1980-2000) ranged from 235 to 130,000 cfs and averaged 6,535 cfs (Cooney et al. 2001, pg. 226). Substantially higher flows at Alston, SC, reflect Tyger and Enoree River inflows. These streams enter the Broad River 18 and 13.5 miles, respectively, above the Parr Shoals dam, significantly increasing flows in the main stem of the river.

Parr Reservoir (see Figure 2-2) was created in 1914 by damming the Broad River at Parr Shoals, approximately 26 miles upstream of the confluence of the Broad and Saluda Rivers for Parr Hydro, a small (15 megawatt) run-of-the-river hydroelectric facility (SCE&G 2000). Prior to 1977, the reservoir's surface area was 1,850 acres (SCE&G 1978, pg. 2.1-16). In 1977, the level of Parr Reservoir was raised by 9 feet, which increased its surface area to approximately 4,400 acres. This modification was necessary to support the development of FPSF, which was built on Frees Creek, a small tributary of the Broad River. In addition, Monticello Reservoir was created to serve as the upper reservoir for FPSF and the cooling water source for VCSNS. Parr Reservoir, which had historically been the source of water for Parr Hydro, assumed a dual function, providing a headwater pool for Parr Hydro and a tailwater pool for FPSF.

The daily cycle of operation at the FPSF transfers up to 29,000 acre-feet per day (9.5×10^9 gallons per day) of water from Parr Reservoir to Monticello Reservoir and back (NRC 1981, pg. 2-10). Operations vary, depending on the season and system needs. In summer, FPSF generally pumps water from Parr Reservoir to Monticello Reservoir between the hours of 11 pm and 8 am and generates power (by releasing water) between the hours of 10 am and 11 pm. In winter, FPSF generally pumps water from Parr Reservoir to Monticello Reservoir between 11 pm and 6 am and generates between the hours of 6 am and 1 pm. The level of generation varies from one generator up to the maximum output of eight, depending on demand. Maximum output may not be necessary on all days. Pumping is normally done at maximum capacity. FPSF is normally operated seven days a week.

As a result of FPSF operations, Parr Reservoir is subject to daily fluctuations in water level of as much as 10 feet (NRC 1981, pg. 2-10), but the daily average is approximately 4 feet (Dames & Moore 1985). These water level fluctuations can expose and then reinundate up to 2,550 acres of Parr Reservoir with each cycle of pumpback and generation (release of water). The amount of water pumped from and returned to Parr Reservoir daily represents as much as 88 percent of its total volume (NRC 1981, pg. 2-18).

Temperatures and dissolved oxygen (DO) levels in water leaving Parr Reservoir are monitored at a USGS water quality monitoring station just downstream of the Parr Hydro powerhouse. Temperature and DO levels vary seasonally, and show an inverse relationship, with high temperatures associated with relatively low DO levels and low temperatures associated with relatively high DO levels. Temperatures in water year 1999-2000 (Oct. 1, 1999 through Sept. 30, 2000) ranged from 38.3°F in February to 87.8°F in August, with corresponding DO concentrations of 13.1 milligrams per liter and 4.9 milligrams per liter (Cooney et al. 2001, pp. 221-224).

Currently, Parr Reservoir maintains an intermediate trophic state among reservoirs in South Carolina; its river-like flows and short retention time (approximately four days) produce high DO levels (in most months) and high turbidity in the reservoir. Aquatic life and recreational uses are "fully supported" in Parr Reservoir, according to SCDHEC (1998, pg. 114), meaning that water quality is adequate to support a balanced indigenous community of organisms, with no restrictions on recreational users.

Monticello Reservoir Hydrology and Water Quality

VCSNS lies on the south shore of Monticello Reservoir (Figure 2-2), which serves as its cooling water source and heat sink. Monticello Reservoir was formed by damming Frees Creek, a small tributary of the Broad River that flowed into Parr Reservoir about 1.2 miles upstream of the Parr Shoals dam. As previously discussed, Monticello Reservoir was designed to serve both as a cooling pond for VCSNS and the upper pool for the FPSF, with an enlarged Parr Reservoir serving as the lower pool. Water flow from the Frees Creek watershed into the newly created Monticello Reservoir was negligible, and FPSF's pumps were used initially to fill the reservoir with water from Parr Reservoir (NRC 1981). Monticello Reservoir's small watershed drains an area of only 11,000 acres, including the reservoir and its subimpoundment (discussed later in this section).

Monticello Reservoir is approximately six miles long with a surface area of 6,500 acres. The average depth is 59 feet and the maximum depth is approximately 126 feet (SCDHEC 1998, pg. 114). FPSF operations can cause water levels in Monticello Reservoir to fluctuate as much as 4.5 feet daily, from 420.5 feet above mean sea level to 425.0 feet above mean sea level. Daily elevation changes vary, depending on system needs.

The most complete source of information on the water quality and biotic resources of Monticello Reservoir is a series of reports prepared in support of a Clean Water Act (CWA) Section 316(a) Demonstration for VCSNS and summarized in a final report (Dames & Moore 1985) submitted to SCDHEC and the U.S. Nuclear Regulatory Commission (NRC) in April 1985. A station-to-station comparison of pre-operational (1978-1982) and operational (1983-1984) water chemistry in Monticello Reservoir showed significant differences in 13 of 27 chemical parameters analyzed (Dames & Moore 1985, pg. 2.2-18). In 10 cases, concentrations of chemicals or measurements were higher in the pre-operational phase and in three cases concentrations were higher in the operational phase. None of these differences were related to operations of VCSNS.

The highest temperature observed in Monticello Reservoir over the 1983-1984 operational phase was 93.6°F at a depth of one foot at Station 14 (the sampling point closest to the discharge canal) in August 1983 (Dames & Moore 1985, pg. 2.2-10). A discernible thermal plume was present on 12 of 24 monthly field surveys at this same location, but survey results were confounded by plant operations (the plant was off-line during four surveys and at 50 percent power or less during three surveys). When plumes were detected, they were observed to a depth of 1 to 3 feet. Below this depth, the influence of the thermal plume was not evident. In more recent years (1995-2000), maximum temperatures at a sampling station just outside the mouth of the discharge canal ranged from 95.2°F to 103.7°F (see Section 4.12 for additional discussion).

Long-term eutrophication studies indicate that Monticello Reservoir's trophic condition is improving (SCDHEC 1998, pg. 114). It is currently rated as one of the least eutrophic reservoirs in South Carolina, and is characterized by low nutrient (total phosphorus and total nitrogen) concentrations.

Broad River/Parr Reservoir Aquatic Communities

The Broad River in the area of VCSNS was characterized (prior to the operation of FPSF and VCSNS) by a high silt load, high DO levels, high suspended solids levels, and low buffering capacity (NRC 1981). Parr Reservoir, a narrow, shallow, run-of-the-river reservoir, had lotic rather than lentic characteristics. Turbidity and flows appeared to limit the production of phytoplankton, and as a consequence they appeared to contribute only marginally to productivity. Zooplankton were also of limited importance. Benthic macroinvertebrates showed very little diversity, but relatively high measures of biomass due to the presence of high densities of the Asiatic clam, *Corbicula*. Fish collections prior to operation of FPSF were dominated by sunfish (bluegill, in particular) and gizzard shad, a forage species. Largemouth bass and white catfish also made up a significant proportion of biomass in collections (NRC 1981).

South Carolina Electric & Gas Company (SCE&G) monitored water quality and aquatic communities in the Broad River, Parr Reservoir, and Monticello Reservoir from mid-1978 through 1984 to assess the impacts of FPSF and VCSNS operations. This represented more than three years of pre-operational data and two years of operational data. These studies, summarized in a final report submitted to SCDHEC in April 1985 as part of a CWA Section 316(a) Demonstration (Dames & Moore 1985), represent the most comprehensive information on the biotic communities of the Broad River in the vicinity of VCSNS.

Parr Reservoir fish collections were dominated numerically in 1983 and 1984 by common warm water species. Approximately 44 percent of fish collected were centrarchids (e.g., bluegill, pumpkinseed, redear sunfish, largemouth bass), while 43 percent were clupeids (gizzard shad and threadfin shad). Gizzard shad and bluegill accounted for the greatest biomass, with 20.9 and 3.4 kilograms/hectare, respectively (Dames & Moore 1985, pp. 2.8-3–2.8-21). Species composition was essentially the same in preoperational (1978-1982) and operational (1983-1984) periods, with collections dominated by centrarchids (sunfish), clupeids (shad), and ictalurids (catfish and bullheads). The species composition was typical of warm, shallow southeastern reservoirs. The fish community of Parr Reservoir appeared to be largely unaffected by operations of VCSNS.

No comprehensive surveys or studies of Parr Reservoir's fish community have been conducted since 1984. The South Carolina Department of Natural Resources (SCDNR) assessed the largemouth bass fishery in the early 1990s and determined that there were fewer largemouth bass per acre in Parr Reservoir than other reservoirs in Fisheries Region III (Hayes 1999). Mean lengths and weights of Parr Reservoir largemouth bass were also lower. Parr Reservoir largemouth bass grew slowly, with fish reaching a minimum harvestable size of 12 inches at age three (Hayes 1999, pg. 19).

No creel survey has ever been conducted on Parr Reservoir to quantify angler effort, harvest, or success. (Hayes 1999, pg. 15). Anecdotal reports and casual interviews of fishermen suggest that catfish, crappie, and largemouth bass are the most targeted species. The extreme water level fluctuations on the reservoir make navigation difficult at times (water levels can be extremely low after pump-back operations) and appear to limit fishing pressure (Hayes 1999, pg. 15).

SCDNR is currently inventorying the aquatic resources of the Broad River and creating a Geographic Information System (GIS) database for natural resource managers in the region. Work began in the fall of 2000 and is scheduled for completion in the fall of 2002 (Bettinger 2001). This work is being supported by SCE&G, Duke Power, and Lockhart Power Company under the auspices of the Broad River Mitigation Trust Fund, whose Trustees are SCE&G, Duke Power, SCDNR, and the U.S. Fish and Wildlife Service (FWS).

In the fall of 2000 and the spring of 2001, 43 species of fish representing 9 families were collected from 9 sampling stations ranging over approximately 75 miles of the Broad River, from Gaston Shoals (near the North Carolina state line) to Bookman Island (15 miles below the Parr Shoals dam). Overall, the most common fish collected were redbreast sunfish, whitefin shiner, and silver redhorse (Bettinger et al. 2001). No exotic species or nuisance species were collected, and no federally listed species were collected. Live native mussels were extremely rare, found only at a single station in the Bookman Island area (Bettinger et al. 2001). All native mussels found were of the genus *Elliptio*. Fish collections at a station 14 miles upstream of Parr Shoals dam (just upstream of the confluence of the Broad River and the Enoree River) were dominated by common centrarchids (e.g., redbreast sunfish and bluegill), notropids (e.g., whitefin shiner and spottail shiner), and ictalurids (e.g., snail bullhead and margined madtom). Because the surveys were intended to provide baseline information on unimpounded sections of the river (tailwaters of dams and reaches of river between dams), Parr Reservoir was not included in the surveys.

<u>Monticello Reservoir Aquatic Communities</u>

Contract biologists using gill nets and electrofishing gear collected 32 species of fish representing 8 families from Monticello Reservoir in 1983 and 1984 (Dames & Moore 1985, Table 2.8.10), the last two years that sampling was conducted in support of the station's CWA Section 316(a) Demonstration. The Monticello Reservoir fish community in 1983-1984 was dominated by centrarchids (55 percent of fish captured) and clupeids (28 percent of fish captured) (Dames & Moore 1985, p. 2.8-10). Smaller numbers of ictalurids (7 percent), catastomids (5 percent), and percids (3 percent) were also captured. The species composition and relative abundance of Monticello Reservoir fish changed very little from 1978 through 1984. In all preoperational and operational years, centrarchids ranked first in abundance and clupeids ranked second. There was no indication that VCSNS operations had an effect on fish populations in Monticello Reservoir.

Based on cove rotenone studies conducted by SCDNR in 1987, 1988, 1995, and 1996, the fish community of Monticello Reservoir remains reasonably balanced and diverse, comprised of warmwater species common to the southeastern U.S. (Nash, Christie, and Stroud 1990; Christie and Stroud 1996, 1997). Three catfish species (blue catfish, channel catfish, and white catfish) made up a substantial proportion (56 percent, by weight) of the reservoir's standing stock in 1996 and provided an important recreational fishery, particularly in summer months. Other species more traditionally regarded as gamefish (largemouth bass, black crappie, white bass) contribute less to the reservoir's standing stocks, but considerable angler effort is directed toward these species in winter, spring, and fall.

In addition to the fish species that are normally sought and harvested by anglers, Monticello Reservoir contains a variety of game and non-game species including clupeids (threadfin shad and gizzard shad, which provide important forage for predators), cyprinids (e.g., common carp, golden shiner, whitefin shiner), catastomids (e.g., silver redhorse, shorthead redhorse, river carpsucker), ictalurids (brown bullhead, flat bullhead, and snail bullhead), centrarchids (e.g., bluegill, redear sunfish, redbreast), and percids (yellow perch and tesselated darter) (Nash, Christie, and Stroud 1990; Christie and Stroud 1996, 1997). All of these species are common to ubiquitous in South Carolina streams, ponds, and reservoirs (Loyacano 1975; Lee et al. 1980; Bennett and McFarlane 1983; SCDNR 1995).

There have been a number of changes in the Monticello Reservoir fish community since VCSNS began operating in 1982, none attributable to station operations. Two species (blue catfish and white perch) that now make up a major portion of the recreational catch first appeared in SCDNR samples in 1995. These species may have been introduced by fisherman or transferred into Monticello Reservoir from Parr Reservoir by pump-back operations. The blue catfish in particular "exploded" in numbers and importance in the reservoir between 1995 and 1996 (Christie and Stroud 1997, pg. 25). In an annual report on the status of fisheries in SCDNR Region IV, Christie and Stroud (1997, pg. 28) voiced concern about the booming population of blue catfish in Monticello Reservoir, noting that Monticello Reservoir has a "...relatively low prey base..." and "the unfortunate introduction of blue catfish may lead to competition for forage between catfish and game species."

The white perch, a semi-anadromous species native to the southeastern coast, is regarded as a "pest" by many inland fisheries managers (SC Bass Federation 2000). It is a species known for its high reproductive potential (high fecundity rate and high hatching rate), slow rate of growth, and long lifespan (up to 17 years), characteristics that tend to create crowded populations of stunted white perch in reservoirs (Wisconsin Sea Grant 1999; SAREP 2000). White perch are known to depress populations of other, more desirable gamefish species, such as walleye and white bass, by competing for limited forage and by feeding heavily on walleye and white bass eggs (Wisconsin Sea Grant 1999).

A number of other fish species (brook silverside, swallowtail shiner, and green sunfish) appeared for the first time in SCDNR's Monticello Reservoir cove rotenone samples in 1995 (Christie and Stroud 1996, pg. 19). These species were known to occur in other waterbodies in the Santee-Cooper drainage basin (which includes the Broad River), but had not been collected previously in Monticello Reservoir by SCDNR. None of these species is expected to have a noticeable effect on the reservoir's fisheries, beyond some minor contribution to the forage base.

Although somewhat less productive than other, older reservoirs in the region, Monticello Reservoir continues to provide fishermen in the South Carolina Midlands and Upstate with a variety of fishing opportunities. Roving creel surveys in 1997-1998 and 1998-1999 that included interviews of selected anglers revealed that roughly half (51 percent in 1997-98; 42 percent in 1998-99) of all fishing effort in Monticello Reservoir was directed at catfish (Christie and Stroud 1999, pp. 20-28). Less effort was expended fishing for black crappie (15 percent in 1997-98; 5 percent in 1998-99), largemouth bass (12 percent in 1997-98; 10 percent in 1998-99), and other species (bluegill, carp, white bass, white perch). The creel surveys indicated that fishing effort (number of hours fished per annum) had increased substantially since the late 1980s. They also showed that fishing pressure (hours fished per acre) was lower on Monticello Reservoir than on other reservoirs in the region (Christie and Stroud 1999, Table 17).

Excluding blue catfish and white perch, both apparently introduced by fishermen, no undesirable non-native fish species appeared in Monticello Reservoir after it was created and no nuisance species appeared to be favored by its operational thermal regimes. There have been no outbreaks of disease, beyond the occasional appearance of *Aeromonas* (*Aeromonas hydrophila*; a bacterium) infections in spawning largemouth bass in the spring. These fish, already stressed by spawning, appeared to have been caught and released by anglers. Handling further stressed these fish and removed protective slime/mucous coating, which resulted in *Aeromonas* infection.

In the late 1980s, a number of limited fish kills (generally involving small catfish) occurred in the VCSNS discharge bay in late summer and early fall. SCE&G set up a monitoring program to help identify the cause of the fish kills. Investigations revealed that the fish kills were associated with relatively high discharge temperatures and Monticello Reservoir drawdowns (through the operation of FPSF). It was determined that reservoir drawdown reduced the inflow of cooler water (from the main body of the reservoir) along the bottom of the discharge canal and into the discharge bay. Reduction or loss of this inflow allowed water temperatures to rise rapidly and kill fish inhabiting the discharge bay. Since the reservoir level was subject to daily fluctuation with the operation of FPSF, fish kills recurred as high reservoir levels (following pumpback operations) allowed more cool water inflow and recolonization of the discharge canal and bay.

SCE&G took several actions over the 1991–1993 period to reduce the frequency and severity of fish kills (SCE&G Environmental Services 1994, pg. 2). In 1991, an elevated area (an old roadbed) was removed from the discharge canal by dredging. This initially appeared to have ameliorated the fish kills, but a major fish kill in August 1992 indicated that removal of the roadbed had not completely solved the problem. In September 1992, Monticello Reservoir drawdown was limited to 422.5 feet mean sea level to prevent further fish kills.

SCE&G dredged the entire length of the discharge canal in July and August of 1993 to allow more cool water inflow at low reservoir levels. The dredging of the discharge canal altered circulation patterns and increased cool water inflow such that temperature at the bottom of the discharge bay in summer remained significantly (10 to 15 degrees) cooler than "end-of-pipe" discharge temperatures (SCE&G Environmental Services 1996, Figure 2). Fish kills ceased once the dredging of the discharge canal was completed. The discharge bay and canal were monitored intensively over the summers of 1994 and 1995, and no fish kills were observed (SCE&G Environmental Services 1996, pg. 3). None have been observed since that time.

The *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS) (NRC 1996, pg. 4-57) briefly discusses the fish kills in the VCSNS discharge bay and mentions SCE&G's investigations on the specific causes of the kills. It concludes that "these fish kills were localized; they do not appear to have had any adverse effect on the cooling pond (fish) population."

<u>Monticello Subimpoundment Aquatic Communities</u>

Monticello Reservoir is a 6,500-acre impoundment. However, it is hydrologically connected (by a conduit that passes under the Highway 99 causeway) to a smaller 300-acre body of water known as the Monticello Subimpoundment (Figure 2-2). This smaller subimpoundment is managed for recreational boating and fishing by SCE&G and SCDNR. SCE&G maintains the property, which includes boat launch, swimming, and picnic facilities; SCDNR manages the subimpoundment's fisheries by setting creel and size limits on fish. Fishing is permitted on Wednesdays and Saturdays only.

Surveys of the subimpoundment's fishery were last conducted in 1984 (Dames & Moore 1985). At that time, the fish community of the subimpoundment was characterized by relatively low species richness (12 species collected in 1983 and 1984), with collections dominated by gizzard shad and centrarchids (e.g., bluegill, redear sunfish, black crappie, and largemouth bass) (Dames & Moore 1985, pg. 2.8-8 and Figure 2.8-24). The Monticello Subimpoundment continues to be a popular fishing spot for local fishermen.

Section 5.6 Ref 7

South Carolina Electric & Gas Company
230 kV Electric Transmission Right-of-Way
Vegetation Management Program

Revision 2 dated January 3, 2008 – JBL

I. PURPOSE

Our goal is to control all types of vegetation that could affect the reliability and safety of the 987 miles of 230 kV transmission rights-of-way on our system. This will be achieved through various methods such as tree trimming, herbicide application, vegetation encroachment removal, mowing, and danger tree removal, all contingent upon local ordinances, codes, federal and state property owner issues, and other property owner issues. All work performed under this vegetation management program will be directed by the System Forester. The System Forester is required to be a registered forester in the state of South Carolina.

II. METHODS

A. Tree Trimming

Both aerial and ground crews will conduct routine tree trimming along our rights-of-way. These crews will trim all vegetation back to the original trim line or easement width depending upon what is best for the tree. Tree trimming will be conducted on an established rotation, which will be determined on a line-by-line basis depending upon the right-of-way width and transmission line structure configurations. This could range from three to twelve years.

B. Herbicide Application

We will apply herbicides to control any vegetation that might grow and interfere with our 230 kV rights-of-way. This will be conducted on a five-year rotation or as needed. Only herbicides that are safe to the environment will be used. All herbicides will be used in accordance to the recommended rates on the label.

C. Vegetation Encroachments

Crews will maintain the rights-of-way by removing any vegetation that has grown into the R/W corridor pursuant to the reconciliation of any outstanding property owner issues. Any vegetation encroachment posing an imminent threat to the dielectric integrity of the line will be immediately removed. Vegetation encroachment schedules will be determined based on inspection results and other information from company personnel, contractors, or property owners.

D. Mowing

When the use of herbicides isn't practical, we will mow the right-of-way. This will be determined by an inspection of the area. All mowing will be done on a three-year cycle, or as needed.

E. Danger Tree Removal

Danger trees will be identified through routine aerial and ground patrols. A danger tree is a tree, on or off the R/W, that is within the fall zone of the line and is dead, diseased, or

has any obvious potential risk to the system. As these trees are identified, they will be removed.
Trimming

III. INSPECTIONS

Aerial Inspections will be performed over the entire 230 kV transmission system once a year except for those parts of the system that must be patrolled from the ground due to FAA regulations or other restrictions. Additional ground patrols will be performed on an as needed, or demand basis.

Additional unscheduled inspections will naturally occur as a result of other line work being conducted as a part of capital projects or other routine line hardware inspections. In all cases, upon discovering any situation that presents an immediate threat of a transmission outage, the discovering party will immediately notify the Transmission System Dispatcher so that remedial action can be taken until the threat is resolved.

IV. TRIMMING CLEARANCES

Clearance 1 – (Clearance at the time the work is performed) – Trimming clearances for each transmission corridor will be either to the edge of the R/W or will be of sufficient width and clearance to satisfy the reliability requirements of the trimming cycle.

Clearance 2 – (Minimum clearance allowed at any time during the trim cycle for designed operating conditions) – Minimum clearances allowed under all designed operating conditions, including emergency ratings for blow-out and sag, are based on IEEE 516-2003, table 5 which specifies a minimum clearance of **1.57 meters** for 230kV phase-to-ground.

V. ANNUAL WORK PLAN - 2006

The following 230KV lines and line sections are scheduled for completion in 2006. Variances to this schedule will be noted as they occur:

A. Inspections

As indicated above, all 230 kV transmission line rights-of-way will undergo visual inspections in 2006. These will be aerial inspections except for those parts of the transmission system that cannot be flown over due to FAA regulations or other restrictions. In those cases, ground patrols will be conducted. R/W maintenance schedules may be adjusted based on inspections results and other information from company personnel, contractors, or property owners.

B. Line Trimming

Line Description	Qrtly Schd	Rev. Schd	Reason for Schedule Revision	Cmpl Qtr
Canadys-Mateeba 230kV	1st.			100%
Mateeba-Williams 230kV	3rd.			40%
Summerville-Williams (To	3rd.			20%

Naval Base Fence)230kV				
Pepper Hill-Ladson Jct. 230kV	2nd.			90%
Goose Creek –Williams 230kV	4th.			0%
Summer- Graniteville 230kV	2nd.			80%
Timberlake Tap 230kV	2nd.			80%
Edenwood-McMeekin 230kV	4th.			0%

C. Herbicide (supports the specified 5 year cycle)

Line Description	Qrtly Schd	Rev. Schd	Reason for Schedule Revision	Cmpl Qtr
Summer-Graniteville 230kV	3rd.			0%
Summer-Newberry 230KV	3rd.			0%
Timberlake Tap 230kV	3rd.			0%
Graniteville-Urquhart 230kV	3rd.			0%
Canadys-Urquhart (Urquhart to SRS fence) 230kV	3rd.			0%

D. Mowing

No R/W is scheduled for mowing in 2006

Reviewed by:

Alan Brock, System Forester — Date

David Burkhalter — Date
Manager - Power Delivery Operations – Northern Region

Jerry B. Lindler — Date
General Manager - Electric Transmission and Construction

Section 5.7 References

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2. NAS (National Academy of Sciences) 2006, *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII – Phase 2,* Committee to Assess Health Risks From Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, Division of Earth and Life Studies, National Research Council, National Academy Press, Washington D.C, 2006. Available at http://www.nap.edu/books/030909156X/html.

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5. U.S. NRC 1999, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Section 6.3, "Transportation," and Table 9-1, "Summary of findings on NEPA issues for license renewal of nuclear power plants," NUREG-1437, Volume 1, Addendum 1, Office of Nuclear Regulatory Research, Washington D.C., August 1999.

Section 5.7 Ref 2

Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 (2006)
Board on Radiation Effects Research (BRER)

√5.7-7

provide direct estimates of the effects of long-term, low-dose, low-LET radiation. It should be noted however that even with the increased sensitivity, the combined analyses are compatible with a range of possibilities, from a reduction of risk at low doses to risks twice those on which current radiation protection recommendations are based.

Veterans Exposed to Radiation Through Weapons Testing

An example of man-made radiation exposures experienced by large numbers of people in the past is the experience of the U.S. atomic veterans during and after World War II. From 1945 to 1962, about 210,000 military and civilian personnel were exposed directly at a distance to aboveground atomic bomb tests (about 200 atmospheric weapons tests were conducted in this period).[14] In general, these exercises, conducted in Nevada, New Mexico, and the Pacific, were intended to familiarize combat teams with conditions that would be present during a potential war in which atomic weapons might be used. As an example, in the series of five atmospheric tests conducted during Operation UPSHOT-KNOTHOLE, individual battalion combat teams experienced low-LET γ-ray doses as low as 0.4 mSv and as high as 31 mSv. This range of exposures would correspond to the equivalent of about five chest X-rays for the lowest-exposed combat team to approximately 390 chest X-rays for the highest-exposed combat team (by assuming a dose from one chest X-ray to be about 0.08 mSv).

EVIDENCE FOR ADVERSE HEALTH EFFECTS SUCH AS CANCER AND HEREDITARY DISEASE

The mechanisms that lead to adverse health effects after exposure to ionizing radiation are not fully understood. Ionizing radiation has sufficient energy to change the structure of molecules, including DNA, within the cells of the human body. Some of these molecular changes are so complex that it may be difficult for the body's repair mechanisms to mend them correctly. However, the evidence is that only a very small fraction of such changes would be expected to result in cancer or other health effects. Radiation-induced mutations would be expected to occur in the reproductive cells of the human body (sperm and eggs), resulting in heritable disease. The latter risk is sufficiently small that it has not been detected in humans, even in thoroughly studied irradiated populations such as those of Hiroshima and Nagasaki.

As noted above, the most thoroughly studied individuals for determination of the health effects of ionizing radiation are the survivors of the Hiroshima and Nagasaki atomic bombs. Sixty-five percent of these survivors received a low dose of radiation (less than 100 mSv; the definition of low dose used by this BEIR VII report). A dosage of 100 mSv is equivalent to approximately 40 times the average yearly background radiation exposure worldwide from all sources (2.4 mSv) or roughly 100 times the worldwide background exposure from low-LET radiation, the subject of this report. At dose levels of about 100 to 4000 mSv (about 40 to 1600 times the average yearly background exposure), excess cancers have been observed in Japanese atomic bomb survivors. Excess cancers represent the number of cancers above the levels expected in the population. In the case of *in utero* exposure (exposure of the fetus during pregnancy), excess cancers can be detected at doses as low as 10 mSv.[15] For the radiation doses at which excess cancers occur in the Hiroshima and Nagasaki studies, solid cancers[16] show an increasing rate with increasing dose that is consistent with a linear association. In other words, as the level of exposure to radiation increased, so did the occurrence of solid cancers.

Major advances have occurred during the last decade in several key areas that are relevant to the assessment of risks at low radiation doses. These advances have contributed to greater insights into the molecular and cellular responses to ionizing radiation and into the nature of the relationship between radiation exposure and the types of damage that underlie adverse health outcomes. Also, more data on radiation-induced cancers in humans have become available since the previous BEIR report on the health effects of low-dose, low-LET radiation, and those data are evaluated in this report.

THE BEIR VII RISK MODELS

Estimating Cancer Risk

An important task of the BEIR VII committee was to develop "risk models" for estimating the relationship between exposure to low levels of low-LET ionizing radiation and harmful health effects. The committee judged that the linear-no-threshold model (LNT) provided the most reasonable description of the relation between low-dose exposure to ionizing radiation and the incidence of solid cancers that are induced by ionizing radiation. This section describes the LNT; the linear-quadratic model, which the committee adopted for leukemia; and a hypothetical linear model with a threshold. It then gives an example derived from the BEIR VII risk models using a figure with closed circles representing the frequency of cancers in the general population and a star representing estimated cancer incidence from ra-

14 National Research Council. 2003. A Review of the Dose Reconstruction Program of the Defense Threat Reduction Agency. Washington, DC: National Academies Press, *http://www.nap.edu/catalog/10697.html*.

15 Doll, R., and R. Wakeford. 1997. Risk of childhood cancer from foetal irradiation. Brit J Radiol 70:130-139.

16 Solid cancers are cellular growths in organs such as the breast or prostate as contrasted with leukemia, a cancer of the blood and blood-forming organs.

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Health Effects of Exposure to Low Levels of Ionizing Radiation: BEIR V

Other Related Books

Section 5.7 Ref 3

EPA 2006

National Air Pollutant Emissions Estimates (fires and dust excluded) For Major Pollutants

	Millions of Tons Per Year							
	1970	1975	1980	1985[1]	1990	1995	2000[1]	2005[2]
Carbon Monoxide (CO)	197.3	184.0	177.8	169.6	143.6	120.0	102.4	89
Nitrogen Oxides (NOx)[3]	26.9	26.4	27.1	25.8	25.2	24.7	22.3	19
Particulate Matter (PM)[4]								
PM_{10}[5]	12.2[1]	7.0	6.2	3.6	3.2	3.1	2.3	2
$PM_{2.5}$[5]	NA	NA	NA	NA	2.3	2.2	1.8	2
Sulfur Dioxide (SO_2)	31.2	28.0	25.9	23.3	23.1	18.6	16.3	15
Volatile Organic Compounds (VOC)	33.7	30.2	30.1	26.9	23.1	21.6	16.9	16
Lead[6]	0.221	0.16	0.074	0.022	0.005	0.004	0.003	0.003
Totals[7]	301.5	275.8	267.2	249.2	218.2	188.0	160.2	141

Notes:

1. In 1985 and 1996 EPA refined its methods for estimating emissions. Between 1970 and 1975, EPA revised its methods for estimating particulate matter emissions.
2. The estimates for 2005 are preliminary.
3. NOx estimates prior to 1990 include emissions from fires. Fires would represent a small percentage of the NOx emissions.
4. PM estimates do not include condensable PM, or the majority of PM2.5 that is formed in the atmosphere from 'precursor' gases such as SO2 and NOx.
5. EPA has not estimated PM2.5 emissions prior to 1990.
6. The 1999 estimate for lead is used to represent 2000 and 2005 because lead estimates do not exist for these years.
7. PM2.5 emissions are not added when calculating the total because they are included in the PM10 estimate.

Section 5.8 References

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9. U.S. EPA 2003. *Water on Tap: What You Need to Know,* EPA 816-K-03-007, Office of Water, Washington, D.C. Available at http://www.epa.gov/safewater/wot/index.html.

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Section 5.8
Ref 1

Fairfield 1997

COMPREHENSIVE PLAN UPDATE, 1997

FAIRFIELD COUNTY

Prepared By: Vismor & Associates, Inc.

RESOLUTION
RECOMMENDING ADOPTION OF
A COMPREHENSIVE PLAN
FOR
FAIRFIELD COUNTY, SOUTH CAROLINA

WHEREAS, the General Assembly of South Carolina enacted in 1994 an amendment to the Code of Laws of South Carolina by adding Chapter 29 to Title 6, "South Carolina Local Government Comprehensive Planning Enabling Act of 1994", and repealing all previously enacted planning Acts and Codes; and

WHEREAS, the 1994 Enabling Act requires that the local planning commission develop and maintain a planning process which will result in the systematic preparation and continued reevaluation and updating of those elements considered critical, necessary, and desirable to guide the development and redevelopment of its area of jurisdiction; and

WHEREAS, the planning process shall include the development of a Comprehensive Plan which shall consist of a population element, an economic element, natural and cultural resources element, a community facilities element, a housing element, and a land use element; and

WHEREAS, the Fairfield County Planning Commission developed and adopted 11-19-92 such a Plan; and

WHEREAS, the 1994 Planning Enabling Act stipulates that the "Planning Commission shall review the Comprehensive Plan or elements of it as often as necessary, but not less than once every five years; and

WHEREAS, the Fairfield County Planning Commission on this five-year anniversary (1997) has reviewed the Plan to determine the need for change, and has recommended amending the Plan to incorporate such change(s) as included in such document and shown on the Plan Map:

NOW THEREFORE, THE FAIRFIELD COUNTY PLANNING COMMISSION, BY RESOLUTION, HEREBY RECOMMENDS FOR ADOPTION BY FAIRFIELD COUNTY COUNCIL A REVISED AND AMENDED "COMPREHENSIVE PLAN" FOR FAIRFIELD COUNTY, INCLUDING ALL REFERENCED PLAN MAPS, THIS 15 DAY OF APRIL, 1997.

Mike Mills

Mike Mills, Chairman
Fairfield County Planning Commission

TABLE OF CONTENTS

INTRODUCTION

Fairfield County was created in 1785, with the division of the Camden District into five counties. Prior to the establishment of the county, it was a hunting ground for the Catawba Indians, and was subsequently settled by the English and Scotch-Irish, beginning in 1740.

Early English settlements were made around rivers and creeks. Eventually these settlements led to a cotton plantation culture which gave way to "share cropping" following the War Between the States.

Share cropping, in turn, led to soil depletion and massive erosion of most of the county. And finally, the arrival of the boll weevil in about 1920 finished the cotton industry in Fairfield County. From this adversity, the county has rebounded with a more vigorous and diversified economic base, as discussed herein.

Fairfield County is organized under the Council-Administrator form of government, authorized by the Home Rule Act of 1974. The centerpiece of the governmental complex is the historical Fairfield County Courthouse, constructed in 1823.

For all the changes that have taken place over time, Fairfield, with an area of about 686 square miles and a population density of only 26.5 persons per square mile, remains a predominantly rural area. However, it is being impacted as never before by the expansion of the Greater Columbia Area, and improved accessibility via I-77 through the county.

These changes have and will continue to support the suburbanization of employment facilities in the county. They may also lead to the exurbanization of Winnsboro and Ridgeway, and the suburbanization of areas in closer proximity to Richland County.

These development scenarios surely will alter the landscape and the rural character of Fairfield County. And if left unplanned and uncontrolled, these changes could result in a patchwork of subdivisions, commercial strips, and incompatible industrial uses completely lacking in character or traditional values, compromising rather than enhancing "quality of life" in the county. In addition to creating negative fall-out sometimes associated with development, and lending order to the process,

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1 Central Midlands Regional Planning Council, Central Midlands Historic Preservation Survey, 1974.

SECTION I

DEMOGRAPHIC AND ECONOMIC OVERVIEW

This initial section of the Plan will dimension the influence of demographics and economics on development and land use in Fairfield County.

Characteristics of the population are studied over time to determine trends, composition, distribution and related information essential to the planning process. The economic base also is assessed in terms of its influence on existing and future development.

DEMOGRAPHIC TRENDS

An awareness of the population base and what it is doing is critical to the development of a Plan. How many people are we planning for? What is the trend? What are the characteristics of the population? Where is growth taking place?

The answer to these questions will tell us much about what to expect in the way of future land use and intensity of development.

The official 1990 Census places the number of county residents at 22,295, up 7.7 percent over the 1980 population, which was up 3.5 percent over 1970. This 20-year growth record reverses an earlier out-migration trend recorded in the 1960s, when the county population declined by 3.4 percent.

Overall, growth of the county has not kept pace with that of the State, which recorded gains of 20 percent and 11.7 percent, respectively during the 70s and 80s. However, growth in two areas of the county, Ridgeway and Winnsboro south, closely mirrors the average rate of increase for the State.

The Ridgeway Census County Division (see Map I) increased by 13.4 percent between 1970 and 1980, and by 12.1 percent between 1980 and 1990, above the state average of 11.1 percent. Increased growth in Winnsboro south was even stronger during the 80s, although the rate was slightly less at 9.6 percent.

The growth of these areas may be attributed to improved linkage by I-77 to the Columbia MSA (Metropolitan Statistical Area), better accessibility to "outside" market areas, and to opening these areas and their inherent amenities to development.

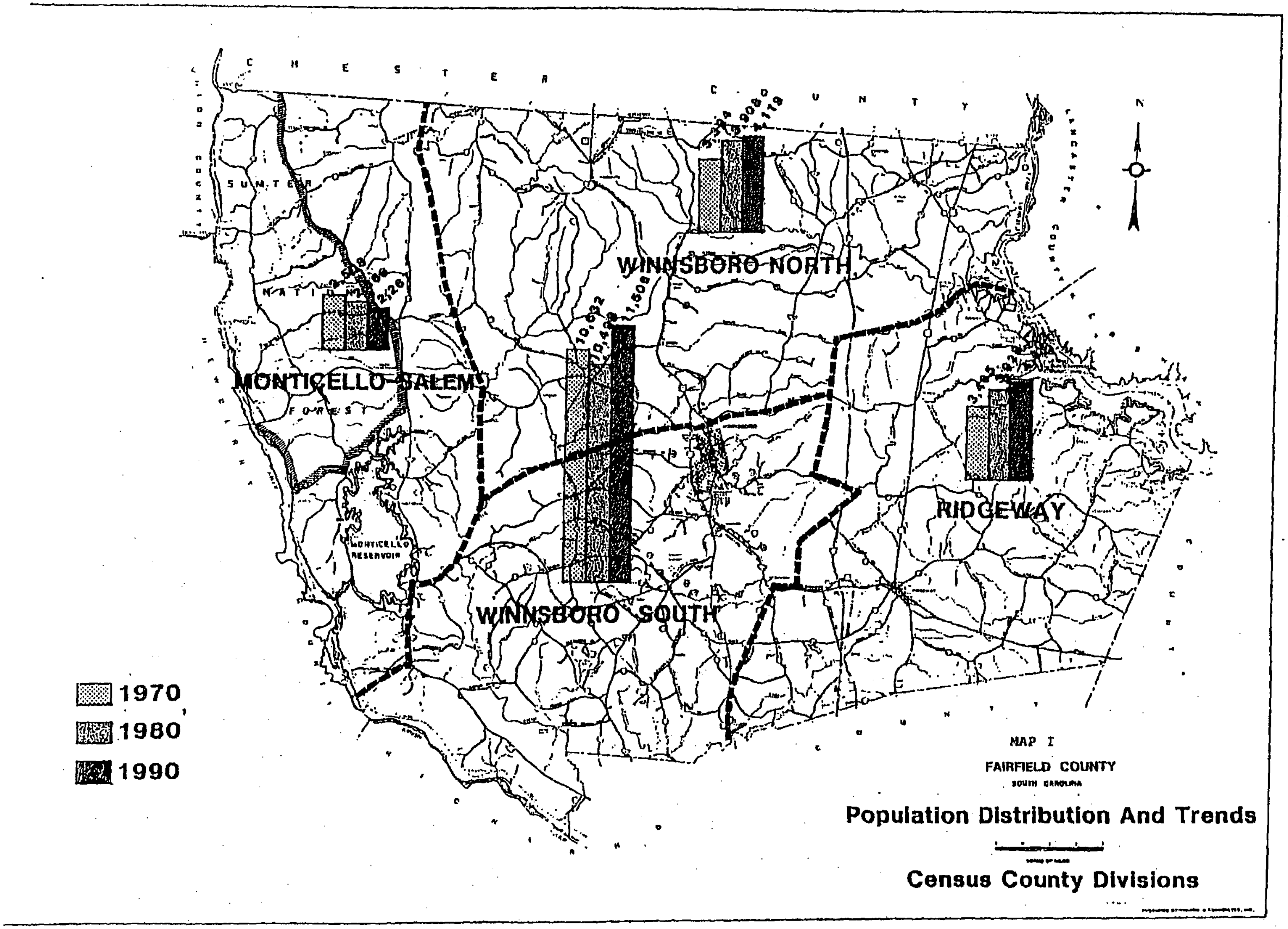

C H E S T E R C O U N T Y
SUMTER
WINNSBORO NORTH
MONTICELLO-SALEM
RIDGEWAY
WINNSBORO SOUTH
MONTICELLO RESERVOIR
10,632
1970
1980
1990
MAP I
FAIRFIELD COUNTY
SOUTH CAROLINA
Population Distribution And Trends
Census County Divisions

TABLE II

GENDER COMPOSITION AND TRENDS
FAIRFIELD COUNTY, 1970-1990

	1970		1980		1990	
	No.	%	No.	%	No.	%
Males	9,756	48.8	9,993	48.3	10,689	47.9
Over 65	776	03.9	959	04.6	1,206	05.4
Females	10,243	51.2	10,707	51.7	11,606	52.1
Over 65	1,083	05.4	1,482	07.2	1,835	08.2

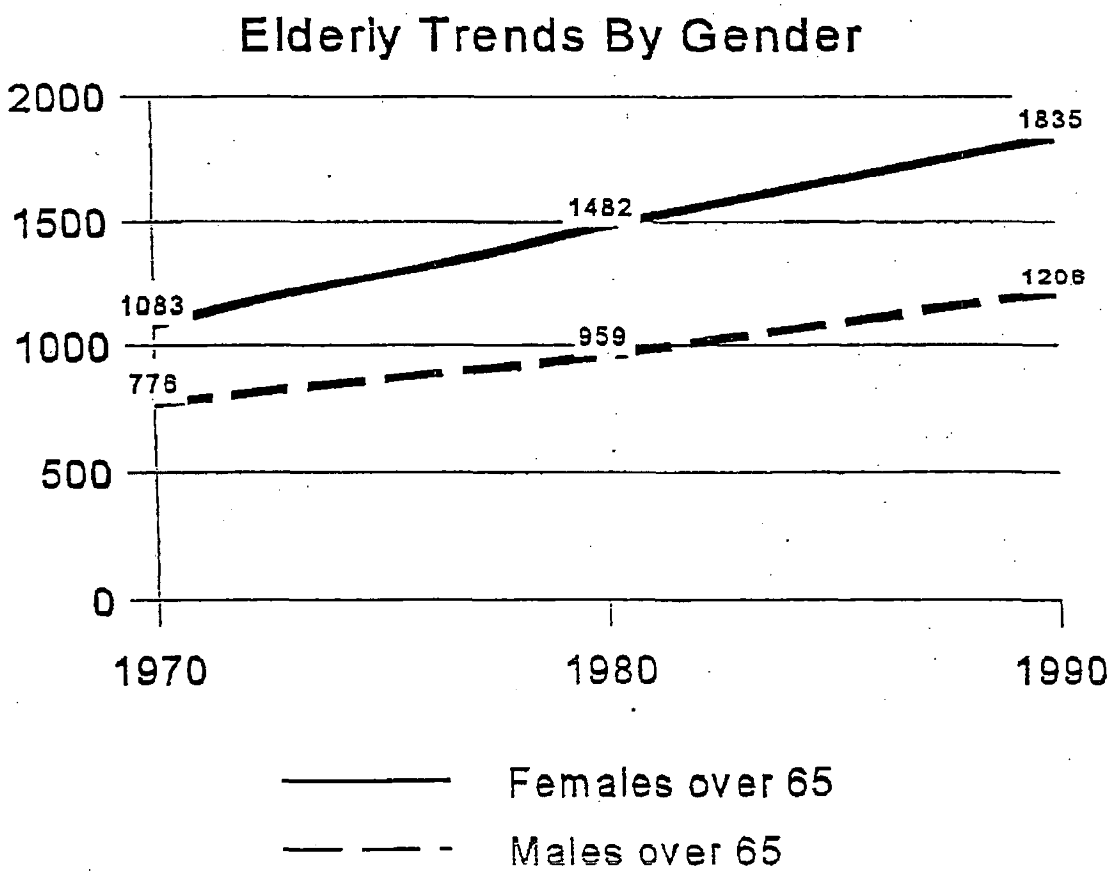


TABLE IV

AGE COMPOSITION AND TRENDS
FAIRFIELD COUNTY, 1970-1990

	1970		1980		1990	
	NO.	%	NO.	%	NO.	%
Under 18	8,172	.41	6,764	.33	6,343	.28
18 - 64	9,968	.50	11,495	.55	12,911	.58
65 and over	1,859	.09	2,441	.12	3,041	.14
TOTAL	19,999	100	20,700	100	22,295	100

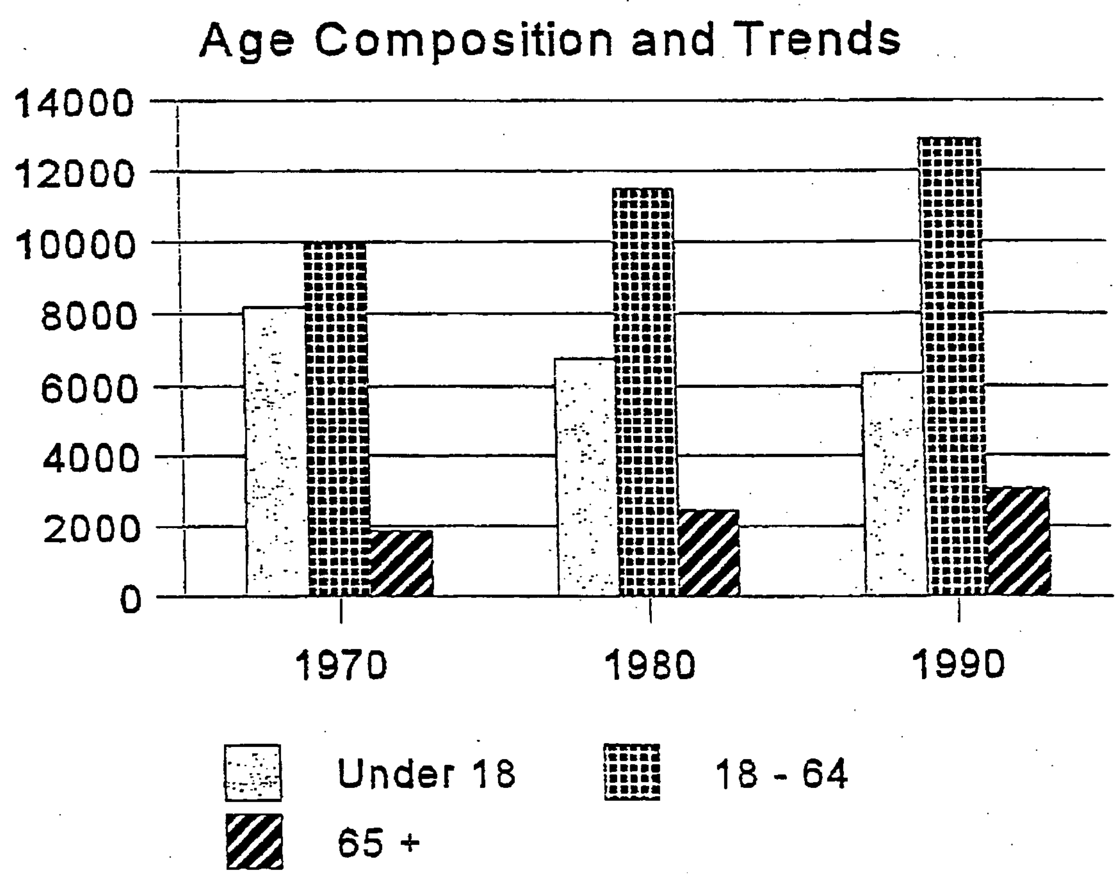
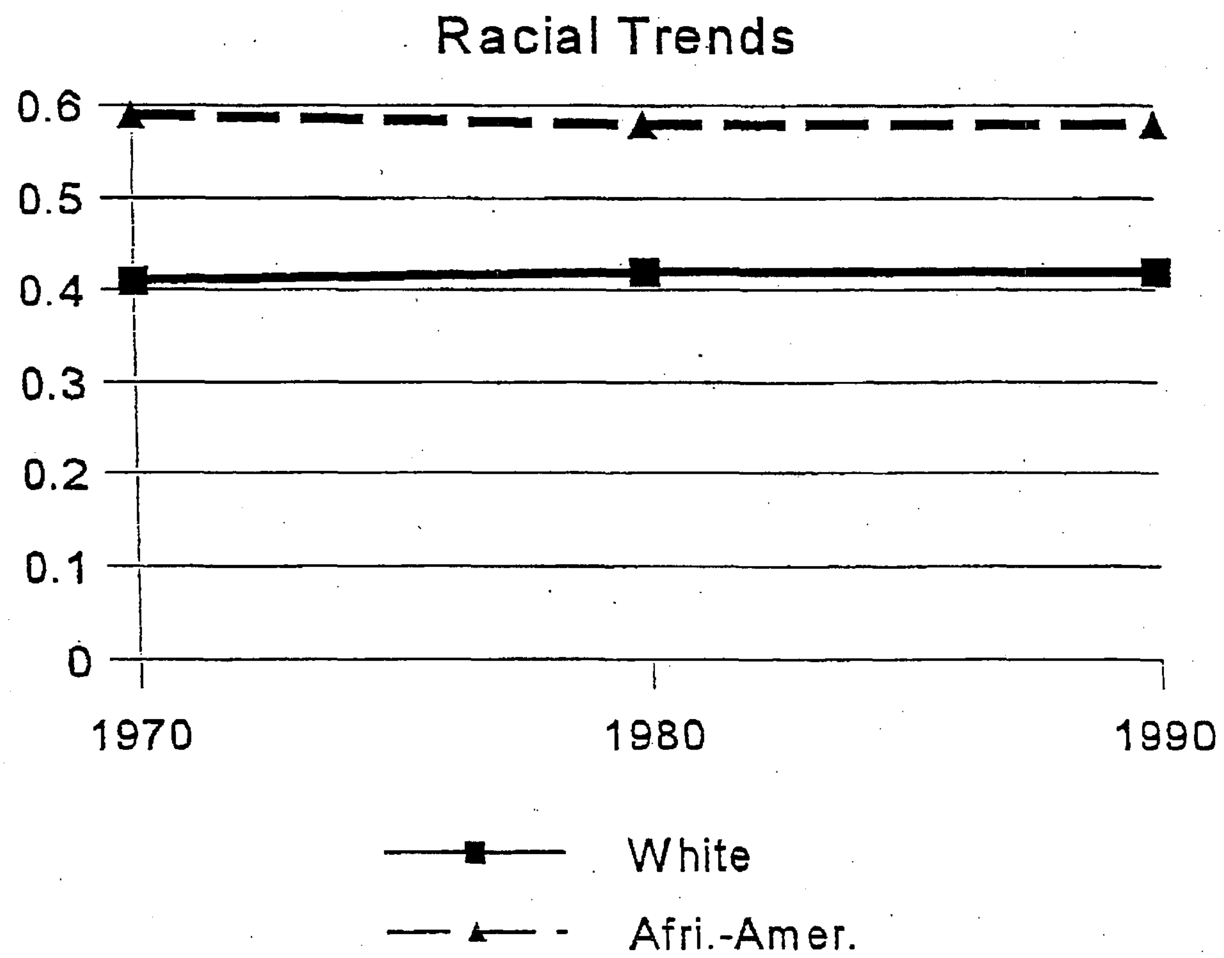


TABLE V

RACIAL COMPOSITION AND TRENDS
FAIRFIELD COUNTY, 1970-1990

				CHANGE			
				1970-1980		1980-1990	
NUMBER	1970	1980	1990	NO.	%	NO.	%
White	8,115	8,580	9,244	465	.06	664	.08
African-Amer.	11,882	12,083	12,994	201	.02	911	.08
Other	2	37	57	35	17.5	20	.54



Winnsboro North Census Divisions. Only the Monticello-Salem Division is projected to decline, but not significantly.

Projected increases in the three "growth" divisions are predicated in part on their proximity to I-77, improved accessibility and enhanced development potential.

Continued polarization of population in the Winnsboro area is projected, together with relatively strong growth in the Ridgeway and Lake Wateree Areas.

At this time, no major deviations from existing patterns of development are projected, only expansions.

HOUSING

Occupancy Characteristics

To be expected, the increase in housing units over the last 20 years (between 1970 and 1990) far exceeded the increase in population. The reason, of course, is that the number of persons per household declined during this period from 3.80 to 2.93. At the same time, the number of one-person households increased from 14 to 22 percent of all households.

Table VII

Household Characteristics
Fairfield County

	1970	1980	1990
Number of Households	5,284	6,355	7,467
Persons Per Household	3.80	3.21	2.93
Number of One-Person Households	741	1,231	1,634
Percent Total	.14	.19	.22

Source: U.S. Bureau of Census, Detailed Housing Characteristics, Selected Years.

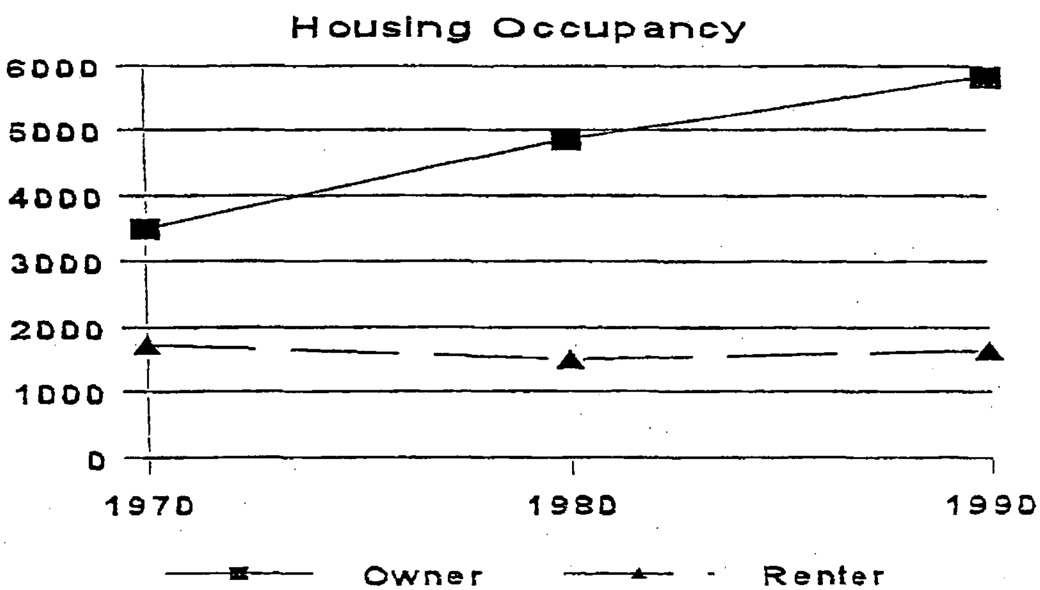
This trend toward smaller households bodes well for the housing industry, as smaller households translate into more housing just to accommodate the same number of people. And in a growth situation, the results are compounded as evidenced by a 17 percent increase in housing between 1970 and 1980, and an 18

TABLE VIII

HOUSING OCCUPANCY CHARACTERISTICS,
FAIRFIELD COUNTY, 1970-1990

	1970	1990	CHANGE 1970-1990 NO.	%
Year-Round Housing Units	5,887	8,115	2,228	38
Owner-occupied	3,497	5,831	2,334	67
Percent	.60	.72		
Renter-occupied	1,729	1,636	- 93	-05
Percent	.29	.20	- 13	-02
Vacant	661	648		
Percent	.11	.08		
Seasonal Recreational Housing Units	120	615	495	413

Source: U.S. Bureau of Census, Detailed Housing Characteristics, 1970, 1980, 1990.



Financial Characteristics

The financial characteristics of owner-occupied housing indicate that a majority of the homes in Fairfield County are relatively low value, and perhaps structurally deficient in some way. Over 53 percent of all owner-occupied housing is valued at less than $50,000, compared with only 37 percent statewide. Conversely, less than 10 percent of all housing is valued at or above $100,000. The median housing value in the county is only $47,500.

These characteristics tell us a lot about living conditions in the county, which appear to reflect a more basic existence for the majority of home owners, irrespective of relative housing and land costs.

Table X

Housing Costs and Values
Fairfield County, 1990

	Owner-Occupied Dwellings	
	No. Units	Ratio
Less than $50,000	1,919	.53
$50,000 - 99,999	1,380	.38
100,000 -149,999	232	.06
150,000 -199,999	60	.02
200,000 plus	26	.01
MEDIAN VALUE $47,500		

Source: Ibid.

INCOME

Income is a definitive measure of life style. As such, it must be considered "below average" in Fairfield County, based on comparables to the State.

Fairfield County residents have per capita incomes approximately 24 percent below the state average. And over the last eight years, from 1981 to 1989, there has been relatively little change in relation to the state.

sector. Job development was not as significant in the other two major business categories (retail and wholesale trade), but increases were recorded in both.

Still the major business activity in Fairfield County is in retail trade, accounting in 1987 for 58 percent of the business establishments, 62 percent of the jobs in business, and 70 percent of sales. While the largest gains have been in the service sector, it is still relatively small compared with the retail sector.

On closer examination of the service sector, we see that health services lead the way in the number of establishments, in spite of a decline between 1982 and 1987. Following in order of numbers of establishments are automotive, business, amusement, legal, hotel, personal, engineering and research.

With respect to retail establishments, the leading business activity is in food stores, followed by eating and drinking establishments, gas stations, general merchandise, building materials and hardware, drug, auto dealers, apparel shops and furniture stores.

Most of these establishments are not in the unincorporated areas of the county however. They are located in the Towns of Winnsboro and Ridgeway, where the population is sufficiently concentrated to support business activities and enterprises. As a result, their impact on land use and development of the unincorporated areas is relatively limited at this time. That is not to say that suburbanization and movement of such activities will not impact the countryside in the future. Indeed, it is quite likely as the ties inevitably strengthen between Fairfield and the Columbia MSA (Metropolitan Statistical Area). And planning to accommodate these potential occurrences is part of what this Plan is all about.

EMPLOYMENT

Employment and job opportunities do more to influence growth and development than perhaps any other factor. In fact, studies show that the creation of 100 new industrial jobs will generate 68 new non-manufacturing jobs, one new retail establishment, and 67 additional families, among other things.

Thirty-one percent of all non-agricultural jobs in Fairfield County were in manufacturing in 1994, down five percent over the last eight years. The largest employer is in transportation equipment, resulting from the location of Mack Trucks in 1987, followed by apparel and other textiles.

In the area of non-manufacturing, which provides about 65

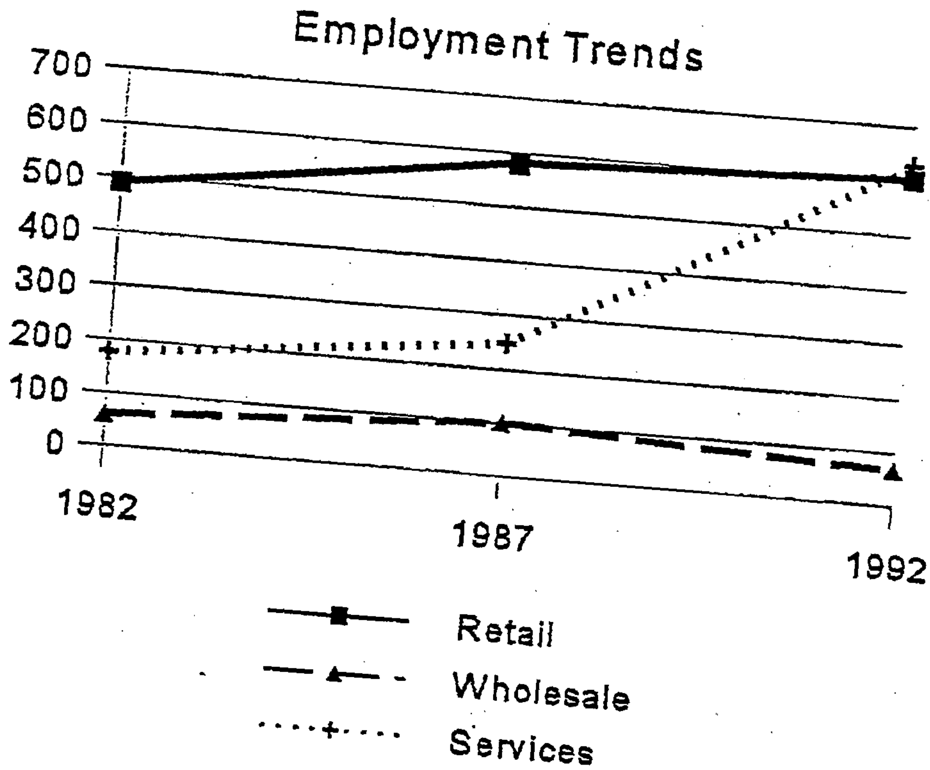


TABLE XII
FAIRFIELD COUNTY
TRENDS IN BUSINESS, EMPLOYMENT
AND SALES, 1982-1992

	1982	1987	1992
Business Establishments*			
Wholesale Trade	14	17	9
Retail Trade	90	90	86
Service Industry	45	48	55
Total	149	155	150
Employment			
Wholesale Trade	60	101	68
Retail Trade	491	491	605
Service Industry	177	248	629
Total	728	930	1302
Annual Sales (000)			
Wholesale Trade	$19,389	$18,202	$17,788
Retail Trade	37,920	60,784	57,369
Service Industry	5,231	7,528	18,898
Total	$62,540	$86,514	$94,055

*Establishments with payrolls.

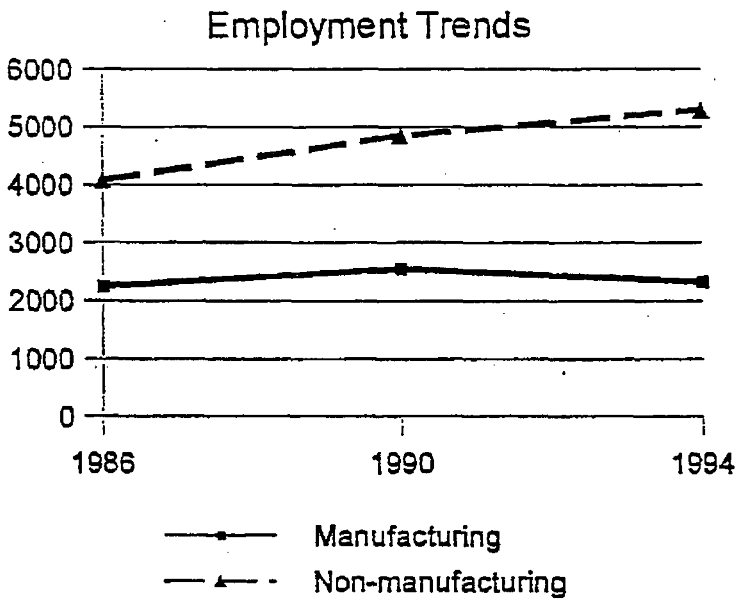


TABLE XIV
FAIRFIELD COUNTY
NON-AGRICULTURAL WAGE AND SALARY
EMPLOYMENT TRENDS, 1986-1994

	1986	1990	1994
TOTAL	6,330	7,400	7,620
Manufacturing	2,250	2,550	2,330
Non-manufacturing	4,080	4,850	5,290
Construction & Mining	270	350	370
Transportation & Public Utility	1,060	920	1,060
Wholesale & Retail Trade	670	1,040	1,180
Finance, Insurance & Real Estate	150	110	100
Services (1)	810	1,130	1,070
Government	1,110	1,300	1,520

(1) Included in services are those services related to agriculture, as well as the wide range of services to individual and business establishments.

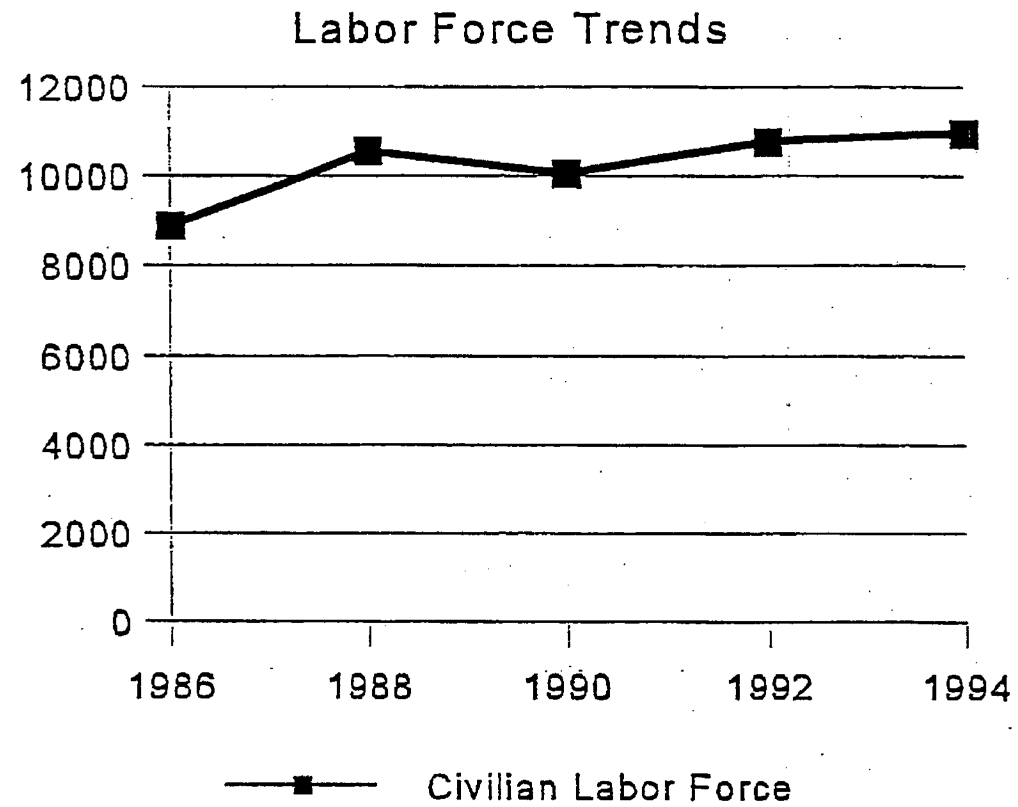


TABLE XVI

FAIRFIELD COUNTY
LABOR FORCE TRENDS, 1986-1994

	Annual Average				
	1986	1988	1990	1992	1994
Civilian Labor Force	8,880	10,550	10,050	10,760	10,960
Employment, Total	8,090	9,960	9,100	9,790	9,890
Unemployment	790	570	950	970	1,070
Percent Labor Force	8.9%	5.4%	9.5%	9.0%	9.7%

Source: S.C. Employment Security Commission, South Carolina's Labor Force in Industry.

SECTION II

ENVIRONMENTAL FEATURES

There are numerous natural environmental conditions that influence the potential use of land. Man has little short-run control over such conditions as climate, geology, soils, wetlands, flood waters, topography, etc. Yet these conditions can and often do present engineering, safety, and economic barriers which limit development potential. Further, unwise use of land in "environmentally sensitive areas" may harm or destroy valuable natural resources. Thus, it is important, from a planning and development perspective, to be aware of the presence and extent of environmental constraints and resources.

This section will dimension such features and conditions to determine their impact on existing and future development in Fairfield Couty.

POSITION IN THE STATE

Fairfield County is positioned on the divide between the Piedmont and the Sandhills. The majority of the county is in the Southern Piedmont Land Resource Area, but about 2,000 acres in the southeast corner lie within the Sand Hills Area.

Fairfield County is located in the Central Midlands Region of South Carolina and lies principally between Chester and Richland Counties north to south, and Kershaw and Newberry Counties east to west. The elevation of the county ranges from slightly less than 200 feet at the confluence of the Broad and Little Rivers to about 625 feet in the upper part of the county.

The county is situated on I-77, between the larger market areas of Columbia and Charlotte, North Carolina, in a position to capitalize on the economic expansion of and growing ties between the two areas.

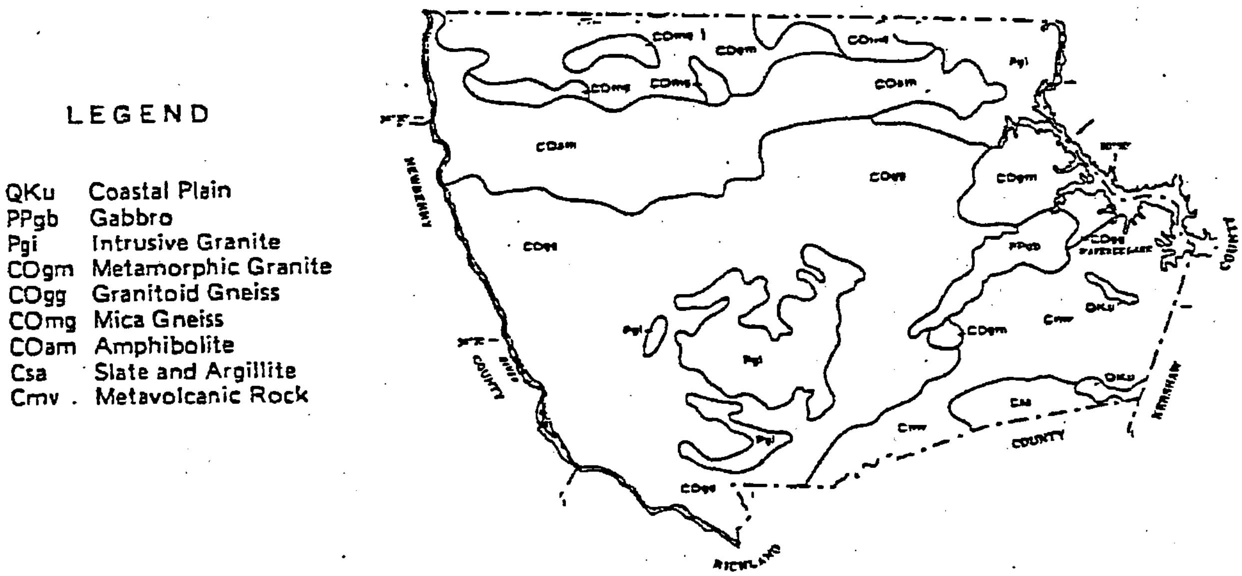
CLIMATE[2]

Fairfield County, like the rest of South Carolina, has a temperate climate. This is typified by ample rainfall in all seasons, short and usually mild winters, and long, warm summers.

2 U. S. Department of Agriculture, SCS, Soil Survey of Chester and Fairfield Counties, South Carolina, 1982.

Intrusive granite and metamorphic granite are generally high in silicate minerals and feldspar and include some mafic minerals. Both are resistant to weathering except where fractured.

Two different geologic units of gneiss, mica gneiss and granitoid gneiss, occur in Fairfield County. Gneiss is a metamorphic rock consisting of various granular minerals in alternate bands. Mica gneiss is dominantly mica but also contains large amounts of feldspar and quartz. Granitoid gneiss has a considerable amount of quartz. Mica gneiss weathers at a moderate rate, but granitoid gneiss is resistant to weathering.



SOILS[4]

Soils generally are assessed in terms of their suitability for agricultural purposes and/or urban development---two extreme or opposite uses. Unfortunately, lands best suited for agricultural use have the fewest constraints to urban development. And since development generally follows the path of least resistance, other factors being equal, there is always the potential for conflict whenever such lands exist in an urbanizing environment.

There are 11 soil associations or groups in Fairfield County, with differing characteristics. They are general by definition, requiring more site specific analysis for individual properties, but are helpful as a guide to development, which is the intent of this Plan. A brief description of each follows.

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4 Ibid.

Cataula, 13 percent Winnsboro, and 6 percent is soils of minor extent.

All these soils are well drained. Wilkes soils are moderately deep, are moderately permeable with brown or olive subsoil. Cataula soils are deep, have a red subsoil, and are slowly permeable. Winnsboro soils are deep, slowly permeable, and have a brown subsoil.

Cataula soils and the gently sloping and sloping Winnsboro soils are on narrow to broad irregularly shaped ridgetops. Wilkes soils and the moderately steep Winnsboro soils are on side slopes adjacent to drainageways.

This unit is mainly pasture and woodland. Some tracts are cultivated. Slope is the main limitation for cultivated crops. A restricted root zone is a limitation in Cataula soils.

In Wilkes soils and the moderately steep Winnsboro soils, suitability is poor for crops and pasture because of the slope. In Cataula soils and the gently sloping Winnsboro soils, it is good to fair for crops. Suitability is fair for woodland throughout and is generally poor for residential and other urban uses.

4. <u>Wilkes-Winnsboro-Mecklenburg</u>

These are well drained, gently sloping to steep, moderately deep and deep clayey soils. These soils occur as broad areas throughout Fairfield County, comprising about 23 percent of the soils. About 49 percent of this association is Wilkes soils, 34 percent Winnsboro, 8 percent Mecklenburg, and 9 percent is soils of minor extent.

All these soils are well drained. Wilkes soils are moderately deep, have moderately slow permeability, and have a brown or olive subsoil. Winnsboro soils are deep, have slow permeability, and a brown subsoil. Mecklenburg soils are deep, have slow permeability and red subsoil.

This unit is mainly pasture and woodland, although some tracts are cultivated.

In Wilkes soils and the moderately steep Winnsboro soils, suitability is poor for crops and pasture because of the slope. In Mecklenburg soils and the gently sloping and sloping Winnsboro soils, it is good to fair for crops. Suitability is fair for woodland throughout the unit. It is poor for residential and other urban uses in most areas because of the steepness of slope, but it is fair in Mecklenburg soils and the gently sloping and sloping Winnsboro soils.

suitability is poor for crops and fair to poor for pasture because of slope and droughtiness. Suitability is good to fair for woodland throughout the unit. It is poor for residential and other urban uses in the moderately steep or steep Rion and Wateree soils, but it is good to fair in the rest of the unit.

7. Cecil-Pacolet-Appling

These are well drained, gently sloping to moderately steep, deep clayey and loamy soils. They are found throughout Fairfield County. They make up about 19 percent of the soils. Forty-six percent of the unit is in Cecil soils, 32 percent in Pacolet, 6 percent in Appling, and 16 percent in soils of minor extent.

These soils are well drained, deep, and moderately permeable. Cecil and Pacolet soils have a red subsoil. Appling soils have a yellow or yellowish red subsoil. Cecil and Appling soils are on moderate to broad ridgetops. Pacolet soils are found mainly on side slopes adjacent to drainageways.

This unit is mainly pasture and woodland, however, some tracts are cultivated.

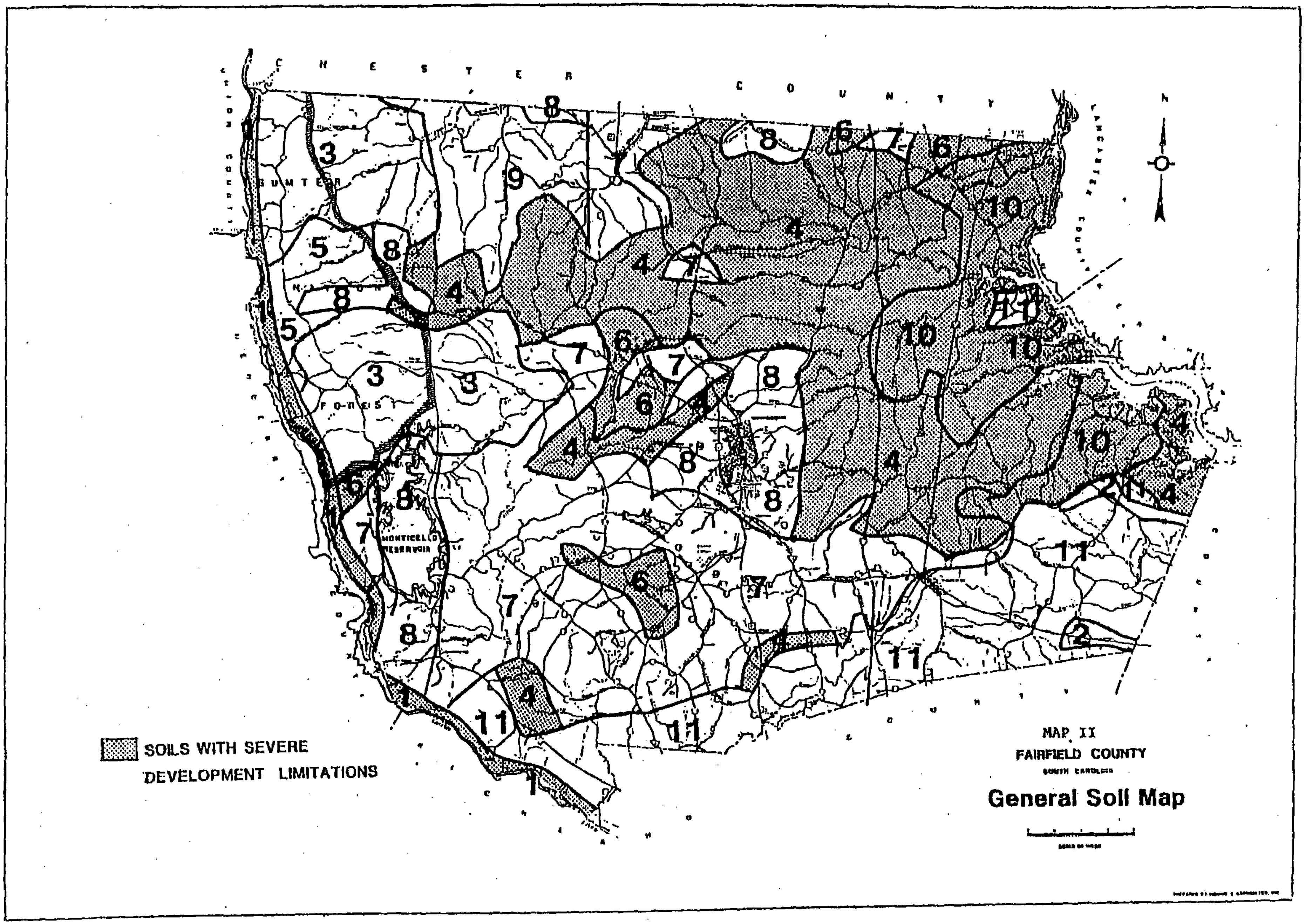
Cecil and Appling soils are rated good to fair for crops and pasture. Pacolet soils are generally unsuited for crops and pasture because of slope. Suitability is good for woodland throughout the unit. It is good to fair for residential and other urban uses in Cecil and Appling soils, but relatively poor in Pacolet soils.

8. Madison-Cecil-Hiwassee

These are well drained, gently sloping to moderately steep, deep clayey soils. They make up about 10 percent of the county's soils. About 40 percent of this unit is in Madison soils, 15 percent in Cecil, 14 percent in Hiwassee, and 31 percent in soils of minor extent.

All these soils are deep, well drained, moderately permeable, and have a red subsoil. Hiwassee soils, and the gently sloping and sloping Madison soils are found on narrow to broad ridgetops. Moderately steep Madison soils are on side slopes adjacent to drainageways.

This unit is mainly in pasture and woodland although some tracts are cultivated. Suitability for crops and pasture is generally good to fair. Suitability is good for woodland throughout most of the unit. Suitability for residential and urban uses is good to fair.


SOILS WITH SEVERE DEVELOPMENT LIMITATIONS
MAP II
FAIRFIELD COUNTY
SOUTH CAROLINA
General Soil Map
CHESTER COUNTY
LANCASTER COUNTY
MONTICELLO RESERVOIR
SUMTER
FOREST
N

prepared by the U.S. Department of Agriculture.

To the extent practical, policies and regulations should be designed to channel future development away from areas with severe soil conditions or impose building requirements that would properly overcome any limitations. Such development guidelines should:

1. discourage or prohibit large scale urban development in areas without public sewage facilities;

2. mandate tie-ons where existing development may be served by a community sewerage system;

3. monitor development in flood plain and wetland areas;

4. require developers to satisfactorily "overcome" severe soil conditions so as not to adversely affect surrounding properties.

Soils Best Suited To Agricultural Use

Agricultural land or land with agricultural potential may be classified in two categories, prime farmland and additional farmland. Prime farmland accounts for 14 percent of the total land area in Fairfield County. It is defined as soils having the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops. Additional farmlands of statewide importance comprise another 85,509 acres. They are defined as lands that will economically produce high yields of crops when treated and managed according to acceptable farming methods.

All these lands are not actively cultivated at this time however, according to the latest Census of Agriculture (1987), which shows only 57,293 acres of farmland, with only 19,360 acres in cropland.

Table XVII

Fairfield County
Soil Suitability for Agricultural Purposes

	Acres	% Total
Prime Farmland	59,590	.14
Additional Farmland	85,509	.20

Source: U.S. Department of Agriculture, Important Farmlands Map, 1984.

Prime farmlands are found principally in the southeastern part of the county and around the Town of Winnsboro. They are concentrated south of Winnsboro and S.C. 34 east of Winnsboro to the Kershaw County Line. They are also found in pockets around Lake Wateree and in the northeast corner of the county, south of the Mitford community.

Additional farmlands of statewide importance are generally mingled throughout the prime farmland areas, and extend in scattered form beyond such areas, west and north of Winnsboro, and in the vicinity of Dutchmans Creek.

Summary Recommendations

In sum, the soil information presented herein is valid for general planning purposes. But because each association has several different soil types, with varying properties, it is imperative that detailed soil borings and tests be made to determine specific limitations and the degree of such limitations before building on or abandoning a potential site. Additional information and assistance are available from the local U.S.D.A. Soil Conservation Service Office.

TOPOGRAPHY

Topographic conditions, or slope characteristics, can have a profound influence on development, both in terms of potential use and development costs. As slopes become steeper, development costs may increase accordingly, while the uses to which the land may be put may decrease.

The major environmental concerns associated with new development on steeply sloped land is the potential for soil erosion. The Soil Conservation Service (SCS) has identified slope constraints to urban development in 33 of the 42 soil types in the county. Of these, 22 percent have severe slope characteristics.

Just as is the case with steep slope land, low to no slope land also may hinder urban development. Large expanses of flat land may be poorly drained. Often, flat land development requires extensive drainage networks; and in the case of flood plain property, costly dikes may be necessary. Fortunately, there is virtually no "table-top" flat land of any consequence in Fairfield County. Just as fortunately, the county has few areas so extensively sloped as to preclude urban development. But there are concerns that development practices adequately address slope conditions in Fairfield County so as not to create any drainage, erosion or sedimentation problems.

morphological, physiological, and/or reproductive adaptation(s) have the ability to persist in anaerobic soil conditions."

Evidence of a minimum of one wetland indicator of either of the three parameters must be found for a site to be designated a wetland. This technical approach should always be applied, unless indicators of one or more parameters cannot be found due to human activities such as land clearing and deposition or fill.

Wetlands generally are found in low-lying areas around creeks and rivers. The USDA, S.C. Soil Survey of Chester and Fairfield Counties, has identified four soils in Fairfield as characteristically wet. They are Armenia, Chewacla, Irdell and Helena.

The U.S. Corps of Engineers, in conjunction with other federal and state agencies, is in the process of mapping all such areas in South Carolina, and has completed mapping for the coastal counties. But, wetlands mapping of Fairfield County has yet to be scheduled.

This does not relieve developers of the responsibility under the new law of securing a "determination of wetlands" from the Corps in the event of their existence. Persons intending to engage in activities involving development within or adjacent to wetlands, as herein defined, should contact the Corps of Engineers for a precise determination of jurisdiction and the consequences of such development.

Jurisdictional Wetlands

Not all wetlands development will require a permit from the Corps. However, no permit will be issued where wetlands are considered and have been determined by the Corps to perform functions important to the public interest. This includes:

(a) Wetlands which serve significant natural biological functions, including food chain production, general habitat and nesting, spawning, rearing and resting sites for aquatic or land species;

(b) Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

(c) Wetlands the destruction or alteration of which would affect detrimentally natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics;

Drainage Prevention Ordinance, to control the development of such areas.

Following this initial move to meet the minimum requirements for participation in the National Flood Insurance Program (NFIP), the county may wish to consider upgrading its Flood Hazard Rating to secure greater savings to those requiring flood insurance.

Under a new community rating system, (CRS), insurers may qualify for 5 to 40 percent savings on their flood policies, depending on the county's classification.

The new "bonus" program is modeled after the ISO (Insurance Service Office) Commercial Risk Services' fire insurance classification program. CRS has 10 classifications from Class 1 to Class 10. As a community or county takes certain steps to reduce the hazards of flooding beyond the minimum to participate in the Flood Insurance Program, it may qualify for a lower rating. Currently, Fairfield County has a Class 10 rating under the new system, but may qualify for a Class 9 rating with only limited improvements or amendments to its current ordinance. This determination may be made with the use of a "Class 9 Quick Check", developed by NFIP.

Clearly, the opportunity to reduce the hazards of flooding and the cost of flood insurance at the same time is worth pursuing although the extent of such conditions is relatively limited in Fairfield County, confined almost exclusively to creek and river beds. It just makes sense.

SECTION III

LAND USE AND INFRASTRUCTURE

That existing land use patterns and infrastructure influence development is clearly evident. Like uses generally attract like uses. Development is dependent on infrastructure. Established commercial areas generally appeal to new commercial development; prestigious residential subdivisions attract new quality residential construction; and many industrial uses seek out the same facilities and areas for development.

It is essential, therefore, to have a thorough understanding of existing land usage, land use patterns, and existing and planned infrastructure in order to adequately assess those areas of the county in which future growth may be expected. A knowledge of "accepted" land use conditions also helps determine the degree of departure, if any, from established patterns of growth and intensity which may be applied to presently undeveloped areas. Toward these ends, a land use and infrastructure survey, inventory and assessment are included as part of this study.

EXISTING LAND USE

As stated previously, Fairfield County has about 438,425 acres. It ranks 18th in area among the state's 46 counties.

The largest single use of land is forest, accounting for 87 percent of the total. This includes all public, commercial and non-commercial forests, as well as farm woodlands. Non-forested land, including urban or developed land greater than 10 acres account for the remaining 13 percent of the county.

About three percent of the forested land is in public ownership. The largest is the Sumter National Forest in the northwestern part of the county. Private ownership of forested land is dominated by corporations, individuals and the forest industry. Only six percent of the county's forested land is owned and managed by farmers.

Developed or urban land use comprises only two percent of the county. It is centered in and just beyond the Town of Winnsboro. Urban concentrations are also found along the shores of Wateree Lake, around Ridgeway, in the Mitford community, and to a lesser extent around parts of Monticello Lake and Jenkinsville.

Water areas comprise about four percent of the county, principally in the form of Lake Wateree and the Catawba River, in the eastern extremity, and the Monticello Reservoir and Broad River in the western extremity.

Farm Use

The amount of agricultural and farmland has been on the decline since the days of the depression. A recent indicator of this trend is shown by Table XIX. Over a nine year period, between 1978 and 1987, the county lost nearly 20,000 acres of farmland. This was accompanied by a seven percent decline in the number of farms and a 19 percent reduction in the average size of farms. Also, the number of farmers engaged principally in farming declined by 13 percent.

The dominant use of farmland is in forest acreage, in spite of a 37 percent decline between 1978 and 1987. Pasture land, both cultivated and wooded, comprises the second major use of farmland. Only nine percent of the land in farms is devoted to harvested crops, while 16 percent is in other uses.

Neither agricultural land use nor production commands a prominent position in Fairfield County. In comparison with other counties in the state, it ranks no higher than 41st in farmland acreage or market value or products sold, while ranking 18th in total area.

Urban and/or Developed Land Use

Estimates from Table XVIII show the amount of urban and/or developed land to be approximately 7,350 acres, based on population concentrations of 10 or more acres. These measurements were computed by the Soil Conservation Service from detailed Soil Surveys, using a 10-acre grid system. Development of less than 10 acres was not computed.

A second estimate employing "per capita land usage ratios", establishes the number of acres in urban or developed land at about 6,900. This estimate is based on a ratio of 0.308 acres per person (22,295), derived from comparable land use studies. It tends to validate the estimates generated by the Soil Conservation Service, suggesting a range between the two.

Urban or developed land consists principally of four broad based land use categories: residential, commercial, industrial and service (public and/or private), i.e. religious, medical, governmental, utilities, transportation, etc. A description of their location and specific characteristics within Fairfield County follows.

General observations reveal:

* Scattered development with concentrations around the seat of county government (Winnsboro) and smaller community clusters, i.e. Ridgeway, Mitford, Jenkinsville.

* Expanses of undeveloped, wood and farm lands.

* Relatively intense development along the Winnsboro By-pass.

* General mixing of development in the unincorporated and unregulated municipal fringe, south of Winnsboro.

* Weak design and construction of most county maintained and farm-to-market roads.

* An influx of alternative low-cost housing in the form of mobile homes.

* Scattered pockets of substandard housing and living conditions.

* An historical presence.

* Underdeveloped resources.

* Rural charm.

* Concentrated development along the shores of Lake Wateree.

* Resource and unfulfilled development potential of the Monticello Reservoir.

* Vital linkage and enhanced accessibility provided by I-77; and

* A bustling industrial complex south of Winnsboro.

Residential Land Use

As mentioned previously, the dominant form of residential use is conventionally built, single-family detached housing. But mobile homes and other manufactured structures are rapidly adding to the county's housing stock. Even multi-family housing is now available in the fringe areas of Winnsboro, where municipal infrastructure is available.

Mack Trucks, Rite Aid, the JPM Company, Standard Products, Uniroyal, Carolina Apparel, the Manhatten Shirt Company, Hon Furniture, Copian Industries, etc. are all located in the unincorporated areas. As a general rule, industry, distribution and warehousing operations tend to locate in proximity to but beyond corporate municipal areas. Such is the case in Fairfield County, where the vast majority of such operations are located.

Recent industrial trends show significant development in the areas south and southeast of Winnsboro, as reflected by the existing land use map.

Service Land Use

Service land uses are scattered throughout the county. They include churches, schools, utilities, governmental buildings and facilities, parks, etc.

Ramifications

Existing land use patterns account for a number of common land use problems, such as incompatible mixed land usage, neighborhood instability, traffic congestion, and strip commercial development.

Mixed land usage and the associated problems of land use incompatibility are found to the north and south of Winnsboro. Much of this is due to the transitional process of older homes giving way to commercial enterprises and other uses. Residential uses are not sufficiently insulated and protected from the negative impact of change occurring around them.

Residential stability is constantly under siege in unprotected transitional areas, such as those south of Winnsboro. Lower intensity uses, i.e. single-family dwellings are pressured for higher intensity development.

Land use intensity, curb cuts, and street alignments have a profound influence on traffic conditions. And there are examples around Winnsboro where improper alignments, excessive or expansive curb cuts, and high intensity development have contributed to traffic congestion and safety hazards.

Strip commercial development is evident and is intensifying along the By-pass. Such development affects not only the movement and safety of traffic, but challenges the purpose of the By-pass, which is to expedite the movement of traffic around the congested center of town. If volumes and congestion along the By-pass reach or surpass those on the original route through Winnsboro, the objective is partially compromised. This is not to say that the By-pass has not served a useful purpose,

TABLE XX

ROADWAY LEVELS OF SERVICE DESCRIPTIONS

Level of Service A

* Free flow conditions
* Low volumes
* High operating speeds
* Uninterrupted flow
* No restriction on maneuverability
* Drivers maintain desired speed
* Little or no delays

Level of Service B

* Stable flow conditions
* Operating speeds beginning to be restricted

Level of Service C

* Stable flow but speed and maneuverability restricted by higher traffic volumes
* Satisfactory operating speed for urban conditions
* Some delays at signals

Level of Service D

* High density, but stable flow
* Restricted speeds
* Noticeable delays at signals
* Little freedom to maneuver

Level of Service E

* Low, but relatively uniform operating speeds
* Volumes at or near capacity
* Approaching unacceptable delays at signals

Level of Service F

* Forced flow conditions
* Stop and go operation
* Volumes below capacity, may be zero
* Average vehicle delay at signals is greater than one minute

Still, all major roadways should be monitored for change, based on traffic volume increases recorded on selected roadways during the 80s (Table XXI). Traffic on I-77 increased by nearly 350 percent between 1981 and 1990. Much of the increase was due to shifting traffic from parallel roadways, U.S. 321 and U.S. 21, where traffic decreases were recorded.

Other, more internal oriented routes also recorded increases, but none as large as those on I-77. S. C. 34 recorded a significant increase between Winnsboro and I-77, and between Ridgeway and Lake Wateree, but only a slight upward move west of Winnsboro.

Traffic on Old River Road increased as a result of interstate accessibility, along with traffic along River Road, due to increased building on Lake Wateree. West of Winnsboro, traffic volume changes were minor by comparison.

From the traffic volume data recorded during the last decade (1981-90), it is obvious that most development activity is taking place south and east of Winnsboro, with few changes occurring to the north and west. And future traffic volume changes on the major roadways in these areas should be carefully monitored to protect their carrying capacity for projected growth and development.

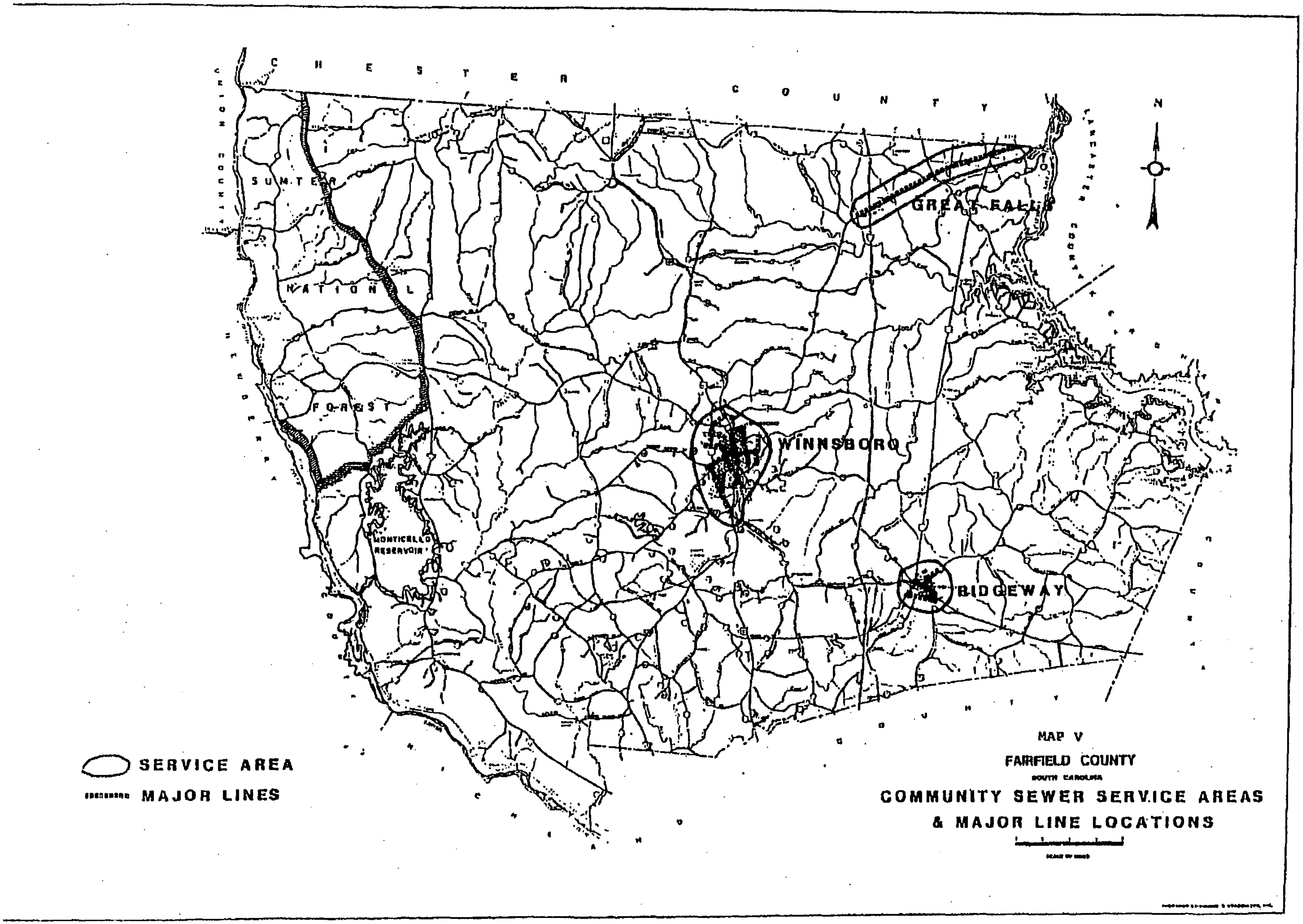
<u>Water Supplies</u>

There are five public water systems in the county serving approximately 51 percent of the population. Additionally, less than two percent receive water from private residential systems. The balance relies on individual wells.

The five public providers are (1) the Town of Winnsboro, (2) the Town of Ridgeway, (3) the Jenkinsville Water District, (4) the Mid-County Water District, and (5) the Mitford Water District. Of the five public providers, only the Town of Winnsboro draws from a surface supply. The source is from a reservoir in the Jackson Mill Creek watershed, west of Winnsboro.

The reservoir contains about 600 million gallons of water, of which approximately one million gallons per day are consumed. The Town's treatment plant has the capacity to process about two MGD, with about 50 percent excess capacity for growth and new development at this time.

The other four public systems draw from groundwater sources, which have a relatively low yield in Fairfield County. Still, each of the systems is currently operating below capacity, with room for additional growth and development, albeit minimal by comparison with Winnsboro's surface water supply.


CHESTER COUNTY
LANCASTER COUNTY
SUMTER
NATIONAL
FOREST
MONTICELLO RESERVOIR
GREAT FALLS
WINNSBORO
RIDGEWAY
N
SERVICE AREA
MAJOR LINES
MAP V
FAIRFIELD COUNTY
SOUTH CAROLINA
COMMUNITY SEWER SERVICE AREAS
& MAJOR LINE LOCATIONS

Natural Gas

Natural gas is supplied to the county by the South Carolina Pipe Line Company serving Richtex and SCANA's Sumner Power Plant, west of S.C. 215. The pipeline company also wholesales gas to the Town of Winnsboro which retails and distributes it along U.S. 321 south and west of Winnsboro, and within the Winnsboro area. The town is also in a position to extend natural gas to other areas of the county in support of development, as economically feasible.

While not essential to all industrial operations, the availability of natural gas is a definite plus when recruiting industrial prospects and promoting economic development.

Fire Protection

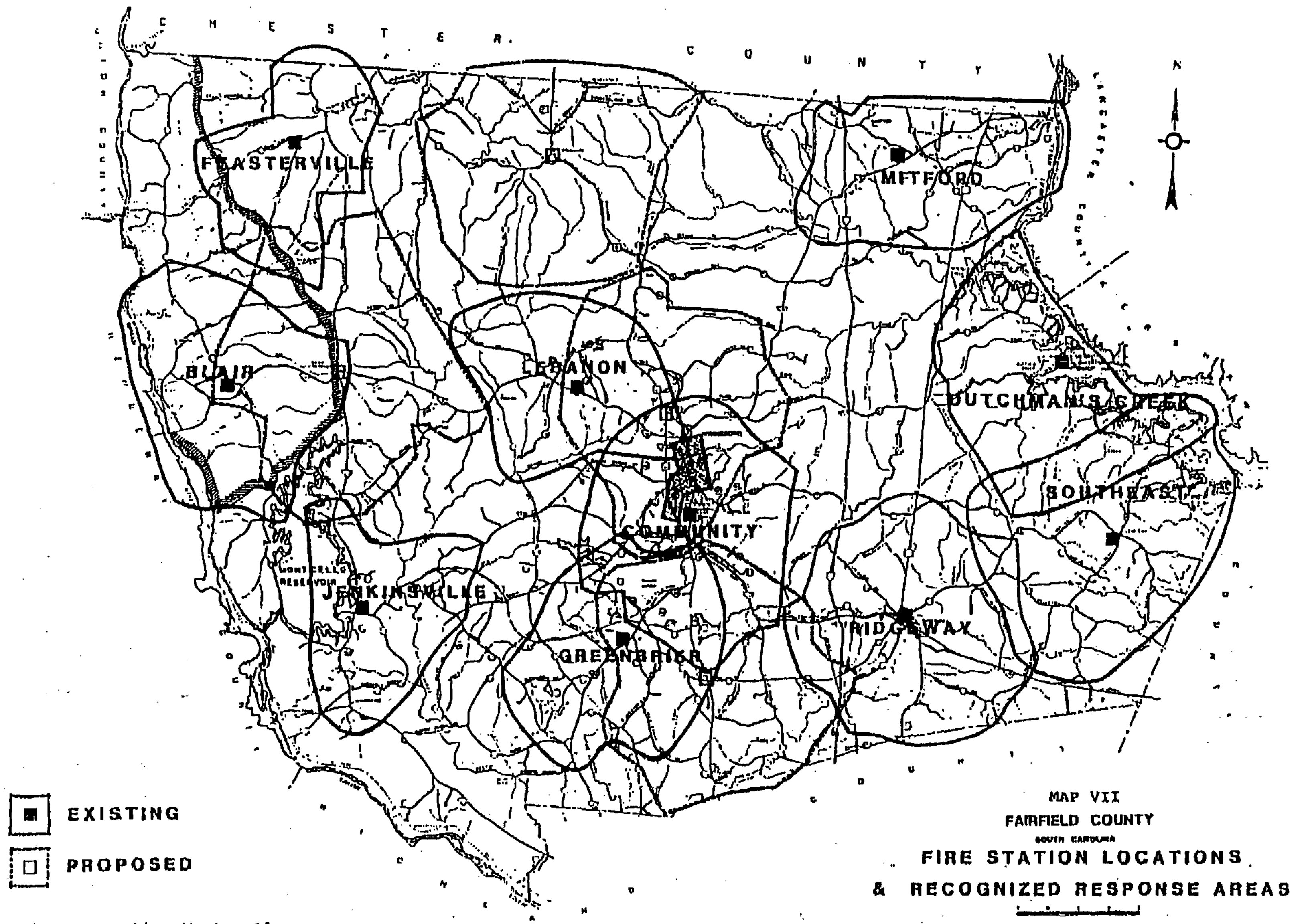
The availability and level of fire protection has a direct bearing on the security of life and property, and the cost of insurance premiums. As such, it is a matter of considerable concern where development is contemplated, especially multi-million dollar industrial and/or commercial investments.

Fire protection in Fairfield County is provided by the public safety department of the Town of Winnsboro and ten stations operated as part of the county fire service. The county fire departments are funded directly by Fairfield County in its operating budget, out of the proceeds of a 3.1 mill fire tax. The Winnsboro Public Safety Department is funded from the budget of the town, supplemented by fire protection contracts. Some of the individual fire departments in the county are engaged in separate fund raising activities, but most of their apparatus and buildings are owned, and their operating expenses paid by the county.

The 10 stations in the county system are:

Community
Greenbrier
Southeast
Dutchman's Creek
Ridgeway
Jenkinsville
Mitford
Lebanon
Blair
Feasterville

All of the departments except Winnsboro, Community, Ridgeway, and Mitford are rated Class Nine. The district covered by the Winnsboro Fire Department is rated Class Five, although some properties located beyond 1,000 feet of a fire hydrant carry



Source: Fire Protection Master Plan, Eckman & Associates.

SECTION IV

LAND USE FORECAST

Forecasting the need for and location of land for future development is one of the principal objectives of any land use plan. But, there are no exact standards by which to measure this need. The amount of land required to support the population of a big city, for example, is considerably less per person than the average amount consumed in Fairfield County. It is a matter principally of land availability and economics.

One fairly reliable method for use in determining future land use needs in the county is to relate land use to population. Over the years, our firm has compiled land use and population data from over 30 local surveys. We have found the average consumption of land in unincorporated areas to be approximately .34 acres per person, allocated among the four basic land use classifications as follows:

Table XXIII

Land Use Classification	Land Use Requirements (acres per person)	Percent of Development
Residential	.21	62.0
Commercial	.01	3.0
Industrial	.08	24.0
Service	.04	11.0
TOTAL	.34	100.0

Source: Vismor & Associates, Inc.

Using these allocations for Fairfield County we estimate that about 512 additional acres will be developed by the year 2000, and an additional 340 acres by the year 2010. Not all of it will come from the rural register, of course. There will be some in-filling of existing subdivisions and development in built-up areas around Winnsboro, effectively reducing the need for raw undeveloped land. Still, the impact will be measurable.

Residential use should comprise approximately 62 percent of all new development, accounting for approximately 430 additional acres by the year 2010.

intense in areas outside of Winnsboro, and at I-77 interchange locations.

The amount of service land needed through time, again, is directly related to the amount of land used principally for residential purposes. The need in the county is projected to be only 95 additional acres by the year 2010. This includes social, medical, recreational, governmental, religious, and related uses. Many of these uses will continue to be found in the county's two municipalities, thus minimizing their impact in the unincorporated areas.

SECTION V

PLANNING ISSUES AND OBJECTIVES

CITIZEN PARTICIPATION IN THE IDENTIFICATION OF ISSUES AND NEEDS

One of the principal objectives of this program is to provide ample opportunity for citizen participation in the planning process---to allow the public to help identify issues and problems that should be addressed by the Plan. Toward this end, the Planning Commission conducted three public "in-put" meetings in various parts of the county. The meetings were held in Ridgeway, Monticello and Winnsboro. Additionally, a select group of students and teachers were surveyed in the same manner to determine their concerns for the future, and how this planning program should address them.

The format consisted of a presentation by the Commission and its consultant-staff. The presentation consisted of factual background data on trends and conditions within the county, followed by population and development forecast for the various geographic areas. Constraints to and capabilities of development were outlined, and preliminary issues identified.

Having briefed or primed the audience, the agenda then focused on citizen participation. To aid in the process, a survey questionnaire was used to guide the discussion. The questionnaire enlisted participation in the identification of community needs and issues, and solicited guidance in charting a course of action to be taken by the Planning Commission and County Council in addressing such needs and issues.

A total of 121 persons participated in the process. While the number is relatively small, and their views may not be considered a mandate, clearly they represent a "good indication" of what needs to be done to improve and enhance the development process through planning and subsequent implementing activities.

As issues, needs and problems tend to vary from area to area, the questionnaire focused on (1) area identification of the respondent and (2) needs within such area. The areas divided generally along the following lines:

Area	Description
1	East of Winnsboro, including Lake Wateree, Simpson, Rockton and Ridgeway.

TABLE XXV

CITIZEN'S RESPONSES TO PLANNING AND DEVELOPMENT ISSUES AND NEEDS

IEED TO:	YES	NO	NOT SURE
1) Protect existing neighborhoods, subdivisions and homes rom incompatible development?	.87	.08	.05
2) Protect "prime" farmland?	.74	.12	.14
3) Regulate development around Lake Monticello and Lake Wateree?	.67	.08	.24
4) Guide the location and regulate the siting of mobile homes ind mobile home parks in the county?	.63	.23	.14
5) Regulate the location of billboards and outdoor advertising signs?	.66	.12	.22
6) Regulate development along major streets and roads to ensure safety, and movement of traffic along existing and proposed highways?	.80	.07	.12
7) Identify and protect for future industrial development, sites with industrial potential?	.60	.07	.31
(8) Require landscaping as part of any new large scale industrial or commercial use?	.69	.13	.17
(9) Adopt guidelines for the location and development of certain land uses which could have a negative impact on the county, such as landfills, hazardous waste dump sites, race tracks, mining operations, nuclear plants, etc.?	.81	.04	.14
10) Regulate the impact of development on the county's natural resources and environmental amenities?	.74	.05	.21

Source: Responses from 121 persons at three public hearings conducted by the Fairfield County Planning Commission and a select group of students and teachers. Responses expressed by percentage of participants.

(9) Mitford
(10) White Oak
(11) Lebanon

SUMMARY LISTING

From the citizens in-put meetings and the data compiled by this study, we are able to identify a number of broader based issues which should be addressed by this Plan. Development related for the most part, they focus on the impact and siting of new and expanded development, as follows:

(1) Growth
(2) Quality Development
(3) Economic Development
(4) Aesthetics
(5) Transportation
(6) Housing
(7) Infrastructure
(8) Resource Preservation
(9) Recreation

AMPLIFICATION OF ISSUES, OBJECTIVES AND RECOMMENDED RESPONSES

Each of the above broad-based issues is amplified in this section. Here specific objectives are established and appropriate responses to implementation recommended, as follows.

ISSUE: GROWTH

OBJECTIVE: TO ACCOMMODATE PROJECTED GROWTH IN AN ORDERLY MANNER, AND TO AMELIORATE ITS IMPACT ON EXISTING LAND USES AND ENVIRONMENTAL RESOURCES

RESPONSE:

This is a fundamental planning issue. At the core is the approach to be taken by the Planning Commission and County Council. It may opt to continue with its current "hands off" policy, relying principally on developers and market conditions to shape the future of the county, or it may adopt planning policies and land use controls to help guide the development process.

Clearly, the county will have little say in the process, this plan notwithstanding, if it fails to take a stronger position on development issues. But how should the county plan for future development? It should start by building a Plan that recognizes market and economic influences, and channel development, particularly low-rise, single-family residential uses. Yet, too little attention generally has been given this particular issue.

c. Building Setbacks and Curb Cuts

Setback and curb cut regulations can help limit future spending on highway widening projects, prevent encroachment by neighboring uses, and reduce the hazard of turning maneuvers on major streets and highways.

d. Performance and Siting Standards for Manufacturing Uses

Performance standards can protect against air and noise pollution, vibration, fumes, odor, glare, and other negative by-products of some manufacturing and related uses.

They can also check or substantially modify the location and operation of potentially incompatible uses such as dump sites, salvage yards, hazardous waste facilities, etc.

e. Erosion and Sediment Control

Erosion is a problem in parts of Fairfield County, due to its rolling terrain. And it is often compounded by development, where proper preventive measures are not employed during and after construction. Where there is erosion there is also a problem with sedimentation, drainage and water pollution. Drainage and storm water run off are addressed by the county's Subdivision Ordinance, but the issue of erosion as a negative by-product of the development process remains unaddresssed. To remedy the situation, the county should enact legislation prescribing "best management practices" where earth disturbing development is taking place.

ISSUE: QUALITY DEVELOPMENT

OBJECTIVE: TO FOSTER QUALITY DEVELOPMENT

RESPONSE:

That projected growth will generate new and expanded development is certain. What is not so certain is the quality of that development.

e. To identify and protect industrially suited sites for future industrial development.

f. To create a more favorable environment for existing industry by protecting them from encroachment by potentially incompatible uses.

g. To develop a high profile industrial park.

h. To support and develop a strong agri-business environment, including forestry, farming, housing, etc.

i. To aggressively pursue the development of programs designed to attract "retirees" to Fairfield County.

Currently, the State Development Board and the Economic Development Council of the Midlands represent the county in its efforts to secure new economic development. But more in the way of a county economic development office may be needed. And, indeed, such a move is being considered by County Council.

Additionally, the county should move to create a more favorable industrial climate by protecting potential industrial sites, as well as existing industry.

There are several industrially developing areas south of Winnsboro and along the S.C. 34 corridor between Winnsboro and I-77. Also, some 14 potential sites with approximately 3,500 acres have been listed with the South Carolina State Development Board for industrial development. And the county is considering the development of an industrial park on I-77, between S.C. 34 and Peach Road.

But unless these sites are secured through options or acquisition they may not be available if and when needed for industrial development. And the loss of good industrial sites could compromise the county's ability to secure much needed industry. It is simply not feasible however for the county to purchase and facilitate all properties with industrial potential, or wise to focus its attention solely on the development of one industrial park, although such a facility is needed. Through its regulatory power, the county can protect at no additional cost, those properties judged best suited to industry. Also the county can help maintain an industrial environment for its existing industries by, again, calling on its regulatory power to preclude encroachment by residential and other incompatible uses.

The county may enact land use regulations to protect industrially suited sites exclusively for manufacturing and related uses. Such a measure is strongly suggested by this establishing a National Homeownership Trust Fund.

Title IV, HOPE Program, providing homeownership and opportunity for people everywhere.

Title VIII, Housing For Persons With Special Needs, providing assistance to the elderly and persons with disabilities.

b. Utilization of existing housing programs, i.e.:

Title V, Housing Assistance-Public, Section 8, and Foster Care Assistance

Title VI, Preservation of Affordable Rental Housing - Prepayment clauses on Section 236, 221(d)3 housing and other preservation provisions.

Title VII, Rural Housing

Title VIII, Housing for Persons With Special Needs - Section 202 and McKinney

Title XI, Community Development Block Grants

c. Greater involvement by local governments, to include:

(1) Inventorying available land for housing development;

(2) Supporting the cost of land planning and engineering to reduce future improvement problems;

(3) Assembling land and clearing titles including lots lost to delinquent taxes and vacant improved lots for in-fill;

(4) Making housing packages available to private developers on a competitive basis; and

(5) Supporting the Building Materials Bank for recycling excess materials from construction sites.

d. Greater involvement by the Central Midlands Regional Planning Council, the private sector and the banking industry.

ISSUE: INFRASTRUCTURE

OBJECTIVE: TO EXTEND WATER AND WASTEWATER SERVICE AND FACILITIES TO ACCOMMODATE PROJECTED GROWTH AND DEVELOPMENT

RESPONSE:

Growth of the county is contingent on the availability of water and sewer. And while prevailing low density patterns over much of it preclude countywide coverage, such facilities are essential to higher intensity development.

With the County Planning Commission responsible for land use planning, five different agents---Winnsboro, Ridgeway, Mitford Water District, Mid-County Water District and the Jenkinsville Water District---responsible for providing water, and three different agents responsible for providing sewer (Winnsboro, Ridgeway, and Great Falls) to the unincorporated areas of the county, the need for a close working relationship among these groups is obvious. One cannot properly function without the other. Cooperation and mutual support are essential to the orderly, planned development of the county, at the most efficient scale.

ISSUE: RESOURCE PRESERVATION AND ENHANCEMENT

OBJECTIVE: TO CONSERVE AND PROTECT THE COUNTY'S NATURAL AND HISTORIC RESOURCES

RESPONSE:

Due to the non-replenishable nature of the county's natural and historic resources, care should be exercised in their use and/or development.

Included among such uses and facilities in Fairfield County are the following:

a. Prime farmlands

b. Water resources; i.e. Lake Wateree, Monticello Reservoir, Winnsboro Reservoir, the Broad River, and smaller creeks and ponds.

c. Historical buildings and places listed by Table XXVII.

d. Woodlands.

TABLE XXVII

INVENTORY OF HISTORICAL PLACES

1. Blink Bonnie
2. Longtown Baptist Cemetery
3. Bryant Hill Cemetery
4. Longtown Presbyterian Church
5. The Dixon House
6. The Hunter House
7. St. Stephen's Episcopal Church
8. Aimwell Presbyterian Church
9. Ruff's Chapel
10. Longleaf
11. Ruff and Company
12. The Century House
13. Ridgeway Baptist Church
14. Mount Hope
15. Cedar Tree

[illegible] Vaughan House

[illegible] Valencia

18. Cason Family Cemetery
19. Durham House
20. Boulware Walls Burying Ground
21. Rocky Mount Battle Marker
22. Johnston Home
23. Rocky Creek Canal
24. Deputary Creek
25. Bethesda Methodist Church
26. Mt. Zion Baptist Church
27. Caldwell House, Mitford Community
28. Grafton House
29. Covenanter Cemetery
30. Covenanter Marker
31. Camp Welfare
32. Mt. Olivet Presbyterian Church
33. White Oak ARP Church
34. Robert E. Patrick Home
35. Galloway-Moore House
36. Concord Presbyterian Church
37. M. T. Patrick Home

[illegible] Lewis Place

39. Calvin Brice Place
40. New Hope ARP Church
41. Dr. Walter Brice House
42. Tom "Shanty" Brice Place
43. Stevenson Home
44. Balwearie
45. Albion
46. The Jane Turner Place
47. Remains of Old Jackson Creek Presbyterian Church
48. The Old Manse
49. Lebanon Presbyterian Church
50. W. K. Turner Home
51. Dr. Hardy Liston Birthplace
52. Martin Place
53. Lemmon Place
54. The Bell Place
55. Happy Valley
56. Salem Presbyterian Church
57. Site of Hans Wagner Fort
58. Old Feaster Cemetery
59. Liberty Universalist Church
60. Feasterville Female and Male Academy
61. The Robert W. Coleman House
62. Clanmore
63. Shelton
64. Cool Branch Baptist Church
65. Beaver Creek Baptist Church
66. Coleman Cemetery
67. Old Yongue Burying Ground
68. Later Yongue Cemetery
69. Mobley Meeting House
70. Means Cemetery
71. Lyles-Feaster Home
72. Ivy Hall
73. Long House
74. Old Lyles Cemetery
75. Rock Creek Baptist Church
76. Fonti Flora
77. McCrorey-Liston School
78. Dawkins House
79. Monticello Methodist Church
80. Davis Plantation Home
81. White Hall AME Church
82. Parr Shoals
83. Chappell Place
84. Mayfair
85. Shiloh Methodist Church
86. Fair View
87. High Point
88. Little River Baptist Church
89. Holley Place
90. Ebenezer ARP Church
91. Kincaid Manor-Heyward Hall
92. Anderson Quarry
93. Union Memorial Presbyterian Church
94. Ashford House
95. Old Horeb Presbyterian Church Si[illegible]
96. Site of Mason's Meeting House
97. Trapp Home
98. Crooked Run Baptist Church
99. Bethel Methodist Church
100. Thomas C. Camak Home
101. Brown-Rexrode House
102. Hawthorne-Brown House
103. Warren Castles House
104. Old Furman Building
105. Fairfield Baptist Church
106. The Oaks
107. The Bob Lemmon Place
108. Kelly Miller School
109. Greenbrier Methodist Church
110. William Estes Home
111. Thomas Nightingale's Cowpen
112. Site of Broome's Mill
113. Thomas Woodward, the Regulator
114. Anvil Rock
115. Tocaland
116. Hunstanton
117. Dr. Daniel Jackson Sanders
118. Wylie House
119. Clowney Place
120. Winnsboro, County Seat

The loss of some open land resources may not be anything to be alarmed over, but the steady erosion of such land will jeopardize the county's legacy to future generations.

ISSUE: RECREATION

OBJECTIVE: TO PROVIDE A COMPREHENSIVE AND BALANCED SYSTEM OF PARKS AND RECREATION FACILITIES

RESPONSE:

Recreation facilities seldom influence development, but they do complement it. They are essential to a balanced social environment. And with growth will come demand for more parks and recreational facilities, although support for more parks appears to be only luke warm according to the citizen in-put forums.

Recreational facilities in Fairfield County are provided by federal, state, county, city and private sponsors.

The federal government owns and manages approximately 11,560 acres in the Sumter National Forest, located in the northwest corner of the county. This facility provides hiking, riding and wilderness experiences, concentrating on recreational activities that require a lot of land.

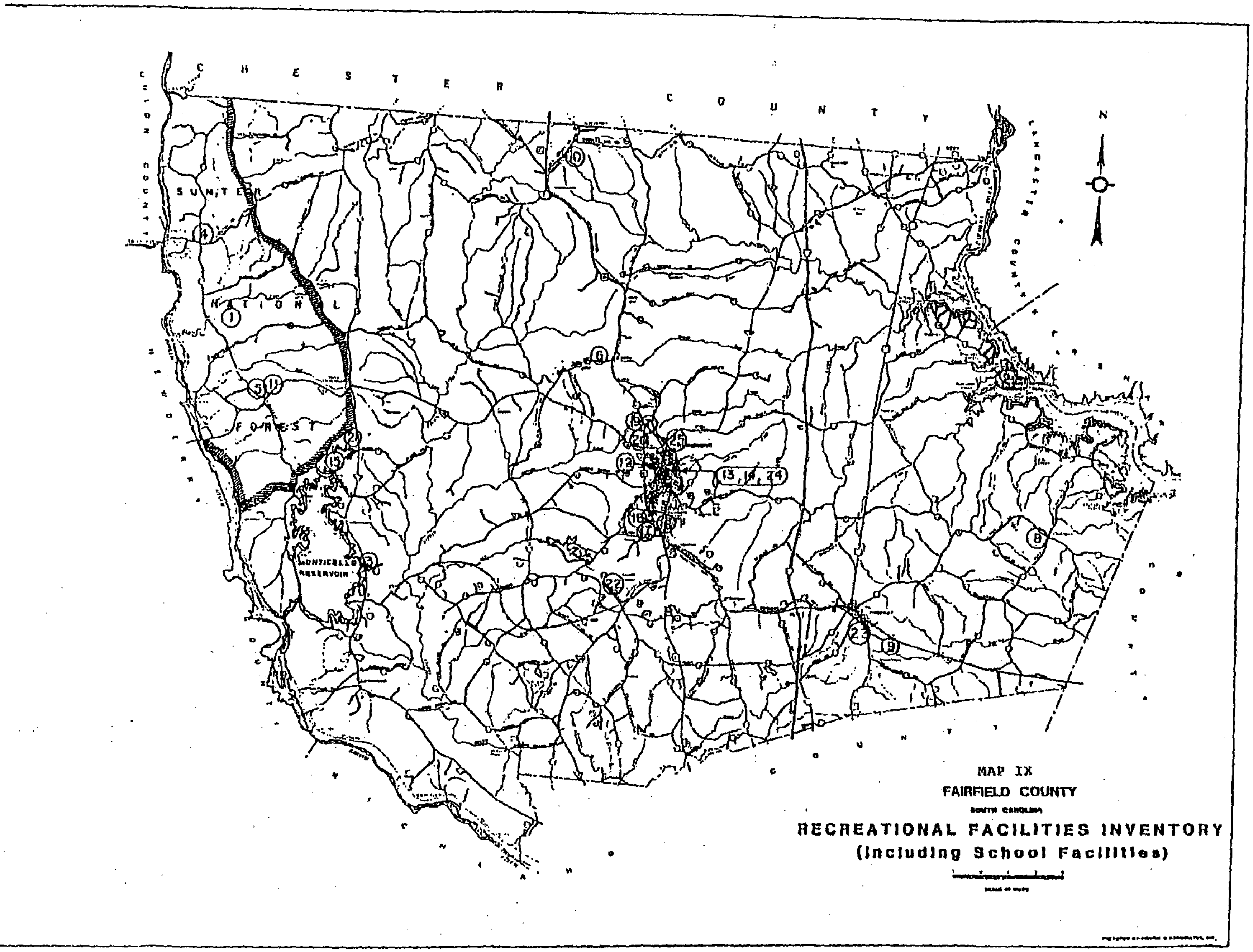
The state owns and operates a large facility on Lake Wateree (Lake Wateree State Park). It includes a multitude of open space and water-oriented activities and facilities.

The Town of Winnsboro has a comprehensive recreation program, with two in-town parks, one of which (Fortunes) contains a swimming pool.

The Fairfield County Recreation Commission manages nine parks countywide, with a tenth being developed at this time. The location and assets at each are listed and shown by the following table and map.

Additionally, there is in the county a Recreation Association, with athletic facilities south of Winnsboro. Also, SCANA provides water-oriented recreation activities at its "Recreation Lake," north of Meadowlake Road, and fishing and boating on the Reservoir Lake.

Finally, the School Board makes it many facilities available for public use through the Fairfield County Recreation Commission.



MAP IX
FAIRFIELD COUNTY
SOUTH CAROLINA
RECREATIONAL FACILITIES INVENTORY
(Including School Facilities)

SECTION VI

COMPREHENSIVE DEVELOPMENT PLAN, 2010

In reviewing the various factors affecting development, i.e. projected growth, existing land use, economic conditions, development trends, and the other elements responsible for development, a skeletal framework begins to take shape. Forces already at work have provided us with a foundation. This Plan is designed to build on that foundation---not alter what has been done or start anew, but guide future development in a manner that will complement and enhance social and economic conditions in the county, and lend order to the development process.

But the trends in process point to impending conflict. Areas of the county with the greatest development potential---in the southeast corner---contain most of the county's prime farmlands and mineral deposits. They are also in the line of expanding industrial and residential development north of Columbia, principally along I-77. By nature, these uses are inherently incompatible, setting the stage for conflict.

The potential for conflict is further compounded by neighboring Richland County's Comprehensive Plan for the I-77 corridor, which designates much of the contiguous area in Richland County for "development", meaning any number of uses under certain conditions. The logic in this approach is to maximize flexibility in meeting future development proposals "as the area has no particular development trend, but has potential for various uses."

East of SR 227 (Hood Road in Fairfield County), the Richland County Plan recommends low-density residential development. Assuming a continuation of "like development" into Fairfield County, east of Hood Road, similar low-density residential development may be expected. Development patterns along the I-77 corridor into Fairfield County will be shaped entirely by economics, on a first come basis, according to the Richland County Plan.

These "planned" scenarios mirror current development trends based principally on economics and locational preference. But they do little to remedy the potential for conflict in Fairfield County or insert order into the development process.

LAND USE PLAN ELEMENT

The Land Use Plan Element of the Comprehensive Plan is designed to do both---bring order and compatibility to the development process---establishing goals and objectives for the various areas of the county. Based in part on factors influencing development, projected needs and potential, goals and objectives are embodied in the following generalized Land Use Classifications, which are portrayed by the use of symbols on the accompanying Comprehensive Development Plan Map.

Land Use Map Symbol	Generalized Land Use Area Classification
GD	General Development
●	Commercial Clusters, within 500'
RC-D	Residential Conservation and Development
IND	Industrial Development
RR	Rural Development-Resource Preservation

GD, General Development

Areas so designated are projected to accommodate most of the future growth and development in the county. As a result, multiple uses (residential, commercial and industrial) are expected in these areas, tempered principally by market conditions. Here "highest and best use" options are advocated by the Plan. But with general, open-ended development options, there is inherent potential for land use conflicts mentioned previously. To prevent this, the Plan recommends the adoption of development standards for these areas:

(1) to ensure that adequate buffers, screens, and setbacks will be provided between potentially incompatible uses;

(2) to address storm drainage and sedimentation problems created by new development;

(3) to regulate outdoor advertising and help prevent visual blight and obstruction to travel;

Objective

The objective of this land use designation is to meet in orderly concentrations the need for commercial development in areas dominated by residential and/or rural uses, and to discourage strip commercial development.

RC-D, Residential Conservation and Development

Without some type of land use regulations or development standards, it is difficult to maintain quality subdivisions and protect existing residential areas.

Even deed restricted subdivisions are vulnerable to incompatible development from all sides, as peripheral lots are exposed to and unprotected from neighboring development, whatever the use.

Residential security is of prime concern in any community. But all residential areas in unincorporated Fairfield County lie unprotected. Many already have been compromised as a result, by mixed, incompatible land uses.

Still, all is not lost. There remains homogeneous quality subdivisions within the county, as well as a number of nearby sites with residential potential. However, both need and warrant "protective zoning". Without it, they are vulnerable to an intrusion of mixed and potentially incompatible land uses.

Objective

Areas designated RC-D on the accompanying Plan Map are designed to protect existing residential uses and nearby areas with residential potential, exclusively for residential purposes, and to restrict or prohibit any use of land which would compromise or otherwise infringe on the prevailing character of established and planned residential areas.

IND, Industrial Development

Specific sites within the designated IND on the Plan Map have been investigated and found to have industrial potential. Most are relatively level, facilitated by or planned for water and sewer, and easily accessible. Many have rail.

Such conditions uniquely qualify these areas for most industrial uses, prompting their reservation principally for future industrial development. The availability of suitable industrial sites is fundamental to industrial development. Where good sites exist, they should be retained, principally if not exclusively for industrial development.

TABLE XXIX

SUMMARY LAND USE PLAN LEGEND

Use Classification	Recommended Density (No. Residential Units Per Acre)	Principal Use(s) Recommended
General Development (GD)	(12) per acre with water and sewer (2) per acre with water, but not sewer (1) per acre without water or sewer	Commercial, business, light industrial, multi-family, motels, commercial recreation, residential, institutional and mobile home parks.
Residential Conservation and Development (RC-D)	(4) units per acre	Single and multi-family residential uses, townhouses, condominiums, patio homes, triplexes, duplexes, and individual mobile homes, but not mobile home parks.
Industrial Development (IND)	(1) unit per 10 acres	Industrial, warehousing, distribution, wholesaling, storage, research and testing facilities and plants.
Rural Development-Resource Conservation (RR)	Not less than (1) per acre	Agricultural and support uses, single-family dwellings, mobile homes and small scale convenience and service commercial uses, hunting and fishing lodges, open air recreation, marinas, and agri-industrial uses.

Proposed Fire Protection Projects

Comprehensive recommendations for improving and expanding fire protection in the county are contained in the county's Fire Protection Master Plan, 1990. Suffice it to say, the key project elements of the Plan call for constructing four new stations, one of which is now underway (Map VII). Cost estimates and priorities are contained in the Plan, as well as other project details designed to improve fire protection throughout Fairfield County.

DEVELOPMENT POLICIES

In addition to the above, the following development policies are hereby established. They form the basis for the planning process by providing a means to evaluate land use proposals for compliance with overall community goals.

(1) General Policies

(a) Encourage planned and orderly growth consistent with the county's Land Use Plan, the capability of the natural resource base and the county's ability to extend or provide the necessary supporting public services and facilities to accommodate development.

(b) Provide for the conservation and protection of natural and historic resources through the proper use and management of land, water, soil, forest and mineral deposits.

(c) Assure that appropriated public funds provide needed public services and facilities in the most cost-effective manner.

(2) Residential Policies

(a) Provide opportunities for an appropriate mix of dwelling types, sites and prices in order to meet the current and projected housing needs of county residents in accordance with their financial capabilities and preferences.

(b) Encourage new housing development to strive toward the best principles of site planning and residential design through the enforcement of the county's subdivision regulations and building codes.

adjacent land uses.

(b) Encourage the clustering of commercial shopping facilities in nodes which are convenient to population concentrations.

(c) Discourage the spread of strip-type commercial development.

(d) Prohibit the encroachment of incompatible commercial development into established residential areas.

(e) Promote the adaptive reuse of existing structures when appropriately located for commercial use.

(f) Coordinate the growth of commercial development with information regarding the potential impact on community facilities, utilities, transportation, adjacent and nearby land uses and effects on the environment.

(4) <u>Industrial Policies</u>

(a) Encourage industrial growth that provides quality employment opportunities and makes effective use of the county's resources.

(b) Encourage the development of industrial uses in areas which will maximize the potential for safe, efficient and compatible operations while minimizing excessive infrastructure improvements and service costs to both industry and government.

(c) Seek to establish and maintain a balanced relationship between industrial, commercial and residential growth to ensure a stable and healthy tax base.

(d) Pursue the development of planned industrial districts and discourage the location of industrial uses in rural or natural resource areas.

(e) Encourage the development and/or expansion of industrial uses which do not produce excessive noise, smoke, dust or other particulate matter, vibration, toxic or noxious waste materials, odors, fire and explosive hazards or other detrimental impacts.

(f) Promote the location of industrial uses in areas which have compatible soils, drainage and other

(b) Ensure adequate rights-of-way for future road improvements and expansions. Right-of-way dedication requirements and building setback lines will be maintained for a heirarchical system of roads based on anticipated level and nature of future use.

(c) Protect the safety and traffic-carrying capacity of interchange areas and major thoroughfares from adverse adjacent land development by minimizing curb cuts along such corridors.

(d) Ensure the provision of safe and adequate parking facilities suitable to each type of development, and establish requirements that vehicular circulation within new development areas function efficiently and safely.

(e) Enact legislation to protect the county's airport.

(7) Open Space and Recreation Policies

(a) Ensure the availability and accessibility of a variety of active and passive recreational opportunities for all persons in the county, including the physically, socially and economically handicapped.

(b) Secure adequate future sites for recreation activities by identifying land and water areas having the best combinations of natural features, size and location suited for the type of experience to be provided. These sites should be acquired by the county or some other public entity and dedicated to recreation development and use.

(c) Preserve the overall positive qualities of the natural environment which give the county its character, and preserve those areas which have important recreational, scenic, historic, archeological, educational and aesthetic values.

(d) Encourage land development practices that reserve open space within or close to developed sites. Such open space should preserve the land's natural features and provide opportunities for the development of active recreation facilities.

SECTION VII

PLAN IMPLEMENTATION

Moving from the drawing board to reality is seldom an easy task in any endeavor. It is particularly difficult where the proper tools for implementation are not in place. Such is the case in Fairfield County.

But what can be done to reach the goals and objectives of this Plan? To start with, the county can begin a media blitz to secure public backing, then move to enact the necessary legislation for implementation.

Chronologically, the recommended process is as follows:

(1) Air the plan at public meetings and through the media.

(2) Adopt the plan as an official guide to future development.

(3) Maintain the plan.

(4) Coordinate the plan with the plans of other agencies operating in the county.

(5) Enact development and land use regulations to assure plan compliance and implementation.

AIR THE PLAN

Public awareness and participation in the land planning process are essential to its acceptance and use as a guide to development. Developers, realtors, property owners, agencies, and the general public alike are responsible for many individual decisions influencing future development. Consequently, they should have a hand in the making and execution of it. With public participation and support, implementation may be assured. Clearly, it is essential. It can promote public understanding of the planning process and expose proposed plans and policies to a broad spectrum of interest, whose reaction may make significant improvements in original proposals.

There are several ways in which to secure citizen involvement and support. It may be accomplished through public hearings, announcements, citizen advisory meetings, selected contacts with community leaders, etc. Also, the dissemination of copies of the Plan to interested groups and conducting informal government, the Recreation Commission, Fairfield United Action, the Recreation Association, the School Board and other county agencies can spell the difference between success and failure. Interaction with these agencies will help to ensure full cooperation in the implementation of the Plan, and improve the efficiency of the development process.

ENACT DEVELOPMENT AND LAND USE REGULATIONS TO ASSURE PLAN COMPLIANCE AND IMPLEMENTATION

Currently the county has a number of codes and ordinances designed to impact the development process and improve the outcome, including:

(1) A Mobile Home Park Ordinance
(2) A Subdivision Ordinance
(3) A Flood Damage Prevention Ordinance
(4) A Building Code
(5) An Electrical Code

Still, these regulations are insufficient to implement many of the goals and objectives outlined by this Plan. More is needed in the way of (1) development regulations and/or (2) land use restrictions. Without such regulations, implementation of this Plan will be limited. This is a Plan, nothing more; it neither requires nor mandates any action on the part of anyone. And until such time as requirements are imposed, the development process will remain unaltered.

But what type of regulations should the county adopt? There are several alternatives it may consider.

First, there is zoning. A Zoning Ordinance can regulate and control the use and development of land in accord with this Plan. But zoning, per se, is seldom a popular issue, particularly in the more rural areas such as Fairfield County.

A second alternative is a concept referred to generally as "performance zoning" or "development standards". It may embrace regulations and concepts found in zoning and subdivision ordinances, and more. These regulations are becoming increasingly popular in counties where attitudes are hardened toward zoning. They differ from conventional land use (zoning) regulations by concentrating on <u>how to</u> achieve good development rather than segregating development on the basis of use. The <u>type of use</u> proposed for development is seldom regulated. The emphasis is on development standards, thus minimizing negative by-products and enhancing sound development practices. Conventional (zoning) regulations generally reverse this concept, concentrating on the regulation of use rather than the multi-faceted impact of development.

districts, with the primary focus on development and performance standards.

Such an ordinance, properly drafted, could give the county sufficient flexibility to accommodate projected growth, while providing safeguards against development that might compromise existing resources or land uses.

Under this arrangement, regulations will vary from one area classification to another, depending on the development objectives of each. But such regulations would not relate to or control the use of land except in designated Use Zones, where land use regulations are needed and recommended to achieve stated plan objectives.

CONCLUSION

This document is to be used as a reference and guide to the future development of Fairfield County. It speaks to specific as well as general issues and concerns identified by the research and planning. The Plan represents an attempt to better infuse long-range planning into the day-to-day decisions affecting development.

The Plan should not be viewed as a static or rigid document, but as an elastic guide to development, accommodating change within its broader confines. As such, it should be reviewed regularly for accountabililty, as required by the state codes. In this way, it will remain an effective and current blueprint for development.

Section 5.8
Ref 2

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Table 80

SOUTH CAROLINA
Full-time Law Enforcement Employees
by State by Metropolitan and Nonmetropolitan Counties, 2005

Data Declaration Download Excel

Metropolitan/Nonmetropolitan	County	Total law enforcement employees	Total officers	Total civilians
Metropolitan Counties	**Aiken**	220	107	113
	Anderson	220	182	38
	Berkeley	185	114	71
	Calhoun	23	21	2
	Charleston	697	254	443
	Darlington	66	60	6
	Dorchester	192	96	96
	Edgefield	53	49	4
	Fairfield	47	45	2
	Florence	229	117	112

	Greenville	432	350	8[illegible]
	Horry	216	37	179
	Horry County Police Department	239	221	18
	Kershaw	68	55	13
	Laurens	107	56	51
	Lexington	376	214	162
	Pickens	132	92	40
	Richland	490	453	37
	Saluda	50	19	31
	Spartanburg	316	288	28
	Sumter	121	112	9
	York	262	125	137
Nonmetropolitan Counties	**Abbeville**	54	26	28
	Allendale	12	10	2
	Bamberg	13	11	2
	Barnwell	38	25	13
	Beaufort	197	178	19
	Cherokee	90	42	48
	Chesterfield	65	43	22
	Clarendon	53	30	23
	Colleton	123	63	60
	Dillon	84	33	51

Georgetown	127	70	57
Greenwood	112	71	41
Jasper	33	28	5
Lancaster	100	68	32
Lee	30	25	5
Marion	38	32	6
Marlboro	25	21	4
McCormick	25	13	12
Newberry	94	46	48
Oconee	133	80	53
Orangeburg	108	75	33
Union	33	29	4
Williamsburg	64	31	33

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Data Declaration

Provides the methodology used in constructing this table and other pertinent information about this table.

Section 5.8
Ref 4

TETRA TECH NUS, INC.
AIKEN, SOUTH CAROLINA

MEETING/TELECON RECORD

Topic/Purpose: VCSNS COL – Obtain property tax information	Date/Time: January 11, 2007, 2:00 p.m.
Project: South Caroline Electric & Gas – VCSNS COL	Charge No.:

Attendees:	Organization:
Kristin L. Sutherlin	Tetra Tech
Barry Burnette	SCANA

Met with Mr. Burnette at SCANA's office in Columbia, SC. Meeting lasted approximately 45 minutes.

Discussion Summary:

- VCSNS currently plans to begin operation of the new unit in 2014 or 2015. This is a prototype application process.
- During construction, the assessed value will be 10.5 percent of the net cost of construction.
- South Carolina law defines power generation facilities as personal property.
- Generators are allowed to buy materials used for power generation free of sales tax.
- Corporate taxes are based partly on capitalization (assessed values) and partly on revenues (gross receipts).
- South Carolina recently enacted legislation to allow counties to use tax-incentive financing to attract power generation facilities. Consequently, Fairfield County has offered an inducement for the construction of two units at VCSNS, consisting of a fee-in-lieu-of-taxes (FILOT) agreement. This agreement includes several provisions, including an assessment ratio of 4.0 percent and a special revenue credit of 20.0 percent of the FILOT payments on the project during the first 20 years that FILOT payments are made. The agreement also provides SCE&G with a fixed millage rate for 30 years (based on meeting an investment minimum). [The draft agreement is cited as SCANA 2007.]
- VCSNS currently pays $13 million per year to Fairfield County at the 10.5 percent rate.

Action Items:	Responsibility
Mr. Burnette will have someone forward tax information to Tetra Tech.	Mr. William Hutson / SCANA
Distribution:	File:

Section 5.8
Ref 5

Flickinger, Scott -- NUS

From: Patton, Ron [PattonRK@dot.state.sc.us]
Sent: Monday, December 04, 2006 5:05 PM
To: Flickinger, Scott -- NUS
Subject: SCDOT Road Level of Service

Attachments: LOS Breakdown.xls

LOS
kdown.xls (33

Scott:
You will need to follow the chart down to a two lane roadway with your desired classification. You need to know whether it is a minor collector, or arterial etc...

LOS "E" is capacity, so as an example, a two lane undivided collector roadway (code 22) reaches capacity with an ADT of 11,524 vehicles. Your scenario, if it was a two lane undivided collector, has a LOS of A (basically free flow) at 4,214 ADT. Your 2,400 ADT would be an A+.
thanks
Ron Patton

> > <<LOS Breakdown.xls>>

MAXIMUM ADT by LEVEL of SERVICE for URBAN FACILITIES
for SCDOT Travel Demand Models

Link Group 1 Coding	Functional Classification	Total # Lanes	LEVEL OF SERVICE A	B	C	D	E
1	Freeway	1	N/A	N/A	N/A	N/A	N/A
		2	14,357	21,682	29,300	33,695	39,262
		3	21,560	32,560	44,000	50,600	58,960
		4	28,714	43,364	58,600	67,390	78,524
		5	35,893	54,205	73,250	84,238	98,155
		6	43,071	65,046	87,900	101,085	117,786
		7	50,250	75,887	102,550	117,933	137,417
		8	57,428	86,728	117,200	134,780	157,048
		10	71,785	108,410	146,500	168,475	196,310
2	Expressway	1	N/A	N/A	N/A	N/A	N/A
		2	10,290	15,540	21,000	24,150	28,140
		3	11,809	17,834	24,100	27,715	32,294
		4	20,580	31,080	42,000	48,300	56,280
		5	23,643	35,705	48,250	55,488	64,655
		6	30,870	46,620	63,000	72,450	84,420
		7	35,476	53,576	72,400	83,260	97,016
		8	41,160	62,160	84,000	96,600	112,560
3	Ramps	1	3,675	5,550	7,500	8,625	10,050
		2	7,350	11,100	15,000	17,250	20,100
11	Principal Arterial Divided	1	4,116	6,216	8,400	9,660	11,256
		2	8,232	12,432	16,800	19,320	22,512
		3	N/A	N/A	N/A	N/A	N/A
		4	16,464	24,864	33,600	38,640	45,024
		5	N/A	N/A	N/A	N/A	N/A
		6	24,696	37,296	50,400	57,960	67,536
		7	N/A	N/A	N/A	N/A	N/A
		8	32,928	49,728	67,200	77,280	90,048
12	Principal Arterial Undivided	1	3,577	5,402	7,300	8,395	9,782
		2	7,154	10,804	14,600	16,790	19,564
		3	8,232	12,432	16,800	19,320	22,512
		4	14,308	21,608	29,200	33,580	39,128
		5	16,464	24,864	33,600	38,640	45,024
		6	21,462	32,412	43,800	50,370	58,692
		7	24,696	37,296	50,400	57,960	67,536
		8	28,616	43,216	58,400	67,160	78,256
13	Minor Arterial Divided	1	3,038	4,588	6,200	7,130	8,308
		2	6,076	9,176	12,400	14,260	16,616
		3	N/A	N/A	N/A	N/A	N/A
		4	12,152	18,352	24,800	28,520	33,232
		5	N/A	N/A	N/A	N/A	N/A

		6	18,228	27,528	[illegible]	42,780	[illegible]
		7	N/A	N/A	[illegible]	N/A	[illegible]
		8	24,304	36,704	[illegible]	57,040	[illegible]
14	Minor Arterial Undivided	1	2,646	3,996	5,400	6,210	7,236
		2	5,292	7,992	10,800	12,420	14,472
		3	6,076	9,176	12,400	14,260	16,616
		4	10,584	15,984	21,600	24,840	28,944
		5	12,152	18,352	24,800	28,520	33,232
		6	15,876	23,976	32,400	37,260	43,416
		7	18,228	27,528	37,200	42,780	49,848
		8	21,168	31,968	43,200	49,680	57,888
21	Collectors Divided	1	2,401	3,626	4,900	5,635	6,566
		2	4,802	7,252	9,800	11,270	13,132
		3	N/A	N/A	N/A	N/A	N/A
		4	9,604	14,504	19,600	22,540	26,264
		5	N/A	N/A	N/A	N/A	N/A
		6	14,406	21,756	29,400	33,810	39,396
		7	N/A	N/A	N/A	N/A	N/A
		8	19,208	29,008	39,200	45,080	52,528
22	Collectors Undivided	1	2,107	3,182	4,300	4,945	5,762
		2	4,214	6,364	8,600	9,890	11,524
		3	4,802	7,252	9,800	11,270	13,132
		4	8,428	12,728	17,200	19,780	23,048
		5	9,604	14,504	19,600	22,540	26,264
		6	12,642	19,092	25,800	29,670	34,572
		7	14,406	21,756	29,400	33,810	39,396
		8	16,856	25,456	34,400	39,560	46,096
32	Centroid Connectors	no lanes	These are loading points not actual facilities				

Section 5.8
Ref 6

Subsistence Living in the Vicinity of VCSNS

Prepared for
SCE&G

Emily McRee
Tetra Tech NUS, Inc.
Aiken, SC

January 4, 2007

Subsistence Living Activities in the Vicinity of VCSNS

As part of the Environmental Justice analysis, TtNUS identified environmental impacts associated with the construction and operation of new units at V.C. Summer Nuclear Station. TtNUS then evaluated whether minority and low-income populations could be disproportionately affected by these impacts.

As part of the analysis, TtNUS sought anecdotal evidence of subsistence living activities in the region. In August 2006, TtNUS contacted local government officials, staff of social welfare agencies, hospitals, and community-based aid programs concerning subsistence living. Geographical coverage focused on the region surrounding the VCSNS site.

Based on the majority of respondents, TtNUS identified no unusual resource dependencies or practices such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately impacted by the construction or operation of new nuclear reactors.

Attached are phone logs and emails detailing communications between TtNUS staff and social service agencies. The following is a summary of these communications.

These interviews support the conclusion that few, if any, subsistence living activities are known to occur near VCSNS. Most agency representatives reported that activities such as hunting, fishing, and gardening were done for recreational purposes, rather than for subsistence. A representative from SC Department of Natural Resources did mention that Vietnamese individuals are occasionally seen collecting *Corbicula* from Monticello Reservoir. However, according to census data (see Section 2.5.4), only one block group with a significant Asian population exists in the 50-mile radius (in Richland County). In addition, Monticello Reservoir is not a Shellfish Management Area under SC DHEC regulations.

Agency representatives felt that most low-income individuals relied on government and/or community aid programs rather than fishing, hunting, or gardening. Fishing does take place recreationally in Monticello Reservoir, Parr Reservoir, and the Broad River. The SC Department of Health and Environmental Control monitors water bodies and published fish advisories for water bodies. No advisories exist for Monticello Reservoir, Parr Reservoir, or the Broad River.

With respect to migrant workers, agency representatives felt that there was not a large migrant worker population in area. No agency representative felt that migrant workers engage in subsistence fishing, hunting, or gardening.

SCE&G COL Application

TtNUS project 00329

TELEPHONE LOG

Date/Time of Call: August 10, 2006 10:00 am

Topic: Subsistence Living Activities in the vicinity of VCSNS

Personnel Involved in Call	Company/Organization
Teresa Powers – Development Director	Newberry County DSS (803-321-2042)
Emily McRee	Tetra Tech NUS, Inc.

Summary of Conversation:

I asked Ms. Powers if she was knowledgeable concerning the prevalence of subsistence living in the region. Ms. Powers was also asked whether there were a lot of migrant workers in the area. Ms. Powers responded that she was not aware of subsistence living in the area, but was not knowledgeable on the subject. Ms. Powers did not believe there were a lot of migrant workers in Newberry county.

Actions Items from Call	Responsibility

Emily H. McRee

TtNUS representative: Emily McRee

Copy to:

McRee, Emily -- NUS

From: fchamber02 [fchamber02@chestertel.com]
Sent: Friday, August 11, 2006 3:00 PM
To: Emily.McRee@ttnus.com
Cc: Tiffany Harrison
Subject: RE: Fairfield County Subsistence Living
Follow Up Flag: Follow up
Flag Status: Red

I'm sorry we don't have that information, however, the Department of Social Services might have some idea and the number of people in the low-income bracket. Other than that churches, or Good Samaritan house might know. DSS is 803 635-5502
Susan

-----Original Message-----
From: tharrison@fairfieldsc.com [mailto:tharrison@fairfieldsc.com]
Sent: Thursday, August 10, 2006 9:07 AM
To: fchamber01@chestertel.com
Cc: fchamber02@chestertel.com
Subject: Fairfield County Subsistence Living

Terry & Susan:

Please see below message -- by chance, do you guys have this data? If not, any suggestions on where I might be able to get it? I'm not sure that this is something we'd track...

Thanks!
Tiffany

Tiffany S. Harrison
Fairfield County Economic Development Director
Government Complex
350 Columbia Road
Post Office Drawer 60
Winnsboro, SC 29180
Office: (803) 712-1923
Cell: (803) 718-0505
Fax: (803) 712-1394

----- Forwarded by tiffany harrison/fairfield on 08/10/2006 09:05 AM -----

"McRee, Emily -- NUS" <

08/07/2006 02:26 PM

To: tharrison@fairfieldsc.com
cc:
Subject: *Fairfield County Subsistence Living*

Ms. Harrison, I am doing research on the amount of subsistence living that typically occurs in midland counties. I am also interested in the number of migrant workers that come through the area, and whether these migrant workers depend on hunting, fishing, or growing their own food to subsist.

Because of your position in the Economic Development Office, I thought you might have an idea concerning the level of subsistence living by minority or low-income populations that occurs in Fairfield County? If not, could you recommend someone within Fairfield County that may have a better idea?

I would also be interested in the number of migrant workers that come to the area for work, and the level of dependency on fishing or hunting that these workers have (if you have personal knowledge of this information).

Please feel free to call me, or I will be happy to give you a call to discuss further. If this is something you are not familiar with, just let me know. Thank you in advance for your time.

*New email address is Emily.McRee@ttnus.com
Emily H. McRee, EIT
Civil/Environmental Engineer
Tetra Tech NUS, Inc.
900 Trail Ridge Road
Aiken, SC 29803
Telephone: (803) 641-4942
FAX: (803) 642-8454
Emily.McRee@ttnus.com
http://www.ttnus.com/
http://www.tetratech.com/

Monday, 7 August 2006

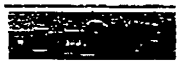
FAIRFIELD COUNTY, SC

Official Economic Development Website

Development Contact

Tiffany Harrison, Economic Development Director
Phone: 803-712-1923
Fax: 803-718-2397
tharrison@fairfieldsc.com

FEATURED BU



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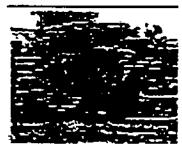

803-712-1923
P O Drawer 60
Winnsboro, SC 29180
fax: 803-712-1394

TELEPHONE LOG

Date/Time of Call: August 14, 2006 1:00 pm

Topic: Subsistence Living Activities in Fairfield & Newberry County

Participants in phone call: Phil Moore, TtNUS, and Robert Stroud, South Carolina Dept of Natural Resources (SCDNR District Biologist; 803-609-7018)

Summary of Conversation:

I called Mr Stroud to follow up on an email (attached) I sent him earlier in the day about subsistence hunting/fishing/gathering in the general area of VCSNS. He said he generally agreed with my assessment, but thought the poor people in Fairfield County might be a little more reliant on subsistence fishing than I suggested, for precisely the reasons I listed (many people in the County are on welfare, disability, limited incomes). He stressed that he has no data to support the assertion that at least small numbers of people in western Fairfield County are reliant on Monticello Res. fish for their sustenance.

He said he often saw Vietnamese fishermen at Lake Wylie (south of Charlotte) gathering *Corbicula*, and occasionally saw them at Monticello Res. He said he'd seen them carry away 5 gal buckets of small clams. I asked if this were illegal and/or required some sort of permit, and he said "No, we regard *Corbicula* as a non-native nuisance species. They can have all they want." I asked if there were significant numbers of Vietnamese in the region, and he said he didn't have any data on this. "All I can tell you is that I sometimes see them."

Mr Stroud suggested that I call the local game wardens (the Stevensons, husband and wife) and another biologist (Bob Harkins) and ask them about subsistence hunting and trapping.

Actions Items from Call	Responsibility
None	

Copy to: Emily McRee

Moore, Phil -- NUS

From: Moore, Phil -- NUS
Sent: Tuesday, August 15, 2006 10:05 AM
To: McRee, Emily -- NUS
Subject: FW: Subsistence fishing and hunting

fyi

From: Moore, Phil -- NUS
Sent: Monday, August 14, 2006 8:32 AM
To: 'StroudR@dnr.sc.gov'
Subject: Subsistence fishing and hunting

Robert,

Missed your call and somehow neglected to write down your phone number as I listened to the messge. Then I called the Union Office and wasn't able to get past the message.

As you know, my firm is preparing an Environmental Report for new nuclear reactors at VC Summer Station. We have been looking, in vain, for information on subsistence fishing/hunting/trapping/gathering by the locals. Based on my years at the plant (1981-1990) and my knowledge of Fairfield County socioeconomics, I'd say there is no fishing/hunting/trapping/gathering in the area/region that falls into the "subsistence" category.

There are a lot of poor folks and unemployed folks and folks on disability in Fairfield County who like to sit on grout buckets at Monticello Reservoir landings and fish for catfish and bream, but I'd say they are doing so for recreation rather than survival. The fish they catch may make their diets more interesting, but they don't really make a meaningful difference in their family's nutrition. Similarly, a lot of locals hunt squirrels, rabbits, and even deer, but they do so for sport rather than survival.

Would you agree with my assessment?

On the Newberry side of the river, I'd say this is even more clearcut. I believe that most folks who jugfish, limb-line, and trot-line in Parr or the Broad R do so because they like to camp out next to the river and drink whiskey under the stars (and eat catfish) not because their survival depends on it, or because the "willow cats" are an important part of their diet.

I have heard stories about Vietnamese gathering Corbicula from Monticello Res. Have you seen them, or heard this?

Any info you might be able to provide would be great.

Thanks,

Phil Moore
Tetra Tech NUS
Aiken

SCE&G COL Application

TtNUS project 00329

TELEPHONE LOG

Date/Time of Call: August 14, 2006 9:00 am

Topic: Subsistence Living Activities in the vicinity of VCSNS

Personnel Involved in Call	Company/Organization
Dee Mattox	DHEC Region 3 Home Health Services
Emily McRee	Tetra Tech NUS, Inc.

Summary of Conversation:

Calls to both Fairfield and Newberry County Health Departments resulted in references to the Home Health Services for the region, serving Fairfield, Lexington, Newberry, Richland, Lancaster, York, and Chester counties.

I asked Ms. Mattox if she was knowledgeable concerning the prevalence of subsistence living in the region. Ms. Mattox responded that she was not aware of populations that engage in hunting, fishing, or gardening to subsist, and that most low-income families receive government aid.

I also inquired about migrant populations in the area. Ms. Mattox responded that she did not provide services for migrant workers in the area and did not believe that there was a large population.

Actions Items from Call	Responsibility

Emily H. McRee

TtNUS representative: Emily McRee

South Carolina Department of Health and Environmental Control - www.scdhec.gov

Region 3 Public Health Office

Serving Chester, Fairfield, Lancaster, Lexington, Newberry, Richland and York Counties

The mission of the Region 3 Public Health Office is to promote, protect and improve the health and environment for the citizens of Chester, Fairfield, Lancaster, Lexington, Newberry, Richland and York Counties. As your public health partner we work to prevent epidemics and the spread of disease, to protect against environmental hazards and to help prevent injuries. We encourage you to engage in healthy behaviors that will help you, your children and their children live a longer, safer and healthier life.

We hope you will use our site to find out about public health in our community, where to find us, and about our services.

Region 3 Regional Office
2000 Hampton Street
Columbia, SC 29204
Located within the Richland County Health Department
803-576-2900
Fax - 803-576-2999

Fairfield

1136 Kincaide Bridge Rd
PO Box 720
Winnsboro, SC 29180
(803) 635-6481

Newberry

2111 Wilson Rd.
Newberry, SC 29108
(803) 321-2170

SOUTH CAROLINA DEPARTMENT OF HEALTH & ENVIRONMENTAL CONTROL

December 1, 2006

Home Health Agencies

DHEC Regulation 61-77

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
ANMED Health Home Health Agency 1926 McConnell Springs Road Anderson, SC 29622 Ms. Betty Phillips PH #: 864-231-2760 **Counties Served:** Anderson	HHA-068 / Expires: 2/28/2007 Anderson / Non-Profit P.O. Box 195 Anderson, SC 29622 AnMed Health **Certified For:**	1
Amedisys Home Health of Camden 715 West DeKalb Street Camden, SC 29020 Ms. Kristen Henshaw PH #: 803-750-7323 **Counties Served:** Calhoun, Fairfield, Kershaw, Lexington, Newberry, Orangeburg, Richland	HHA-194 / Expires: 2/28/2007 Orangeburg / Ltd. Liability 715 West DeKalb Street Camden, SC 29020 Amedisys SC, L.L.C. **Certified For:**	7
Amedisys Home Health of Charleston 2675 Lake Park Drive North Charleston, SC 29406-9100 Ms. Jenny Slaughter PH #: 843-553-1263 **Counties Served:** Berkeley, Charleston, Dorchester	HHA-172 / Expires: 9/30/2007 Charleston / Corporation 2675 Lake Park Drive North Charleston, SC 29406-9100 Amedisys Home Health, Inc. of South Carolina **Certified For:**	3
Amedisys Home Health of Clinton 210 Physicians Park Drive, Ste. U Clinton, SC 29325 Ms. Mikki Barrett PH #: 864-833-3212 **Counties Served:** Abbeville, Greenville, Greenwood, Laurens	HHA-186 / Expires: 1/31/2007 Laurens / Corporation 210 Physicians Park Drive, Ste. U Clinton, SC 29325 Amedisys Home Health, Inc. of South Carolina **Certified For:**	4
Amedisys Home Health of Conway 176 Waccamaw Medical Park Court Conway, SC 29526 Ms. Diana Russell PH #: 843-347-5899 **Counties Served:** Horry	HHA-195 / Expires: 3/31/2007 Horry / Corporation 176 Waccamaw Medical Park Court Conway, SC 29526 Amedisys Home Health, Inc. of South Carolina **Certified For:**	1
Amedisys Home Health of Georgetown 1105 Church Street Georgetown, SC 29440-3201 Ms. Kathy Dawson PH #: 843-546-1730 **Counties Served:** Georgetown, Williamsburg	HHA-192 / Expires: 1/31/2007 Georgetown / Ltd. Liability 1105 Church Street Georgetown, SC 29440-3201 Amedisys SC, L.L.C. **Certified For:**	2

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Amedisys Home Health of Georgetown East 1105-C Church Street Georgetown, SC 29440-3201 Ms. Kathleen Dawson PH #: 843-546-1730 **Counties Served:** Georgetown, Williamsburg	HHA-188 / Expires: 1/31/2007 Georgetown / Ltd. Liability 1105-C Church Street Georgetown, SC 29440-3201 Amedisys SC, L.L.C. **Certified For:**	2
Amedisys Home Health of Hilton Head 11 Palmetto Parkway, Suite 101 Hilton Head Island, SC 29926-3733 Ms. Noel Mailhut PH #: 843-681-7605 **Counties Served:** Beaufort, Jasper	HHA-189 / Expires: 1/31/2007 Beaufort / Ltd. Liability 11 Palmetto Parkway, Suite 104 Hilton Head Island, SC 29926-3733 Amedisys SC, L.L.C. **Certified For:**	2
Amedisys Home Health of Myrtle Beach 1705 North Oak Street, Suite A Myrtle Beach, SC 29577-3580 Ms. Becky Melvin PH #: 843-839-2380 **Counties Served:** Horry	HHA-187 / Expires: 1/31/2007 Horry / Ltd. Liability 1705 North Oak Street, Suite A Myrtle Beach, SC 29577-3580 Amedisys SC, L.L.C. **Certified For:**	1
Amedisys Home Health of North Charleston 7301 Rivers Avenue, Suite 100 North Charleston, SC 29406-4650 Ms. Ann Double PH #: 843-797-2942 **Counties Served:** Berkeley, Charleston, Colleton, Dorchester, Hampton	HHA-191 / Expires: 1/31/2007 Charleston / Ltd. Liability 7301 Rivers Avenue, Suite 100 North Charleston, SC 29406-4650 Amedisys SC, L.L.C. **Certified For:**	5
Amedysis Home Health of West Columbia 172 McSwain Drive, Suite B-1 West Columbia, SC 29169-4804 Ms. Debbie Elliott PH #: 803-750-7323 **Counties Served:** Calhoun, Edgefield, Lee, Lexington, Newberry, Orangeburg, Richland, Sumter	HHA-190 / Expires: 1/31/2007 Lexington / Ltd. Liability 172 McSwain Drive, Suite B-1 West Columbia, SC 29169-4804 Amedisys SC, L.L.C. **Certified For:**	8
Beaufort-Jasper Home Health Agency 721 Okatie Highway Ridgeland, SC 29936 Mrs. Bessie Washington PH #: 843-987-7400 **Counties Served:** Beaufort, Jasper	HHA-017 / Expires: 8/31/2007 Jasper / Non-Profit Post Office Box 357 Ridgeland, SC 29936 Beaufort-Jasper-Hampton Comprehensive Health Services, Inc **Certified For:**	2

Name of Agency Location Street Location City, State Administrator		License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Bethea Home Health 157 Home Avenue Darlington, SC 29532 Ms. Chrystal Hayes	PH #: 843-393-2867	HHA-143 / Expires: 7/31/2007 Darlington / Non-Profit P. O. Drawer 4000 Darlington, SC 29532 South Carolina Baptist Ministries for the Aging, Inc. **Certified For:**	0
Counties Served: **Serving Bethea Baptist Home Residents Only.**			
CarePro Home Health 1101 Elmwood Avenue, Suite G Columbia, SC 29201 Ms. Valerie Aiken	PH #: 803-758-4000	HHA-152 / Expires: 10/31/2007 Richland / Corporation PO Box 1786 Columbia, SC 29202 Advantage Health Systems, Inc. **Certified For:**	2
Counties Served: Richland, Sumter			
Caring Neighbors Home Health 102 US Highway 321 Bypass North Winnsboro, SC 29180 Ms. Suzette Taylor	PH #: 803-635-4210	HHA-132 / Expires: 6/30/2007 Fairfield / County PO Box 620 Winnsboro, SC 29180 Fairfield Memorial Hospital Board of Trustees **Certified For:**	1
Counties Served: Fairfield			
Carolina Home Health Care 810 Dutch Square Blvd., Ste. 206 Columbia, SC 29210 Ms. Rebecca Aaron	PH #: 803-791-3704	HHA-154 / Expires: 11/30/2007 Richland / Corporation 810 Dutch Square Blvd., Ste. 206 Columbia, SC 29210 Capital CareResources of South Carolina, Inc. **Certified For:**	2
Counties Served: Lexington, Richland			
Carolina Home Health Care - Greenville 430 Roper Mountain Road, # E-1 Greenville, SC 29615-4236 Mrs. Jane Garrett	PH #: 864-277-9505	HHA-158 / Expires: 1/31/2007 Greenville / Corporation 600 East Washington Street, Suite 618 Greenville, SC 29601 Capital CareResources of South Carolina, Inc. **Certified For:**	8
Counties Served: Anderson, Cherokee, Greenville, Laurens, Oconee, Pickens, Spartanburg, Union **Note: Union County is restricted to the acceptance of patients whose initial diagnosis requires intravenous therapy and/or uterine activity monitoring.**			

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Chesterfield Visiting Nurses Service, Inc. 918 Chesterfield Highway Cheraw, SC 29520 Ms. Judy Oliver PH #: 843-537-3020 **Counties Served:** Chesterfield, Darlington, Marlboro	HHA-065 / Expires: 8/31/2007 Chesterfield / Corporation P.O. Box 813 Cheraw, SC 29520 Chesterfield Visiting Nurses Service, Inc. **Certified For:**	3
Clarendon Memorial Home Health 409 South Mill Street Manning, SC 29102 Ms. Rebecca Cartwright PH #: 803-435-4494 **Counties Served:** Clarendon	HHA-141 / Expires: 1/31/2007 Clarendon / Non-Profit 409 South Mill Street Manning, SC 29102 Clarendon Hospital District **Certified For:**	1
Clemson Area Retirement Center Home Health Agency 500 Downs Loop Clemson, SC 29631 Ms. Susan Davis PH #: 864-654-1155 **Counties Served:** **Serving Clemson Area Retirement Center Residents Only.**	HHA-153 / Expires: 11/30/2007 Pickens / Corporation 500 Downs Loop Clemson, SC 29631 CARC, Inc. **Certified For:**	1
Cypress Club Home Health Agency, The 20 Lady Slipper Lane Hilton Head Island, SC 29926 Ms. Ann Harrison PH #: 843-689-7000 **Counties Served:** **Serving Cypress Club Residents Only.**	HHA-146 / Expires: 7/31/2007 Beaufort / Corporation 20 Lady Slipper Lane Hilton Head Island, SC 29926 The Cypress Club, Inc. **Certified For:**	0
DHEC Region 1 Home Health Services-North 220 McGee Road Anderson, SC 29625 Ms. Mary Ellenburg PH #: 864-260-5617 **Counties Served:** Anderson, Oconee	HHA-001 / Expires: 9/30/2007 Anderson / State 220 McGee Road Anderson, SC 29625 South Carolina Department of Health & Environmental Control **Certified For:**	2

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
DHEC Region 1 Home Health Services-South 1736 South Main Street Greenwood, SC 29646 Ms. Susie Madden PH #: 864-942-3600	HHA-012 / Expires: 4/30/2007 Greenwood / State 1736 South Main Street Greenwood, SC 29646 South Carolina Department of Health & Environmental Control **Certified For:**	6
Counties Served: Abbeville, Edgefield, Greenwood, Laurens, McCormick, Saluda		
DHEC Region 2 Home Health Services-East 151 East Wood Street Spartanburg, SC 29305-4217 Ms. Phyllis Boyles PH #: 864-596-3322	HHA-003 / Expires: 1/31/2007 Spartanburg / State P.O. Box 4217 Spartanburg, SC 29305-4217 South Carolina Department of Health & Environmental Control **Certified For:**	3
Counties Served: Cherokee, Spartanburg, Union		
DHEC Region 2 Home Health Services-West Pickens County Health Dept., 509 South Lewis Street Pickens, SC 29671 Ms. Sally Stone PH #: 864-282-4367	HHA-002 / Expires: 5/31/2007 Pickens / State P. O. Box 2507 Greenville, SC 29602 South Carolina Department of Health & Environmental Control **Certified For:**	2
Counties Served: Greenville, Pickens		
DHEC Region 3 Home Health Services 1136 Kincaid Bridge Road Winnsboro, SC 29180 Ms. Dee Mattox PH #: 803-276-5818	HHA-040 / Expires: 9/30/2007 Fairfield / State P. O. Box 270 Winnsboro, SC 29180 South Carolina Department of Health & Environmental Control **Certified For:**	7
Counties Served: Fairfield, Lexington, Newberry, Richland, Lancaster, York, Chester		
DHEC Region 4 Home Health Services-East 1705 West Evans Street, Florence Annex Florence, SC 29501 Ms. Linda Vann PH #: 843-661-4762	HHA-009 / Expires: 9/30/2007 Florence / State 1705 West Evans Street, Florence Annex Aiken, SC 29501 South Carolina Department of Health & Environmental Control **Certified For:**	6
Counties Served: Chesterfield, Darlington, Dillon, Florence, Marion, Marlboro		
DHEC Region 4 Home Health Services-West 105 North Magnolia Street Sumter, SC 29150 Ms. Janet Caputo PH #: 803-773-5511	HHA-014 / Expires: 1/31/2007 Sumter / State P.O. Box 1628 Sumter, SC 29151-1628 South Carolina Department of Health & Environmental Control Certified For:	4
Counties Served: Clarendon, Kershaw, Lee, Sumter		

SOUTH CAROLINA DEPARTMENT OF HEALTH & ENVIRONMENTAL CONTROL **December 1, 2006**

Home Health Agencies

DHEC Regulation 61-77

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
DHEC Region 5 Home Health Services Orangeburg County Health Department, 1550 Carolina Avenue Orangeburg, SC 29115 Ms. Brenda McLellan PH #: 803-536-9117 **Counties Served:** Aiken, Allendale, Bamberg, Barnwell, Orangeburg, Calhoun **Located in the Orangeburg County Health Department effective 11-16-06.**	HHA-008 / Expires: 10/31/2007 Orangeburg / State P. O. Box 1126 Orangeburg, SC 29116 South Carolina Department of Health & Environmental Control **Certified For:**	6
DHEC Region 6 Home Health Services 2830 Oak Street Conway, SC 29526 Ms. Candra Johnson PH #: 843-365-3126 **Counties Served:** Georgetown, Horry, Williamsburg	HHA-013 / Expires: 6/30/2007 Horry / State 2830 Oak Street Conway, SC 29526 South Carolina Department of Health & Environmental Control **Certified For:**	3
DHEC Region 7 Home Health Services 1941 Savage Road, Suite 300 E Charleston, SC 29407 Ms. Cansas Deitz PH #: 843-724-5850 **Counties Served:** Berkeley, Charleston, Dorchester	HHA-011 / Expires: 7/31/2007 Charleston / State 1941 Savage Road, Suite 300 E Charleston, SC 29407 South Carolina Department of Health & Environmental Control **Certified For:**	3
DHEC Region 8 Home Health Services 1000 Pine Street Varnville, SC 29944 Ms. Judith Rockwell PH #: 803-943-4649 **Counties Served:** Colleton, Hampton	HHA-006 / Expires: 11/30/2007 Hampton / State P. O. Box 933 Varnville, SC 29944 South Carolina Department of Health & Environmental Control **Certified For:**	2
Florence Visiting Nurses Service, Inc. 1605C West Palmetto Street Florence, SC 29502 Ms. Linda Stephenson PH #: 843-667-1515 **Counties Served:** Dillon, Florence, Lee, Marion	HHA-064 / Expires: 1/31/2007 Florence / Corporation P.O. Box 4598 Florence, SC 29502 Florence Visiting Nurses Services, Inc. **Certified For:**	4

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Franklin C. Fetter Home Health Agency 51 Nassau Street Charleston, SC 29403 Ms. Sylvia Barnes-Gailliard PH #: 843-722-4112 **Counties Served:** Charleston	HHA-018 / Expires: 12/31/2006 Charleston / Non-Profit 51 Nassau Street Charleston, SC 29403 Franklin C. Fetter Family Health Center, Inc. **Certified For:**	1
Greenville Hospital System Home Health Agency 255 Enterprise Boulevard, Suite 120 Greenville, SC 29615 Ms. Landace Woods PH #: 864-454-8046 **Counties Served:** Greenville, Pickens	HHA-020 / Expires: 6/30/2007 Greenville / District 701 Grove Road, 3rd Floor- ISC Greenville, SC 29605-5601 Greenville Hospital System **Certified For:**	2
Health Related Home Care 105 Court Square Abbeville, SC 29620 Ms. Sharon Gorryce PH #: 864-366-9151 **Counties Served:** Abbeville, Greenwood, Laurens, McCormick, Saluda	HHA-116 / Expires: 12/31/2006 Abbeville / County 105 Court Square Abbeville, SC 29620 Abbeville County Memorial Hospital **Certified For:**	5
Home Care of HospiceCare of the Piedmont 408 West Alexander Avenue, Greenwood Medical Center Greenwood, SC 29646 Ms. Nancy Corley PH #: 864-227-9393 **Counties Served:** Abbeville, Greenwood, Laurens, McCormick, Saluda **Note: Restricted to terminally ill patients only.**	HHA-134 / Expires: 9/30/2007 Greenwood / Non-Profit 408 West Alexander Avenue Greenwood, SC 29646 Hospice Care of the Piedmont, Inc. **Certified For:**	5
Home Care of Lancaster 902 West Meeting Street, Suite A Lancaster, SC 29720 Ms. Stephanie Gardner PH #: 803-286-1472 **Counties Served:** Lancaster	HHA-050 / Expires: 5/31/2007 Lancaster / Corporation 902 West Meeting Street, Suite A Lancaster, SC 29720 Lancaster Hospital Corporation **Certified For:**	1

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Home Health Services of Carolinas Hospital System 121 East Cedar Street Florence, SC 29501 Mr. Ronnie Welch PH #: 843-629-6801 **Counties Served:** Darlington, Dillon, Florence, Marlboro, Williamsburg	HHA-109 / Expires: 3/31/2007 Florence / Corporation PO Box 100550 Florence, SC 29501 QHG of South Carolina, Inc. **Certified For:**	4
Home Health Services of Self Regional Healthcare 1123 Spring Street Greenwood, SC 29646 Ms. Linda Russell PH #: 864-330-7600 **Counties Served:** Abbeville, Greenwood, Laurens, McCormick, Saluda	HHA-049 / Expires: 1/31/2007 Greenwood / Non-Profit 1325 Spring Street Greenwood, SC 29646 Self Memorial Hospital, Inc. **Certified For:**	5
Home Health of South Carolina, Inc. 1668 Herlong Court Rock Hill, SC 29732 Ms. Linda Cantu PH #: 803- **Counties Served:** York	HHA-099 / Expires: 6/30/2007 York / Corporation P. O. Box 5599 Florence, SC 29502-5599 Home Health of South Carolina, Inc. **Certified For:**	1
Home Health of South Carolina, Inc.- Lowcountry 112-C West Doty Avenue Summerville, SC 29484 Ms. Linda Cantu PH #: 843-851-0999 **Counties Served:** Berkeley, Dorchester	HHA-138 / Expires: 1/31/2007 Dorchester / Corporation Post Office Box 5599 Florence, SC 29502-5599 Home Health of South Carolina, Inc. **Certified For:**	2
Home Health of South Carolina, Inc.-Midlands 2858 Sunset Boulevard West Columbia, SC 29169 Ms. Linda Cantu PH #: 803-939-0266 **Counties Served:** Lexington, Richland	HHA-151 / Expires: 7/31/2007 Lexington / Corporation P. O. Box 5599 Florence, SC 29502-5599 Home Health of South Carolina, Inc. **Certified For:**	2
HomeCare of the Regional Medical Center 1895 St. Matthews Road Orangeburg, SC 29118 Ms. Ann Marie Poon PH #: 803-533-2600 **Counties Served:** Calhoun, Orangeburg	HHA-122 / Expires: 1/31/2007 Orangeburg / Non-Profit P.O. Box 2352 Orangeburg, SC 29116-2352 Regional Medical Center of Orangeburg & Calhoun Counties **Certified For:**	2

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Hospice Care of the Lowcountry Home Health 119 Palmetto Way Bluffton, SC 29910 Mr. Rick Smith PH #: 843-681-7814 **Counties Served:** Beaufort, Jasper **Note: Restricted to terminally ill only**	HHA-117 / Expires: 9/30/2007 Beaufort / Non-Profit P. O. Box 3827 Bluffton, SC 29910-3827 Hospice Care of the Lowcountry, Inc. **Certified For:**	2
Hospice of Charleston Home Health Agency 3870 Leeds Avenue, Suite 101 North Charleston, SC 29405 Ms. Catherine Cosgrove PH #: 843-529-3100 **Counties Served:** Berkeley, Charleston, Dorchester	HHA-051 / Expires: 12/31/2006 Charleston / Non-Profit 3870 Leeds Avenue, Suite 101 North Charleston, SC 29405 Hospice of Charleston, Inc. **Certified For:**	3
InCare Home Health, Inc. 4685 Highway 17 South Bypass Myrtle Beach, SC 29577 Mr. Robert Lippert PH #: 843-293-4614 **Counties Served:** Georgetown, Horry	HHA-039 / Expires: 2/28/2007 Horry / Corporation 4685 Highway 17 South Bypass Myrtle Beach, SC 29577 Incare Home Health, Inc. **Certified For:**	2
Interim HealthCare of Greenville, Inc. 16 Hyland Road Greenville, SC 29615 Mr. Raymond Schroeder PH #: 864-627-1200 **Counties Served:** Anderson, Cherokee, Greenville, Oconee, Pickens, Spartanburg	HHA-057 / Expires: 6/30/2007 Greenville / Corporation PO Box 12243 Greenville, SC 29612-2243 Interim HealthCare of Greenville, Inc. **Certified For:**	6
Interim Healthcare of Rock Hill 154 Amendment Avenue, Suite 106 Rock Hill, SC 29732 Ms. Margaret Webb PH #: 803-324-4166 **Counties Served:** York	HHA-169 / Expires: 11/30/2007 York / Corporation 2526 Ward Boulevard Wilson, NC 27893 Interim Healthcare of the Triad, Inc. **Certified For:**	1

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Intrepid USA Healthcare Services 2170 Ashley Phosphate Road, Suite 501 North Charleston, SC 29406 Mr. Brooks Ruple PH #: 843-766-2929 **Counties Served:** Allendale, Berkeley, Charleston, Colleton, Dorchester, Georgetown	HHA-180 / Expires: 6/30/2007 Charleston / Corporation 2170 Ashley Phosphate Road, Suite 501 North Charleston, SC 29406 F. C. of South Carolina, Inc. **Certified For:**	6
Island Health Care, Inc. 58 Shelter Cove Lane, Suite C Hilton Head Island, SC 29928 Mrs. Lynda Laff PH #: 843-681-7035 **Counties Served:** Beaufort	HHA-111 / Expires: 2/28/2007 Beaufort / Corporation Post Office Box 8011 Savannah, GA 31412-8011 Island Health Care, Inc. **Certified For:**	1
Kershaw County Medical Center Home Health 2001 West Dekalb Street Camden, SC 29020 Mr. Thoyd Warren PH #: 803-425-1182 **Counties Served:** Kershaw	HHA-080 / Expires: 7/31/2007 Kershaw / Church 2001 West Dekalb Street Camden, SC 29020 Kershaw County Medical Center **Certified For:**	1
Liberty Home Care - Myrtle Beach 2035 Glenns Bay Road, Suite 102 Surfside Beach, SC 29575 Ms Carolyn Radecke PH #: 843-215-4140 **Counties Served:** Horry	HHA-163 / Expires: 12/31/2006 Horry / Ltd. Liability 2035 Glenns Bay Road, Suite 102 Surfside Beach, SC 29575-8613 Liberty Home Care, LLC **Certified For:**	1
Liberty Home Care-Bennettsville 603-G Broad Street, Suite G Bennettsville, SC 29512 Ms. Alexis Faison PH #: 843-479-9711 **Counties Served:** Marlboro	HHA-159 / Expires: 12/31/2006 Marlboro / Ltd. Liability 603-G Broad Street, Suite G Bennettsville, SC 29512 Liberty Home Care, LLC **Certified For:**	1

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Matria Women's and Children's Health, LLC-Midlands 100 Executive Center Drive, Suite 111A Columbia, SC 29210 Ms. Lynne Flood PH #: 803-750-0022	HHA-130 / Expires: 3/31/2007 Richland / Corporation 1850 Parkway Place Marietta, GA 30067 Matria Women's and Children's Health, Inc. **Certified For:**	13

Counties Served:
Aiken, Beaufort, Berkeley, Charleston, Colleton, Dorchester, Fairfield, Georgetown, Kershaw, Lancaster, Lexington, Richland, Newberry, Newberry
Note: Restricted to obstetric patient only.

Matria Women's and Children's Health, LLC-Piedmont 25 Woods Lake Road, Suite 329 Greenville, SC 29601 Ms. Lynne Flood PH #: 864-233-5537	HHA-128 / Expires: 3/31/2007 Greenville / Corporation 1850 Parkway Place Marietta, GA 30067 Matria Women's and Children's Health, Inc. **Certified For:**	33

Counties Served:
Abbeville, Allendale, Bamberg, Barnwell, Calhoun, Cherokee, Chester, Chesterfield, Clarendon, Darlington, Dillon, Edgefield, Florence, Greenville, Greenwood, Hampton, Horry, Jasper, Laurens, Lee, Marion, Marlboro, McCormick, Oconee, Orangeburg, Pickens, Saluda, Spartanburg, Sumter, Union, Williamsburg, York, Abbeville, Anderson, Anderson
Note: Restricted to obstetric patients only.

McLeod Home Health 300 South Dargan Street Florence, SC 29506 Ms. Lynn Brown-Bulloch PH #: 843-669-3050	HHA-085 / Expires: 5/31/2007 Florence / Corporation 300 South Dargan Street Florence, SC 29506 McLeod Regional Medical Center of the Pee Dee, Inc. **Certified For:**	5

Counties Served:
Darlington, Dillon, Florence, Lee, Marion

Memorial Care One Home Health Services, Inc. 23 Plantation Park Drive, Suite 503 Bluffton, SC 29910 Ms. Jodi Grubb PH #: 843-815-8088	HHA-123 / Expires: 12/31/2006 Beaufort / Corporation 23 Plantation Park Drive, Suite 503 Bluffton, SC 29910 Memorial CareOne Home Health Services, Inc. **Certified For:**	3

Counties Served:
Beaufort, Hampton, Jasper

NHC HomeCare - Aiken 30 Physician Drive Aiken, SC 29801 Ms. Donna Berry PH #: 803-643-1701	HHA-181 / Expires: 6/30/2007 Aiken / Limited Partner Post Office Box 3636 Aiken, SC 29802-3636 NHC/OP, LP **Certified For:**	1

Counties Served:
Aiken

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
NHC HomeCare - Greenwood 615 South Main Street Greenwood, SC 29646 Ms. Julie Coates PH #: 864-229-9888 **Counties Served:** Greenwood	HHA-182 / Expires: 6/30/2007 Greenwood / Limited Partner 615 South Main Street Greenwood, SC 29646 NHC/OP, LP **Certified For:**	1
NHC HomeCare - Laurens 700 Plaza Circle, Suite O Clinton, SC 29325 Ms. Jenny Mitchell PH #: 864-833-2368 **Counties Served:** Greenville, Laurens	HHA-183 / Expires: 6/30/2007 Laurens / Limited Partner PO Box 309 Laurens, SC 29360 NHC/OP, LP **Certified For:**	2
Neighbors Care Home Health Agency 173 Columbia Street Chester, SC 29706 Ms. Laura Peacock PH #: 803-581-9416 **Counties Served:** Chester	HHA-184 / Expires: 10/31/2007 Chester / Corporation One Medical Park Drive Chester, SC 29706 Chester HMA, Inc. **Certified For:**	1
OMH Home Health 206 West North 1st Street Seneca, SC 29678 Mr. R.Craig McCoy PH #: 864-888-8411 **Counties Served:** Anderson, Oconee, Pickens	HHA-164 / Expires: 7/31/2007 Oconee / Corporation 206 West North 1st Street Seneca, SC 29678 Oconee Memorial Hospital , Inc. **Certified For:**	3
PHC Home Health 1923-D Maybank Highway Charleston, SC 29412 Mr. Hugh Durrence PH #: 843-762-3601 **Counties Served:** Charleston	HHA-084 / Expires: 4/30/2007 Charleston / Corporation 1923-D Maybank Highway Charleston, SC 29412 Hedgemark Brentwood Medical Services, Inc. **Certified For:**	1

SOUTH CAROLINA DEPARTMENT OF HEALTH & ENVIRONMENTAL CONTROL — **December 1, 2006**

Home Health Agencies

DHEC Regulation 61-77

Name of Agency Location Street Location City, State *Administrator*	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Palmetto Health HomeCare 1400 Pickens Street Columbia, SC 29201 Ms. Helen "Holly" Knight PH #: 803-401-3100	HHA-148 / Expires: 2/28/2007 Richland / Non-Profit P.O. Box 7275 Columbia, SC 29202 Palmetto Health Alliance **Certified For:**	3
Counties Served: Bamberg, Lexington, Richland **Note: Bamberg County serving terminally ill only.**		
Roper - St. Francis Home Health Care 1483 Tobias Gadson Blvd., Sixty-One West Building, Suite 208 Charleston, SC 29407 Ms. Bonnie Mello PH #: 843-402-7000	HHA-062 / Expires: 12/31/2006 Charleston / Non-Profit 1483 Tobias Gadson Blvd., Sixty-One We Charleston, SC 29407 Roper Hospital, Inc. **Certified For:**	3
Counties Served: Berkeley, Charleston, Dorchester		
Sandpiper Home Health Services, LLC 1224 Village Creek Lane, Unit A-6 Mount Pleasant, SC 29464 Ms. Pamaella Gaye PH #: 843-884-5735	HHA-193 / Expires: 2/28/2007 Charleston / Ltd. Liability 1224 Viillage Creek Lane, Unit A-6 Mount Pleasant, SC 29464 Sandpiper Home Health Services, LLC **Certified For:**	1
Counties Served: **Note: Exclusively serving residents of Sandpiper Community only.**		
Sea Island Home Health 3627 Maybank Highway Johns Island, SC 29455 Mrs. Gwendolyn Bennett PH #: 843-559-4137	HHA-025 / Expires: 4/30/2007 Charleston / Non-Profit Post Office Box 689 Johns Island, SC 29457 Sea Island Comprehensive Health Care Corporation **Certified For:**	2
Counties Served: Charleston, Colleton		
Seabrook Wellness and Home Health Care, The 300 Woodhaven Drive Hilton Head Island, SC 29928 Mrs. Phyllis Ehlers PH #: 843-842-3747	HHA-173 / Expires: 11/30/2007 Beaufort / Non-Profit 300 Woodhaven Drive Hilton Head Island, SC 29928 Seabrook of Hilton Head, Inc., The **Certified For:**	1
Counties Served: **Serving The Seabrook of Hilton Head, Inc. Continuing Care Retirement Community residents only.**		

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Spartanburg Regional Medical Center Home Health Services 120 Heywood Avenue, Suite 300 Spartanburg, SC 29302 Mr. David Church PH #: 864-560-3900 **Counties Served:** Spartanburg	HHA-038 / Expires: 9/30/2007 Spartanburg / District 120 Heywood Avenue, Suite 300 Spartanburg, SC 29302 Spartanburg Regional Healthcare System **Certified For:**	1
St. Francis Hospital Home Care 414 -A Pettigru Street Greenville, SC 29601 Mr. Jim Rogers PH #: 864-233-5300 **Counties Served:** Anderson, Greenville, Pickens, Spartanburg	HHA-167 / Expires: 12/31/2006 Greenville / Non-Profit 414-A Pettigru Street Greenville, SC 29601 St. Francis Hospital, Inc. **Certified For:**	4
St. Joseph Home Health Care Services 2803 Wrightsboro Road, Daniel Village Shopping Center Augusta, GA 30909 Ms. Debbie Keith PH #: 706-729-6000 **Counties Served:** Aiken, Barnwell, Edgefield	HHA-035 / Expires: 12/31/2006 Aiken / Non-Profit 2260 Wrightsboro Road Augusta, GA 30904 St. Joseph Hospital, Augusta, Ga., Inc. **Certified For:**	3
Total Care of North Carolina - Rock Hill 430 South Herlong, Suite 101 Rock Hill, SC 29732 Ms. Susie Davis PH #: 803-329-3184 **Counties Served:** Cherokee, Chester, Union, York	HHA-178 / Expires: 11/30/2007 York / Corporation 430 South Herlong, Suite 101 Rock Hill, SC 29732 Total Care Home Health of North Carolina, Inc. **Certified For:**	4
Total Care of South Carolina - Coastal 4101 Mayfair Street Myrtle Beach, SC 29577 Ms. Lynn Wood PH #: 843-448-7060 **Counties Served:** Georgetown, Horry, Williamsburg	HHA-179 / Expires: 11/30/2007 Horry / Corporation 4101 Mayfair Street Myrtle Beach, SC 29577 Total Care Home Health of South Carolina, Inc. **Certified For:**	3
Tri-County Home Health Care & Services, Inc. 1950 Bush River Road Columbia, SC 29210-6816 Ms. Jo Milling PH #: 803-561-7680 **Counties Served:** Lexington, Richland, Saluda, Sumter	HHA-026 / Expires: 12/31/2006 Richland / Corporation 1950 Bush River Road Columbia, SC 29210-6816 Tri-County Home Health Care & Services, Inc. **Certified For:**	4

Name of Agency Location Street Location City, State Administrator	License #/Expiration Date County / Ownership Type Mailing Address Licensee	Number of Counties Served:
Tuomey Home Health 115 North Sumter Street, Ste. 410 Sumter, SC 29150 Ms. Kimberly Price PH #: 803-774-4663 **Counties Served:** Clarendon, Lee, Sumter	HHA-175 / Expires: 2/28/2007 Sumter / Non-Profit 115 North Sumter Street, Ste. 410 Sumter, SC 29150 Tuomey **Certified For:**	3
University Home Health - North Augusta 106-B East Martintown Road North Augusta, SC 29841 Ms. Mary Harden PH #: 803-278-0770 **Counties Served:** Aiken, Edgefield	HHA-137 / Expires: 10/31/2007 Aiken / Corporation 106-B East Martintown Road North Augusta, SC 29841 University Health Services, Inc. **Certified For:**	2
VNA of Greater Bamberg, Inc. 212 Midway Street Bamberg, SC 29003 Ms. Eva Fletcher PH #: 803-245-5611 **Counties Served:** Allendale, Bamberg, Barnwell, Calhoun, Colleton, Hampton, Orangeburg	HHA-045 / Expires: 12/31/2006 Bamberg / Corporation P.O. Box 1048 Bamberg, SC 29003 VNA of Greater Bamberg, Inc. **Certified For:**	7

Total Number of Home Health Agenies: 78 — Total Number of Counties Served: **262**

SCE&G COL Application

TtNUS project 00329

TELEPHONE LOG

Date/Time of Call: August 15, 2006 10:00 am

Topic: Subsistence Living Activities in the vicinity of VCSNS

Personnel Involved in Call	Company/Organization
Monica Miller – Regional Community Development Agent for Fairfield, Kershaw, Lexington, and Richland counties	Clemson Public Service (803-238-8411)
Emily McRee	Tetra Tech NUS, Inc.

Summary of Conversation:

I asked Ms. Miller if she had any information regarding the prevalence of subsistence living in the region and whether there was a large migrant worker population. Ms. Miller stated that she was not aware of any subsistence hunting, fishing, or gardening in the area and that these activities are enjoyed for recreation with her assigned region. Ms. Miller stated that she did not believe there was a large population of migrant workers in the area, and did not think that those in the area depended on hunting, fishing, or gardening for subsistence. Ms. Miller also checked with Ms. Terrana Kahn from the Richland County Extension Service who agreed with Ms. Miller's statement. Attempts to contact Ms. Kahn personally at 803-865-1261 were unsuccessful despite leaving multiple messages.

In addition, several attempts were made (beginning on 8/10/2006) to contact Mr. Will Cullen, the Regional Community Development Agent for Laurens, Newberry, Saluda, and Union counties. Repeated messages were left, but Mr. Cullen did not return the calls.

Actions Items from Call	Responsibility

Emily H. McRee

TtNUS representative: Emily McRee

Copy to:

SCE&G COL Application

TtNUS project 00329

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Topic: Subsistence Living Activities in the vicinity of VCSNS

Personnel Involved in Call	Company/Organization
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Summary of Conversation:

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Actions Items from Call	Responsibility

Emily H. McRee

TtNUS representative: Emily McRee

Copy to:

CLEMSON
PUBLIC SERVICE

Clemson Institute...

Institute on Poverty and Deprivation

History The South Carolina Institute on Poverty and Deprivation was founded a
1984 through a joint sponsorship of the South Carolina Department of Social S
College of Social Work at the University of South Carolina. The Institute provid
analysis and legislative initiatives regarding poverty in South Carolina. Mission
community about the nature and extent of poverty in South Carolina To develo
programs to assist the poor towards greater self-sufficiency To recruit and dev
partners to address issues affecting the poor To research and analyze policy to
changes that will reduce and/or eliminate poverty in South Carolina The missic
carried out through formal and informal presentations, collaboration, public aw
private partnerships and advocacy activities. Goals The goals of the Institute a
commitment among persons in the influential sectors to work towards the elim
poverty as cited in the 'influential sectors' proposal. To minimize the negative i
reform on recipients through initiatives such as the faith-based mentoring prog
support for a living wage for every full-time employee based on the findings in
study. To increase public understanding of poverty-related issues through the
"Understanding Poverty: A Course on Poverty" being taught in several colleges
South Carolina, North Carolina and Alabama. To build the capacity of rural chu
social concerns through a faith-based consortium.

☆ = Content added in the last 14 days

Last updated on **12/28/05** (Version 0)
Created by **tdvs** on **11/22/05**

CLEMSON
PUBLIC SERVICE

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Administrative Assistant

Letitia Basket
Administrative Specialist
Letitia J. "Tish" Baskett, Administrative Specialist

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Adminstrative Assistant

Deborah Koon
Budget Manager

Mike Edwards
Computer Consultant
Information Resources Consultant for Sandhill Research and Education Center;...

Paul "Mac" Horton, Ph. D.
Director
Director of Sandhill REC Director of CICED Associate Dean Community Developme

Sandhill REC Faculty and Staff

Timothy Davis
Areawide Fire Ant Suppression Specialist
Fire Ants and Turfgrass Entomology

Austin Jenkins
Extension Specialist Natural Resources

Sherry Beasley
Grants Development Director
Sherry Beasley, Grants Director. She has a M.A. in English from University of...

Will Medlin
Intern
Natural Resouces Intern with Sandhill REC

David Wagner
Intern
About David Wagner

Nichole Bennett
Intern at Sandhill REC
Clemson Biological Sciences Major

Regional Community Development Programs

Bob Guinn
Regional Community Development Agent
Beaufort-Colleton-Hampton-Jasper Counties

Eleanor Whitesides Jones
Regional Community Development Agent
Cherokee-Chester-Lancaster-York Counties

Beth Stedman
Regional Community Development Agent
Marion and Georgetown Counties

Will Culler
Regional Community Development Agent
Laurens-Newberry-Saluda-Union Counties

Ernie Church
Regional Community Development Agent
Abbeville-Aiken-Edgefield-Greenwood-McCormick Counties

Terri Smith
Regional Community Development Agent
Allendale-Barnwell-Bamberg-Calhoun-Orangeburg Counties

Jennifer Boyles
Regional Community Development Agent
Chesterfield-Darlington-Dillon-Florence-Marlboro Counties

Monica Miller
Regional Community Development Agent
Fairfield-Kershaw-Lexington-Richland Counties

Chip Boling
Regional Community Development Agent
Berkeley-Charleston-Dorchester Counties

Lou J. Robinson
Regional Community Development Agent

Barbara Brown
Sumter County Extension
Senior Extension Agent

Richland Co. Ext: Office
Terrace Khaker
865-1261
Statewide
EPnet

Clemson Institute for Community and Economic Developmen

David Lamie
Associate Professor and Extension Specialist

William Molnar
Associate Project Director
William Molnar, AICP Associate Project Director William Molnar is an Associate...

Stanley Green
Director, Education and Professional Development

Walter Harris
Exec. Director, SC Rural Development Council

David Hughes
Professor and Extension Specialist

Ben Boozer
Program Director
Ben Boozer, Community Development Program Director. Boozer is the former dire

Bill Workman
Project Coordinator Consultant

Randy Wilson
Project Coordinator Consultant

☆ = Content added in the last 14 days

SCE&G COL Application

TtNUS project 00329

TELEPHONE LOG

Date/Time of Call: August 7, 2006 4:00 pm

Topic: Subsistence Living Activities in Newberry County

Personnel Involved in Call	Company/Organization
Sharon Morris, Billing Supervisor	Newberry County Memorial Hospital 803-405-7147
Emily McRee	Tetra Tech NUS, Inc.

Summary of Conversation:

I asked Ms. Morris if she was aware of any subsistence living in Newberry County. Ms. Morris contacted the individuals within the hospital that do charity work and deal with low-income and minority populations on a regular basis.

Ms. Morris stated that patients are not usually asked about subsistence living specifically. However, she stated that no patients have mentioned relying on fishing, hunting, or gardening for survival.

Actions Items from Call	Responsibility

Emily H. McRee

TtNUS representative: Emily McRee

Copy to:

▶ patient financial services

Learn more about NCMH services

CFO: Steve Sawyer
(803) 405-7137
Controller: Shannon Rippy
(803) 405-7136
Billing Supervisor: Sharon D. Morris
(803) 405-7147 or 405-7135
Fax: (803) 405-7196

Billing for healthcare services is complicated. We are here to help you understand your bill. If necessary, we can work with individuals within hospital guidelines to set up a payment plan or make other arrangements.

Questions concerning your bill?
If you need to discuss your bill with us, you may come by the main Newberry office of the Patient Financial Services Department at 2531 Evans St., Suite C. The entrance is at the back of the office building.

You may also call one of our Patient Account Representatives. Please call according to your last name based on the alphabetical breakdown below:

Name	Contact Person	Phone number
	Non-Gov (BCBS, Commercial, Workers Comp)	
A-Ge	S. Turner, Patient Account Rep	(803) 405-7103
Gf-N	D. Tolland, Patient Account Rep	(803) 405-7139
O-Z	S. Marshall, Patient Account Rep	(803) 405-7128
	Government (Medicare, Medicaid and Tricare)	
A-Ki	T. Price, Patient Account Rep	(803) 405-7459
Kj-Z	K. Moore, Patient Account Rep	(803) 405-7416

Bill Payment
Payment may be made in one of three ways.

- Send payment to: NCMH, PO Box 497, Newberry, SC 29108
- Pay at the main Patient Financial Services office behind the hospital at 2531 Evans St., Suite C., Newberry, SC 29108. The entrance is at the back of the office building.
- Pay by credit card by calling 405-7135

We look forward to serving you.

Contact
Please feel free to call (803) 405-7135 for general questions about your bill at NCMH.

P.O. Box 497 Newberry SC 29108
803.276.7570

McRee, Emily -- NUS

From: Pam Young [pam.young@fairfieldmemorial.com]
Sent: Thursday, August 17, 2006 2:16 PM
To: McRee, Emily -- NUS
Subject: RE: Fairfield County subsistence living

Sorry,

I don't know of anyone that depend on hunting, fishing or growing their own food. Maybe, the County's Chamber of Commerce may have this information.

My call back 3 is (803) 635-0206.

Pam Young
\

-----Original Message-----
From: McRee, Emily -- NUS [mailto:Emily.McRee@ttnus.com]
Sent: Thursday, August 10, 2006 8:48 AM
To: Pam Young
Subject: Fairfield County subsistence living

Ms. Young, I am doing research on the amount of subsistence living that typically occurs in midland counties, meaning populations that depend on hunting, fishing, or growing their own food to subsist.

Because you work in the social services department, I thought you might have an idea concerning the level of subsistence living by minority or low-income populations that occurs in Fairfield County?

Please feel free to call me, or I will be happy to give you a call to discuss further. If this is something you are not familiar with, just let me know. Thank you in advance for your time.

*New email address is Emily.McRee@ttnus.com Emily H. McRee, EIT Civil/Environmental Engineer Tetra Tech NUS, Inc.
900 Trail Ridge Road
Aiken, SC 29803
Telephone: (803) 641-4942
FAX: (803) 642-8454
Emily.McRee@ttnus.com
http://www.ttnus.com/
http://www.tetratech.com/

McRee, Emily -- NUS

From: McRee, Emily -- NUS
Sent: Thursday, August 10, 2006 8:48 AM
To: 'Pam.Young@FairfieldMemorial.com'
Subject: Fairfield County subsistence living

Ms. Young, I am doing research on the amount of subsistence living that typically occurs in midland counties, meaning populations that depend on hunting, fishing, or growing their own food to subsist.

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Civil/Environmental Engineer
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Aiken, SC 29803
Telephone: (803) 641-4942
FAX: (803) 642-8454
Emily.McRee@ttnus.com
http://www.ttnus.com/
http://www.tetratech.com/

Fairfield MEMORIAL HOSPITAL
Modern Medicine. Old-Fashioned Care.

Fairfield FAST HEALTH. Click Here for Health Information.

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Social Services

Social Services are available at Fairfield Memorial Hospital. Living Wills are also available and can be made upon request.

Additional Information
If you would like to learn more about the facilities or services at Fairfield Memorial Hospital, we would like to hear from you. Feel free to contact us with your questions and concerns.

Telephone: 803-635-0206
E-Mail: Social Services

Pam Young

(803) 635-5548

McRee, Emily -- NUS

From: McRee, Emily -- NUS
Sent: Monday, August 07, 2006 1:29 PM
To: 'khunt1@echalk.fairfield.k12.sc.us'
Subject: Fairfield County migrant population

Ms. Hunt, I am doing research on the amount of subsistence living that typically occurs in midland counties. I am also interested in the number of migrant workers that come through the area, and whether these migrant workers depend on hunting, fishing, or growing their own food to subsist.

Could you give me an idea concerning the level of subsistence living by minority or low-income populations that occurs in Fairfield County? I realize that this may be outside your area of expertise. If so, could you recommend someone within the Fairfield County school district that may have a better idea?

I would also be interested in the number of migrant workers that come to the area for work, and the level of dependency on fishing or hunting that these workers have. I imagine that you would have the most knowledge on this issue.

Please feel free to call me, or I will be happy to give you a call to discuss further. I couldn't find a phone number on the website. Thank you in advance for your time.

***New email address is Emily.McRee@ttnus.com**

Emily H. McRee, EIT
Civil/Environmental Engineer
Tetra Tech NUS, Inc.
900 Trail Ridge Road
Aiken, SC 29803
Telephone: (803) 641-4942
FAX: (803) 642-8454
Emily.McRee@ttnus.com
http://www.ttnus.com/
http://www.tetratech.com/

9/10 840 AM
left message

District Home Login Help Search

The School District of Fairfield County
Excellence Created by Example

Directory Administration & Staff Administration

Directory

Fairfield County School District Listing

Administration & Staff

District Office Departments

District Resources

District Calendar

Administration

Member Name: Go

Position: All Positions

MK

- Bettye A. Bellamy — Director Adult Education
- Cynthia Berley — Director Special Education
- Latongia Brown — Benefits Coordinator
- Chasity Hanton — Director Food Services
- Jannette L. Henry — Deputy Superintendent Human Resources and Administration
- ~~kim hunt~~ — Bilingual-Migrant Coordinator
- Jeffery E. Long — Director
- Michael Mew — Director of Technology
- Diane Mitchell — Director of Personnel
- Eddie Nelson — Director of Purchasing
- Kevin Robinson — Director Finance
- Marie Rosborough — Deputy Superintendent
- Moses Seibles — Director Maintenance
- Blair Turner — Deputy Superintendent
- Dr. Clarence Willie — Superintendent

Back to Administration & Staff

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Contact Us | User Policy

Fairfield County School District, Drawer 622, Winnsboro, SC 29180
Phone: 803-635-4607 | Fax: 803-635-6578
Locale District

4270

McRee, Emily -- NUS

From: Hugh gray [hgray@newberry.k12.sc.us]
Sent: Wednesday, August 09, 2006 8:38 AM
To: Emily -- NUS McRee
Subject: Re: Newberry County subsistence living

Follow Up Flag: Follow up
Flag Status: Red

I can give you free/reduced rates for each school. But that's about as close as I get to "subsistence living" numbers. That sounds like a question that DSS may be able to answer.

Hugh B. Gray, Jr.
Public Information Officer/Grants Coordinator School District of Newberry County
803.321.2600 (office)
803.944.0451 (cellular)

>>> "McRee, Emily -- NUS" <Emily.McRee@ttnus.com> 08/07/06 2:08 PM >>>
Mr. Gray, I am doing research on the amount of subsistence living that typically occurs in midland counties. I am also interested in the number of migrant workers that come through the area, and whether these migrant workers depend on hunting, fishing, or growing their own food to subsist.

Could you give me an idea concerning the level of subsistence living by minority or low-income populations that occurs in Newberry County? If not, could you recommend someone within the Newberry County school district that may have a better idea?

I would also be interested in the number of migrant workers that come to the area for work, and the level of dependency on fishing or hunting that these workers have (if you have personal knowledge of this information).

Please feel free to call me, or I will be happy to give you a call to discuss further. Thank you in advance for your time.

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FAX: (803) 642-8454
Emily.McRee@ttnus.com
http://www.ttnus.com/
http://www.tetratech.com/

McRee, Emily -- NUS

From: McRee, Emily -- NUS
Sent: Monday, August 07, 2006 2:08 PM
To: 'hgray@newberry.k12.sc.us'
Subject: Newberry County subsistence living

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Emily.McRee@ttnus.com
http://www.ttnus.com/
http://www.tetratech.com/

Newberry County School District

PO Box 718, Newberry, SC 29108 *Phone: 803-321-2600
*Fax: 803-321-2604

- Welcome
- School Board
- Administration
- Human Resources
- District Schools
- District Calendar
- District News
- Instructional Links
- Local Links
- Prof. Development
- Lunch Menu
- Technology/SASI
- Employee Email
- Construction Info.
- Safety Info.
- Home

Office of the Superintendent

Mr. Bennie Bennett, Superintendent
Mrs. Doretha Simpson, Administrative Assistant

Office of Human Resources

Mrs. Pamela Arrington, Director
Mrs. Jackie Boozer, Administrative, Assistant
Mrs. Nancy Alford, Benefits
Mrs. Marlene Rollins, District Receptionist

Office of Student Services

Mr. James Caldwell, Director
Mrs. Judy McGee, Administrative Assistant

Office of Instruction

Dr. Cynthia Downs, Assistant Superintendent
Mrs. Kelly Ringer, Administrative Assistant
Dr. George Suggs, Director of Middle & Secondary Education
Mrs. Jan Redden, Administrative Assistant
Mr. David Jenkins, Director of Elementary Education
Mrs. Jan Redden, Administrative Assistant
Mrs. Paula Hamm, Director of Special Education Services
Mrs. Mary Scurry, Administrative Assistant
Mrs. Cindy Hall, Director of Teacher Quality
Mrs. Marvis Floyd, Administrative Assistant
Mr. David Green, Director of Adult Education
Mrs. Linda Branham, Administrative Assistant
Mrs. Lynn Johnson, School to Work/Transition

Coordinator

Mrs. Patsy Chapman, Administrative Assistant

Mrs. Emily Crump-Saddler, Parenting Coordinator

Mrs. Patsy Chapman, Administrative Assistant

Mrs. Kim Merchant, School Nurse Coordinator

Mrs. Wendy Long, Administrative Assistant

Mrs. Vicki Mays, Instructional Technology

Mr. Hugh Gray, Public Information, Grants, and Foundation Officer

Office of District Operations

Mr. Greg Mack, Assistant Superintendent

Mrs. Mary-Helen Stuhr, Administrative Assistant

Mrs. Susan Dowd, Director of Finance

Mrs. Patsy Parks, Accounting

Mrs. Dolly Lambert, Payroll

Mrs. Vicki Bowers, Accounts Payable

Mrs. Deborah Howe, Accounting Clerk

Mr. Rufus Rogers, Director of Buildings and Grounds

Mrs. Paula Couch, Administrative Assistant

Mr. Steve Martin, Director of Technology

Mrs. Mary Marr, Administrative Assistant

Mrs. Cindy Mills, SASI

Mrs. Ann Aley, Director of Food Service

Mr. Jim Parks, Energy Education Manager

Mr. Roy Mills, Transportation Coordinator, Newberry & Mid-Carolina areas

Mr. Jason Black, Transportation, Whitmire area

TELEPHONE LOG

Date/Time of Call: August 14, 2006 11:00 am

Topic: Subsistence Living Activities in the vicinity of VCSNS

Personnel Involved in Call	Company/Organization
Jennifer Moore – Director of Food, Shelter, and Safety	United Way of the Midlands
Emily McRee	Tetra Tech NUS, Inc.

Summary of Conversation:

I asked Ms. Moore if she was knowledgeable concerning the prevalence of subsistence living in the region. Ms. Moore responded that she was not aware of populations that engage in hunting, fishing, or gardening to subsist, and described these activities as done for sport or hobby in the region.

Ms. Moore stated that most low-income families receive aid from the government or other charities within the area.

Ms. Moore also forwarded my inquiry to Denise Holland at Harvest Hope (803-254-4432). No response was received after repeated calls.

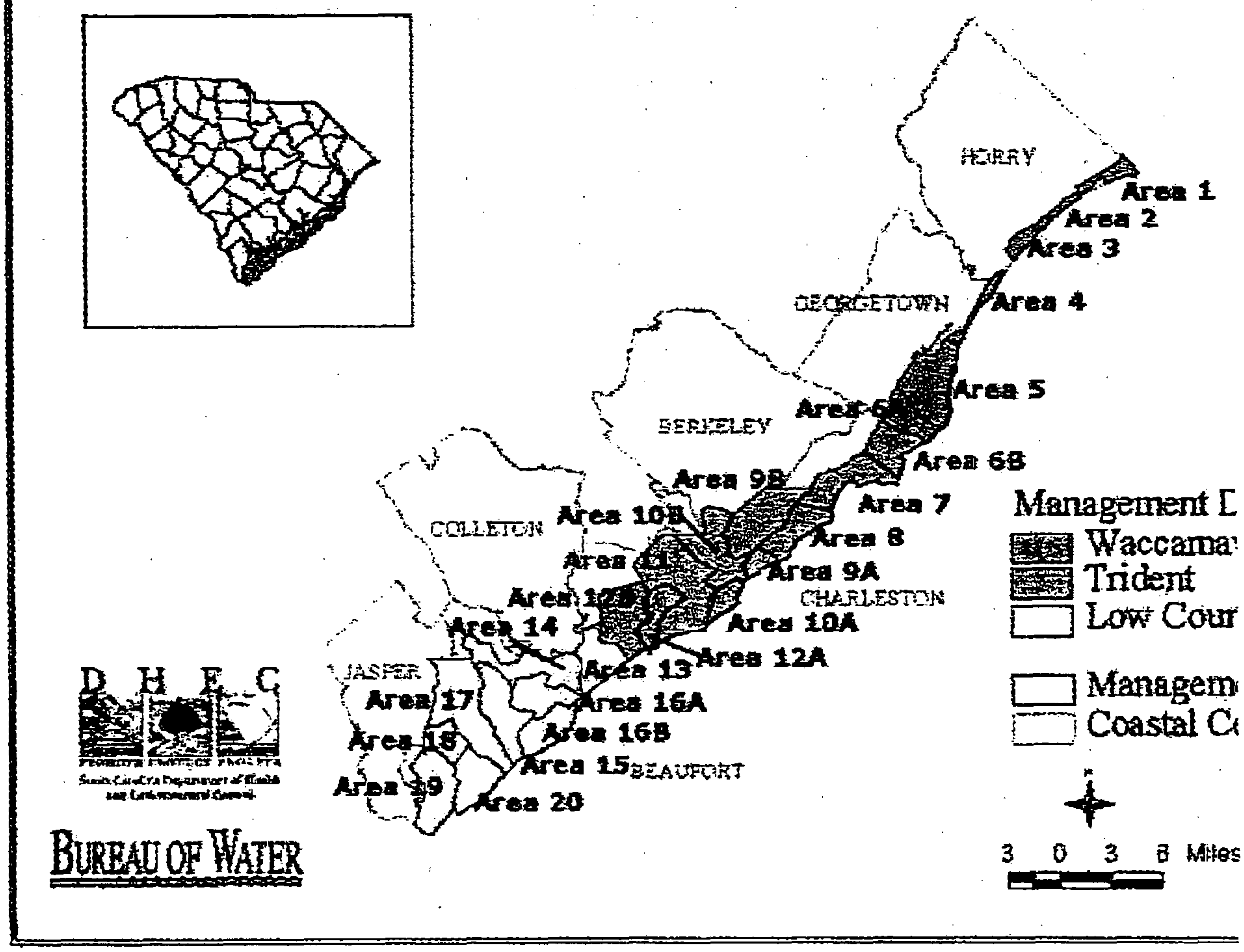
Actions Items from Call	Responsibility

Emily H. McRee

TtNUS representative: Emily McRee

Copy to:

Shellfish Management Areas



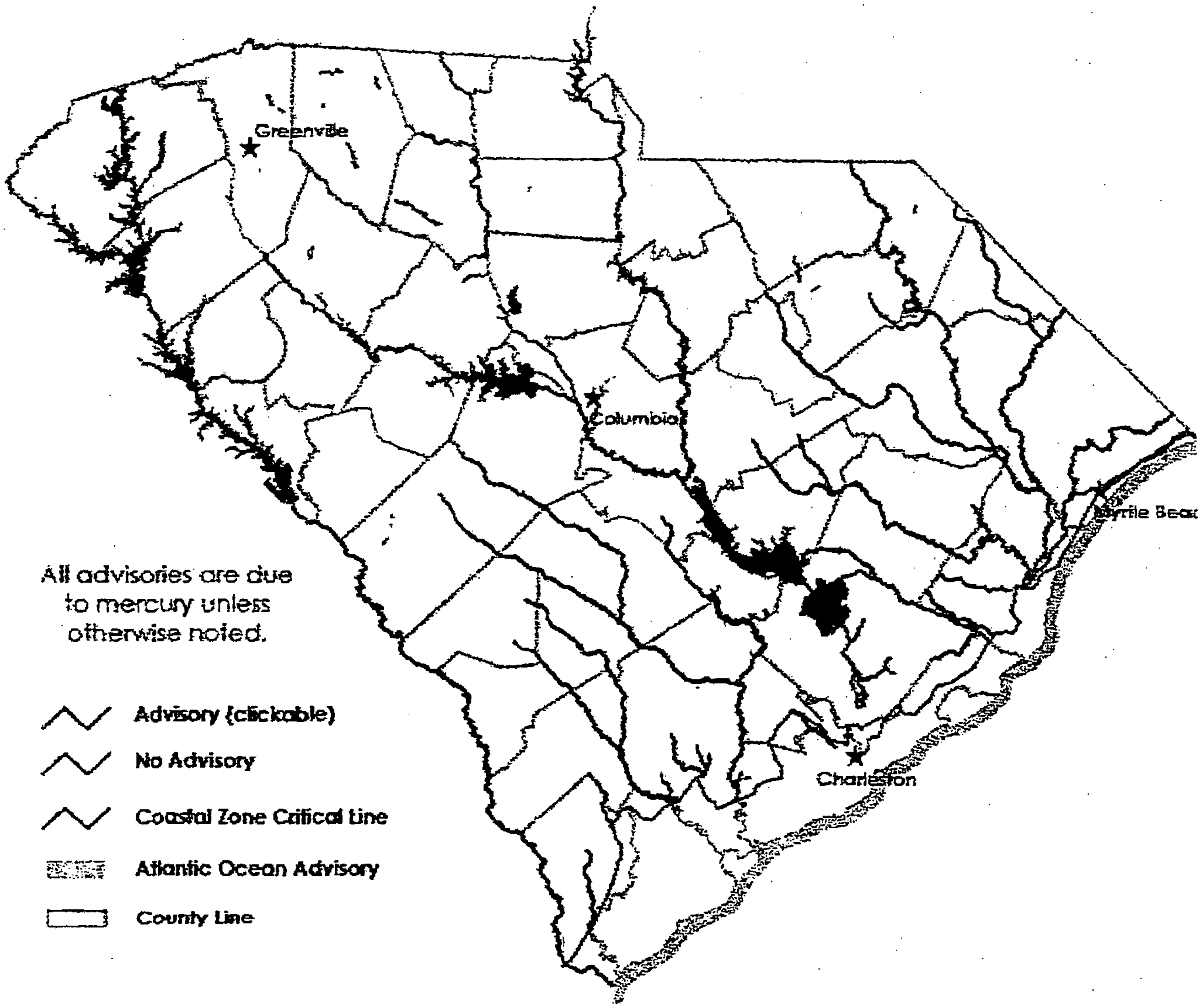
Environmental Quality Control

S.C. Department of Health and Environmental Con

Fish Smart! Eat Smart! It's for your health!

South Carolina Fish Consumption Advisories

**Roll your mouse over a red area to see the name of the waterbody.
Click to view the current advisories.**



Click here to download current advisories, tables, and maps.

Index of ALL tested waterbodies
-includes waterbodies with advisories and waterbodies with no advisories-

ACE Basin
Ashepoo River
Ashley River
Ashley River (downstream of U.S. Hwy 17)
Atlantic Ocean
Back River Reservoir
Black Creek
Black Mingo Creek
Goose Creek Reservoir
Great Pee Dee River
Horseshoe Creek
Intracoastal Waterway
Lake Blalock
Lake Bowen
Lake Conestee
Lake Cooley
Lake Cunningham
Little River
Little Salkehatchie River
Louthers Lake
Lower Wando River
Lumber River
Lynches River
Middle Tyger River
Muddy Bay
New River

Black River
Broad River
Broadway Lake
Cape Romain
Cary's Lake
Catawba River
Cedar Creek Reservoir
Charleston Harbor
Chessey Creek
Clarks Creek
Combahee River
Combahee River (downstream of U.S. Hwy. 17)
Congaree River
Cooper River
Coosawhatchie River
Diversion Canal (Santee Cooper Lakes)
Durham Creek
Edisto River
Edisto River (downstream of U.S. Hwy. 17)
Fishing Creek Reservoir
Flat Rock Pond
Four Hole Swamp
Forest Lake
Lake Greenwood
Lake H.B. Robinson
Lake Hartwell
Lake J.A. Robinson (Greenville County)
Lake J. Strom Thurmond *(Clarks Hill Lake)*
Lake Joccassee
Lake Keowee
Lake Marion
Lake Monticello
Lake Monticello Sub-Impoundment
Lake Moultrie
Lake Murray
Lake Prestwood
Lake Rabon
Lake Russell
Lake Secession
Lake Tugaloo
Lake Wallace
Lake Wateree
Lake Wylie
Lake Yonah
Langley Pond
Little Pee Dee River
North Fork Edisto River
North Santee River
North Tyger River
Parr Reservoir
Pocotaligo River
Port Royal Sound
Rediversion Canal (Santee Cooper Lakes)
Russ Creek
Salkehatchie River
Saluda River
Sampit River
Santee River
Savannah River
Sesquicentennial State Park
South Santee River
Vaucluse Pond
Waccamaw River
Wadboo Creek
Wadmacon Creek
Wambaw Creek
Wateree River
Windsor Lake
Winyah Bay

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Last updated: 01/04/2007

Water Home

Section 5.8 Ref 7

UNITED STATES DEPARTMENT OF COMMERCE
Economic and Statistics Administration
BUREAU OF ECONOMIC ANALYSIS
Washington, D.C. 20230

October 17, 2006

Scott Flickinger
900 Trail Ridge Road
Aiken, SC 29803

Dear Mr. Flickinger:

Enclosed are the RIMS II multipliers you requested for Columbia, SC Region 2. Please see attachment for region definition.

The output, earnings, and employment multipliers can be found on the enclosed CD-ROM. The multipliers are based on the Bureau of Economic Analysis' 1997 benchmark input-output accounts for the U.S. and 2003 regional accounts data. The industries in RIMS II incorporate the North American Industry Classification System. See Appendix B for a complete list of the RIMS II detailed industries. The CD-ROM also includes distribution costs tables based on the BEA's 2003 annual input-output accounts for the U.S. For more information on the contents of the CD-ROM, please see the README.TXT file.

The CD-ROM contains a JAVA-based retrieval program (RIMS II Viewer) that can be used to access the multipliers. **Due to recent changes in the Viewer, JAVA 5.0 must be installed.** If you have not previously installed this software, select the JAVA 5.0 box during the installation process. A separate JAVA folder will be installed in C:\Program Files. A Viewer icon is no longer automatically placed on the computer's desktop. You will be given the option to create a desktop icon during the installation process.

Information on the RIMS II model can found in the third edition of the RIMS II handbook, ARegional Multipliers: A User Handbook for the Regional Input-Output Modeling System.@ This handbook is located on BEA's web site, http://www.bea.gov/rims.htm.

If you have any questions, please feel free to call me at (202) 606-5343.

Sincerely,

Rebecca Bess

Rebecca Bess
Regional Economist
Regional Economic Analysis Division

SC 1774

COLUMBIA, SC REGION 2

1) Fairfield County, SC
2) Lexington County, SC
3) Newberry County, SC
4) Richland County, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
1111A0 Oilseed farming	1.6442	0.2414	10.7232	2.8076	2.1074
1111B0 Grain farming	1.6132	0.2351	10.4676	2.8052	2.1324
111200 Vegetable and melon farming	1.6699	0.3153	16.2622	2.1934	1.6659
1113A0 Fruit farming	1.7546	0.3915	26.0578	2.0779	1.4155
111335 Tree nut farming	1.7649	0.4093	27.7265	2.0068	1.3954
111400 Greenhouse and nursery production	1.5842	0.3946	17.7751	1.6620	1.5055
111910 Tobacco farming	1.0000	0.0000	0.0000	0.0000	0.0000
111920 Cotton farming	1.8324	0.3371	16.0288	2.9940	2.1839
1119A0 Sugarcane and sugar beet farming	1.0000	0.0000	0.0000	0.0000	0.0000
1119B0 All other crop farming	1.6347	0.2450	12.8186	2.7713	1.8086
112100 Cattle ranching and farming	1.8372	0.2628	11.8173	3.1366	2.3843
112300 Poultry and egg production	1.6969	0.2407	9.8620	2.8582	2.1325
112A00 Animal production, except cattle and poultry and eggs	1.7872	0.2568	10.7559	3.0646	2.3946
113A00 Forest nurseries, forest products, and timber tracts	1.7948	0.3385	12.9318	3.6204	5.1719
113300 Logging	1.8554	0.3580	11.7575	2.2452	2.5284
114100 Fishing	1.0000	0.0000	0.0000	0.0000	0.0000
114200 Hunting and trapping	1.0000	0.0000	0.0000	0.0000	0.0000
115000 Agriculture and forestry support activities	1.9120	0.6477	29.6154	1.6487	1.4591
211000 Oil and gas extraction	1.4499	0.2922	6.1091	1.7813	3.3408
212100 Coal mining	1.0000	0.0000	0.0000	0.0000	0.0000
212210 Iron ore mining	1.0000	0.0000	0.0000	0.0000	0.0000
212230 Copper, nickel, lead, and zinc mining	1.0000	0.0000	0.0000	0.0000	0.0000
2122A0 Gold, silver, and other metal ore mining	1.7037	0.4264	11.7105	1.8249	2.2960
212310 Stone mining and quarrying	1.7570	0.4529	12.1845	1.8556	2.3897
212320 Sand, gravel, clay, and refractory mining	1.7446	0.4651	12.8415	1.7801	2.1915
212390 Other nonmetallic mineral mining	1.0000	0.0000	0.0000	0.0000	0.0000
213111 Drilling oil and gas wells	1.0000	0.0000	0.0000	0.0000	0.0000
213112 Support activities for oil and gas operations	1.0000	0.0000	0.0000	0.0000	0.0000
21311A Support activities for other mining	1.0000	0.0000	0.0000	0.0000	0.0000
2211A0 Power generation and supply	1.5144	0.3284	7.7931	1.8219	3.1255
221200 Natural gas distribution	1.3449	0.2210	5.5004	1.7893	2.6698
221300 Water, sewage and other systems	1.8191	0.4713	14.3302	2.0160	2.4043
230000 Construction	2.1207	0.6451	21.6584	1.9258	2.0452
311111 Dog and cat food manufacturing	1.5306	0.2239	6.2024	2.5695	3.7585
311119 Other animal food manufacturing	1.6471	0.2481	7.1084	2.8476	3.9724
311211 Flour milling	1.7830	0.2853	8.6530	3.2743	4.1707
311212 Rice milling	1.0000	0.0000	0.0000	0.0000	0.0000
311213 Malt manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311221 Wet corn milling	1.0000	0.0000	0.0000	0.0000	0.0000
311222 Soybean processing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
311223 Other oilseed processing	1.0000	0.0000	0.0000	0.0000	0.0000
311225 Fats and oils refining and blending	1.0000	0.0000	0.0000	0.0000	0.0000
311230 Breakfast cereal manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311310 Sugar manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311320 Confectionery manufacturing from cacao beans	1.0000	0.0000	0.0000	0.0000	0.0000
311330 Confectionery manufacturing from purchased chocolate	1.5613	0.2554	10.9077	2.4819	1.8635
311340 Nonchocolate confectionery manufacturing	1.6120	0.2981	10.5224	2.2535	2.0724
311410 Frozen food manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311420 Fruit and vegetable canning and drying	1.0000	0.0000	0.0000	0.0000	0.0000
311511 Fluid milk manufacturing	1.7388	0.2459	8.0203	2.7911	3.4982
311512 Creamery butter manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311513 Cheese manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311514 Dry, condensed, and evaporated dairy products	1.0000	0.0000	0.0000	0.0000	0.0000
311520 Ice cream and frozen dessert manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311611 Animal, except poultry, slaughtering	1.7492	0.2347	8.6804	2.6939	2.8786
311612 Meat processed from carcasses	1.7562	0.2725	8.7225	2.8454	3.1968
311613 Rendering and meat byproduct processing	1.0000	0.0000	0.0000	0.0000	0.0000
311615 Poultry processing	2.5176	0.4004	15.4580	3.4104	3.1112
311700 Seafood product preparation and packaging	1.0000	0.0000	0.0000	0.0000	0.0000
31181A Bread and bakery product, except frozen, manufacturing	1.7102	0.4089	13.3521	1.8339	1.9234
311813 Frozen cakes and other pastries manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311821 Cookie and cracker manufacturing	1.6354	0.3047	8.6732	2.2170	2.7236
311822 Mixes and dough made from purchased flour	1.0000	0.0000	0.0000	0.0000	0.0000
311823 Dry pasta manufacturing	1.7687	0.2790	8.0321	3.0195	3.8542
311830 Tortilla manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311911 Roasted nuts and peanut butter manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311919 Other snack food manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311920 Coffee and tea manufacturing	2.0243	0.3595	12.1229	4.1256	3.5659
311930 Flavoring syrup and concentrate manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311941 Mayonnaise, dressing, and sauce manufacturing	1.6507	0.2473	7.2165	2.8383	3.5194
311942 Spice and extract manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311990 All other food manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
312110 Soft drink and ice manufacturing	1.6237	0.2606	7.0377	2.5783	3.7487
312120 Breweries	1.0000	0.0000	0.0000	0.0000	0.0000
312130 Wineries	1.0000	0.0000	0.0000	0.0000	0.0000
312140 Distilleries	1.0000	0.0000	0.0000	0.0000	0.0000
312210 Tobacco stemming and redrying	1.0000	0.0000	0.0000	0.0000	0.0000
312221 Cigarette manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
312229 Other tobacco product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
313100 Fiber, yarn, and thread mills	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
313210 Broadwoven fabric mills	1.8796	0.3761	11.7619	2.3772	2.6284
313220 Narrow fabric mills and schiffli embroidery	1.8670	0.4569	16.1426	1.9908	1.8846
313230 Nonwoven fabric mills	1.8669	0.3376	9.7839	2.5622	3.0238
313240 Knit fabric mills	1.0000	0.0000	0.0000	0.0000	0.0000
313310 Textile and fabric finishing mills	1.8872	0.3514	11.4568	2.6410	2.6765
313320 Fabric coating mills	1.0000	0.0000	0.0000	0.0000	0.0000
314110 Carpet and rug mills	1.7473	0.2801	8.5996	2.7377	2.8714
314120 Curtain and linen mills	1.8120	0.3448	11.9859	2.3913	2.2549
314910 Textile bag and canvas mills	1.8418	0.4565	17.8091	1.9224	1.7363
314992 Tire cord and tire fabric mills	2.0041	0.3571	10.4524	2.8413	3.0821
31499A Other miscellaneous textile product mills	1.7909	0.4040	13.3798	2.0445	2.0885
315111 Sheer hosiery mills	1.0000	0.0000	0.0000	0.0000	0.0000
315119 Other hosiery and sock mills	1.7488	0.4148	15.2948	1.9318	1.8356
315190 Other apparel knitting mills	1.0000	0.0000	0.0000	0.0000	0.0000
315200 Cut and sew apparel manufacturing	1.7804	0.3731	13.4119	2.1594	2.0619
315900 Accessories and other apparel manufacturing	1.8742	0.4483	14.8310	2.0437	2.1349
316100 Leather and hide tanning and finishing	1.0000	0.0000	0.0000	0.0000	0.0000
316200 Footwear manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
316900 Other leather product manufacturing	1.6217	0.3773	15.1247	1.8165	1.6245
321113 Sawmills	2.3329	0.4158	13.4954	3.3910	3.7571
321114 Wood preservation	2.4306	0.4029	13.2039	4.4361	4.3675
32121A Veneer and plywood manufacturing	2.3369	0.4627	14.7427	2.9156	3.2449
32121B Engineered wood member and truss manufacturing	2.1322	0.4507	15.7621	2.4415	2.3470
321219 Reconstituted wood product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
321911 Wood windows and door manufacturing	2.0279	0.4435	14.4530	2.3447	2.4704
321912 Cut stock, resawing lumber, and planing	2.3091	0.4367	16.6640	3.0396	2.4164
321918 Other millwork, including flooring	2.2767	0.4780	15.6782	2.6371	2.7447
321920 Wood container and pallet manufacturing	2.2664	0.4954	19.8696	2.4447	2.0026
321991 Manufactured home, mobile home, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
321992 Prefabricated wood building manufacturing	2.1157	0.4546	16.0290	2.4952	2.3673
321999 Miscellaneous wood product manufacturing	2.1322	0.4997	19.2831	2.2468	1.9654
322110 Pulp mills	1.0000	0.0000	0.0000	0.0000	0.0000
3221A0 Paper and paperboard mills	1.8438	0.3190	8.3683	2.8582	5.1111
322210 Paperboard container manufacturing	2.1455	0.3983	10.3771	2.7372	3.9098
32222A Coated and laminated paper and packaging materials	1.9523	0.3321	8.9500	3.0618	4.4288
32222B Coated and uncoated paper bag manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322225 Flexible packaging foil manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322226 Surface-coated paperboard manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322231 Die-cut paper office supplies manufacturing	2.1525	0.4021	12.4858	2.9788	2.9002
322232 Envelope manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
322233 Stationery and related product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322291 Sanitary paper product manufacturing	1.7633	0.2648	7.0006	3.1768	5.2694
322299 All other converted paper product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
32311A Commercial printing	2.0297	0.5111	15.7058	2.0087	2.1779
323116 Manifold business forms printing	1.9913	0.4048	11.4445	2.3616	2.8919
323117 Books printing	1.0000	0.0000	0.0000	0.0000	0.0000
323118 Blankbook and looseleaf binder manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
323121 Tradebinding and related work	1.9178	0.6148	22.8052	1.6833	1.6314
323122 Prepress services	1.8632	0.6246	16.1789	1.6315	2.1341
324110 Petroleum refineries	1.0000	0.0000	0.0000	0.0000	0.0000
324121 Asphalt paving mixture and block manufacturing	1.8292	0.3525	8.4224	2.9060	7.2564
324122 Asphalt shingle and coating materials manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
324191 Petroleum lubricating oil and grease manufacturing	1.6718	0.3655	8.4206	2.0998	3.9542
324199 All other petroleum and coal products manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325110 Petrochemical manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325120 Industrial gas manufacturing	1.6518	0.3011	7.4743	2.5353	4.1498
325130 Synthetic dye and pigment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325180 Other basic inorganic chemical manufacturing	1.7365	0.3368	8.2168	2.5341	4.6311
325190 Other basic organic chemical manufacturing	1.6526	0.2791	7.0591	2.8656	5.5076
325211 Plastics material and resin manufacturing	1.5790	0.2465	6.2812	2.7191	4.7982
325212 Synthetic rubber manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325221 Cellulosic organic fiber manufacturing	1.7608	0.3776	9.4653	2.2227	3.4511
325222 Noncellulosic organic fiber manufacturing	1.7052	0.3242	8.3283	2.5123	3.9410
325311 Nitrogenous fertilizer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325312 Phosphatic fertilizer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325314 Fertilizer, mixing only, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325320 Pesticide and other agricultural chemical manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325400 Pharmaceutical and medicine manufacturing	1.5734	0.2824	7.4495	2.3374	3.4027
325510 Paint and coating manufacturing	1.6661	0.2942	7.8314	2.4388	3.4106
325520 Adhesive manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325611 Soap and other detergent manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325612 Polish and other sanitation good manufacturing	1.6163	0.2681	7.2536	2.6445	3.7336
325613 Surface active agent manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325620 Toilet preparation manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325910 Printing ink manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325920 Explosives manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325991 Custom compounding of purchased resins	1.0000	0.0000	0.0000	0.0000	0.0000
325992 Photographic film and chemical manufacturing	1.7148	0.3399	8.3250	2.2095	3.7375
325998 Other miscellaneous chemical product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
326110 Plastics packaging materials, film and sheet	1.8774	0.3424	9.2329	2.5087	3.4095

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
326120 Plastics pipe, fittings, and profile shapes	1.9029	0.3545	10.7373	2.5228	2.7005
326130 Laminated plastics plate, sheet, and shapes	1.9804	0.4025	11.1905	2.4769	3.0946
3261A0 Foam product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
326160 Plastics bottle manufacturing	1.9241	0.3508	9.9380	2.5346	3.1430
326192 Resilient floor covering manufacturing	1.6183	0.2895	6.7110	2.2073	4.4884
32619A Plastics plumbing fixtures and all other plastics products	1.8555	0.4096	12.4605	2.0730	2.2659
326210 Tire manufacturing	1.8095	0.3740	9.7496	2.1777	3.1626
326220 Rubber and plastics hose and belting manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
326290 Other rubber product manufacturing	1.7796	0.3963	11.9949	2.0565	2.3023
327111 Vitreous china plumbing fixture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327112 Vitreous china and earthenware articles manufacturing	1.9303	0.5677	19.4043	1.8214	1.8198
327113 Porcelain electrical supply manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327121 Brick and structural clay tile manufacturing	1.8940	0.5092	14.3709	1.9160	2.3694
327122 Ceramic wall and floor tile manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
32712A Clay refractory and other structural clay products	1.0000	0.0000	0.0000	0.0000	0.0000
327125 Nonclay refractory manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327213 Glass container manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
32721A Glass and glass products, except glass containers	1.8117	0.4133	11.1472	2.0781	2.7402
327310 Cement manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327320 Ready-mix concrete manufacturing	1.8880	0.4190	11.8935	2.3528	2.9946
327331 Concrete block and brick manufacturing	1.9161	0.4791	14.0417	2.1119	2.5354
327332 Concrete pipe manufacturing	1.8173	0.4504	12.7574	1.9765	2.4682
327390 Other concrete product manufacturing	1.8935	0.5037	14.3850	1.9291	2.3293
327410 Lime manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327420 Gypsum product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327910 Abrasive product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327991 Cut stone and stone product manufacturing	2.0348	0.5720	19.3360	1.9842	1.9934
327992 Ground or treated minerals and earths manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327993 Mineral wool manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327999 Miscellaneous nonmetallic mineral products	1.7461	0.3893	10.5049	2.0557	2.7615
331111 Iron and steel mills	1.7923	0.3318	8.5222	2.6705	4.5171
331112 Ferroalloy and related product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
331210 Iron, steel pipe and tube from purchased steel	1.0000	0.0000	0.0000	0.0000	0.0000
331221 Rolled steel shape manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
331222 Steel wire drawing	1.0000	0.0000	0.0000	0.0000	0.0000
331311 Alumina refining	1.0000	0.0000	0.0000	0.0000	0.0000
331312 Primary aluminum production	1.0000	0.0000	0.0000	0.0000	0.0000
331314 Secondary smelting and alloying of aluminum	1.7397	0.2932	9.7881	3.3339	3.0735
331315 Aluminum sheet, plate, and foil manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
331316 Aluminum extruded product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
331319 Other aluminum rolling and drawing	1.0000	0.0000	0.0000	0.0000	0.0000
331411 Primary smelting and refining of copper	1.3700	0.1800	5.1445	2.0466	2.5665
331419 Primary nonferrous metal, except copper and aluminum	1.0000	0.0000	0.0000	0.0000	0.0000
331421 Copper rolling, drawing, and extruding	1.0000	0.0000	0.0000	0.0000	0.0000
331422 Copper wire, except mechanical, drawing	1.0000	0.0000	0.0000	0.0000	0.0000
331423 Secondary processing of copper	1.0000	0.0000	0.0000	0.0000	0.0000
331491 Nonferrous metal, except copper and aluminum, shaping	1.0000	0.0000	0.0000	0.0000	0.0000
331492 Secondary processing of other nonferrous	1.0000	0.0000	0.0000	0.0000	0.0000
331510 Ferrous metal foundries	1.7967	0.4798	12.2155	1.8598	2.6009
33152A Aluminum foundries	1.7266	0.4412	12.7070	1.3445	2.2079
33152B Nonferrous foundries, except aluminum	1.0000	0.0000	0.0000	0.0000	0.0000
332111 Iron and steel forging	1.8058	0.3956	10.4160	2.0498	2.7277
332112 Nonferrous forging	1.5242	0.3214	8.4882	1.7697	2.3179
332114 Custom roll forming	1.0000	0.0000	0.0000	0.0000	0.0000
33211A All other forging and stamping	1.8981	0.4627	13.7986	1.9850	2.2171
332211 Cutlery and flatware, except precious, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332212 Hand and edge tool manufacturing	1.8370	0.4657	14.1450	1.9179	2.1101
332213 Saw blade and handsaw manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332214 Kitchen utensil, pot, and pan manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332311 Prefabricated metal buildings and components	2.0863	0.4414	12.1687	2.4766	3.1345
332312 Fabricated structural metal manufacturing	1.8582	0.3899	11.1221	2.1892	2.6158
332313 Plate work manufacturing	1.8782	0.4859	12.7932	1.8587	2.4265
332321 Metal window and door manufacturing	1.7383	0.3739	12.6151	2.0493	2.0092
332322 Sheet metal work manufacturing	1.8517	0.4585	14.1317	1.9121	2.0682
332323 Ornamental and architectural metal work manufacturing	1.8813	0.4505	14.2568	1.9780	2.0644
332410 Power boiler and heat exchanger manufacturing	1.7695	0.4322	13.5145	1.8699	2.0015
332420 Metal tank, heavy gauge, manufacturing	1.9111	0.4543	13.1278	2.0343	2.3652
332430 Metal can, box, and other container manufacturing	1.6761	0.2752	7.5722	2.5726	3.4511
33299A Ammunition manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332994 Small arms manufacturing	1.7749	0.4338	12.0400	1.9578	2.3969
332995 Other ordnance and accessories manufacturing	1.6590	0.4664	17.0741	1.6397	1.5940
332500 Hardware manufacturing	1.7266	0.3887	11.6400	1.9498	2.1845
332600 Spring and wire product manufacturing	1.6841	0.3968	11.6857	1.8282	2.0996
332710 Machine shops	1.8785	0.5746	17.5249	1.7505	1.9384
332720 Turned product and screw, nut, and bolt manufacturing	1.7877	0.4745	14.3108	1.8093	2.0355
332811 Metal heat treating	1.7491	0.4142	12.6650	1.9499	2.1683
332812 Metal coating and nonprecious engraving	1.8483	0.3858	12.3294	2.1616	2.1999
332813 Electroplating, anodizing, and coloring metal	1.8736	0.5616	16.5008	1.7379	2.0137
332910 Metal valve manufacturing	1.6521	0.3625	11.1694	1.9246	2.0917
332991 Ball and roller bearing manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
332996 Fabricated pipe and pipe fitting manufacturing	1.8518	0.4132	11.9278	2.0759	2.4111
332997 Industrial pattern manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332998 Enameled iron and metal sanitary ware manufacturing	1.6477	0.3273	10.4557	2.0252	2.0850
332999 Miscellaneous fabricated metal product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333111 Farm machinery and equipment manufacturing	1.7805	0.3445	9.8210	2.4092	2.8687
333112 Lawn and garden equipment manufacturing	1.8280	0.3022	9.4067	3.0251	2.9499
333120 Construction machinery manufacturing	1.8276	0.3493	9.6652	2.5439	3.2402
333131 Mining machinery and equipment manufacturing	1.7639	0.3762	10.4568	2.1382	2.6430
333132 Oil and gas field machinery and equipment	1.0000	0.0000	0.0000	0.0000	0.0000
333210 Sawmill and woodworking machinery	1.0000	0.0000	0.0000	0.0000	0.0000
333220 Plastics and rubber industry machinery	1.0000	0.0000	0.0000	0.0000	0.0000
333291 Paper industry machinery manufacturing	1.7802	0.4345	12.0075	1.9522	2.4105
333292 Textile machinery manufacturing	1.7833	0.4663	13.5318	1.8691	2.1706
333293 Printing machinery and equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333294 Food product machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333295 Semiconductor machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333298 All other industrial machinery manufacturing	1.7820	0.4473	11.8974	1.9187	2.5176
33331A Automatic vending, commercial laundry and drycleaning machinery	1.7745	0.3786	11.2907	2.1578	2.3724
333313 Office machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333314 Optical instrument and lens manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333315 Photographic and photocopying equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333319 Other commercial and service industry machinery manufacturing	1.8157	0.4282	12.4731	2.0503	2.3782
333411 Air purification equipment manufacturing	1.7873	0.4217	14.0532	1.9893	1.9739
333412 Industrial and commercial fan and blower manufacturing	1.7885	0.4291	11.6843	1.9468	2.4491
333414 Heating equipment, except warm air furnaces	1.7241	0.3863	11.7221	1.9689	2.1702
333415 AC, refrigeration, and forced air heating	1.8089	0.3749	11.2427	2.3754	2.6662
333511 Industrial mold manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333512 Metal cutting machine tool manufacturing	1.8735	0.4796	13.0697	2.0284	2.5829
333513 Metal forming machine tool manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333514 Special tool, die, jig, and fixture manufacturing	1.9441	0.6339	17.1958	1.7129	2.1275
333515 Cutting tool and machine tool accessory manufacturing	1.8815	0.5411	15.4073	1.8200	2.1600
33351A Rolling mill and other metalworking machinery	1.0000	0.0000	0.0000	0.0000	0.0000
333611 Turbine and turbine generator set units manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33361A Speed changers and mechanical power transmission equipment	1.0000	0.0000	0.0000	0.0000	0.0000
333618 Other engine equipment manufacturing	1.7059	0.3049	8.1367	2.4963	3.4100
333911 Pump and pumping equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333912 Air and gas compressor manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333913 Measuring and dispensing pump manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333921 Elevator and moving stairway manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333922 Conveyor and conveying equipment manufacturing	1.8310	0.4636	12.6735	1.9172	2.3921

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
333923 Overhead cranes, hoists, and monorail systems	1.7834	0.3785	11.3823	2.1809	2.4035
333924 Industrial truck, trailer, and stacker manufacturing	1.8876	0.3946	10.9427	2.4374	3.0531
333991 Power-driven handtool manufacturing	1.6394	0.3198	9.0856	2.1826	2.7376
333992 Welding and soldering equipment manufacturing	1.7206	0.3888	10.4768	1.9622	2.5110
333993 Packaging machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333994 Industrial process furnace and oven manufacturing	1.7824	0.4360	13.2213	1.9547	2.1574
333995 Fluid power cylinder and actuator manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333996 Fluid power pump and motor manufacturing	1.7578	0.4338	11.9759	1.9592	2.4280
33399A Scales, balances, and miscellaneous general purpose machinery	1.7468	0.4412	12.2351	1.8691	2.2952
334111 Electronic computer manufacturing	1.6870	0.2778	7.3629	2.9414	4.5188
334112 Computer storage device manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334113 Computer terminal manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334119 Other computer peripheral equipment manufacturing	1.8623	0.4256	11.8929	2.2722	2.7800
334210 Telephone apparatus manufacturing	1.5812	0.3013	8.5721	2.1268	2.5548
334220 Broadcast and wireless communications equipment	1.6719	0.3702	9.4794	1.9802	2.7469
334290 Other communications equipment manufacturing	1.7971	0.4435	12.6735	1.9961	2.4217
334300 Audio and video equipment manufacturing	1.6627	0.2975	8.7080	2.5173	2.9864
334411 Electron tube manufacturing	1.8759	0.4311	10.9758	2.2182	3.2657
334413 Semiconductors and related device manufacturing	1.5057	0.2775	7.5329	2.1092	2.7762
33441A All other electronic component manufacturing	1.7649	0.4175	11.7452	2.0156	2.4507
334510 Electromedical apparatus manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334511 Search, detection, and navigation instruments	1.0000	0.0000	0.0000	0.0000	0.0000
334512 Automatic environmental control manufacturing	1.7527	0.4466	11.7933	1.8868	2.4908
334513 Industrial process variable instruments	1.8418	0.5022	14.9658	1.8999	2.2662
334514 Totalizing fluid meters and counting devices	1.0000	0.0000	0.0000	0.0000	0.0000
334515 Electricity and signal testing instruments	1.6313	0.3992	11.6858	1.7987	2.0857
334516 Analytical laboratory instrument manufacturing	1.9272	0.5296	15.5857	1.9933	2.6194
334517 Irradiation apparatus manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33451A Watch, clock, and other measuring and controlling device manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334611 Software reproducing	1.5855	0.4050	9.4476	1.6037	2.3194
334612 Audio and video media reproduction	1.0000	0.0000	0.0000	0.0000	0.0000
334613 Magnetic and optical recording media manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335110 Electric lamp bulb and part manufacturing	1.8460	0.3910	12.1388	2.2696	2.3723
335120 Lighting fixture manufacturing	1.7946	0.3873	10.6855	2.2476	2.9311
335211 Electric housewares and household fan manufacturing	1.7438	0.3228	8.8303	2.5262	3.4157
335212 Household vacuum cleaner manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335221 Household cooking appliance manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335222 Household refrigerator and home freezer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335224 Household laundry equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335228 Other major household appliance manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
335311 Electric power and specialty transformer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335312 Motor and generator manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335313 Switchgear and switchboard apparatus manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335314 Relay and industrial control manufacturing	1.9698	0.4728	12.8340	2.2374	2.8820
335911 Storage battery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335912 Primary battery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335921 Fiber optic cable manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335929 Other communication and energy wire manufacturing	1.7569	0.3056	7.8081	2.5464	4.1117
335930 Wiring device manufacturing	1.7491	0.3968	10.7773	2.0358	2.6097
335991 Carbon and graphite product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335999 Miscellaneous electrical equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336110 Automobile and light truck manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336120 Heavy duty truck manufacturing	2.0002	0.3101	7.4670	3.7724	9.3774
336211 Motor vehicle body manufacturing	1.8244	0.3408	9.7083	2.6749	3.3279
336212 Truck trailer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336213 Motor home manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336214 Travel trailer and camper manufacturing	1.8225	0.3713	9.3945	2.2859	3.4705
336300 Motor vehicle parts manufacturing	1.8328	0.3755	9.3583	2.3559	3.7671
336411 Aircraft manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336412 Aircraft engine and engine parts manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336413 Other aircraft parts and equipment	1.0000	0.0000	0.0000	0.0000	0.0000
336414 Guided missile and space vehicle manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33641A Propulsion units and parts for space vehicles and guided missiles	1.0000	0.0000	0.0000	0.0000	0.0000
336500 Railroad rolling stock manufacturing	1.9144	0.3689	9.5921	2.6394	3.8119
336611 Ship building and repairing	1.0000	0.0000	0.0000	0.0000	0.0000
336612 Boat building	1.8795	0.3777	10.5935	2.2761	2.8173
336991 Motorcycle, bicycle, and parts manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336992 Military armored vehicles and tank parts manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336999 All other transportation equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337110 Wood kitchen cabinet and countertop manufacturing	1.9748	0.4924	17.8613	1.9898	1.8995
337121 Upholstered household furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337122 Nonupholstered wood household furniture manufacturing	1.9777	0.4882	19.4656	2.0280	1.7612
337124 Metal household furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337127 Institutional furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33712A Other household and institutional furniture	1.0000	0.0000	0.0000	0.0000	0.0000
337211 Wood office furniture manufacturing	1.9251	0.4855	15.5186	1.9779	2.1134
337212 Custom architectural woodwork and millwork	1.8833	0.5561	20.0503	1.7096	1.6822
337214 Office furniture, except wood, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337215 Showcases, partitions, shelving, and lockers	1.9037	0.4896	14.9880	1.8816	2.0772
337910 Mattress manufacturing	1.7765	0.3540	11.9774	2.3139	2.2702

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
337920 Blind and shade manufacturing	1.7912	0.3908	14.2446	2.0813	1.9113
339111 Laboratory apparatus and furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339112 Surgical and medical instrument manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339113 Surgical appliance and supplies manufacturing	1.6770	0.3884	10.9769	1.9272	2.3329
339114 Dental equipment and supplies manufacturing	1.7391	0.4447	10.8152	1.8767	2.7999
339115 Ophthalmic goods manufacturing	1.7396	0.4411	15.9654	1.8890	1.7977
339116 Dental laboratories	1.7827	0.5580	16.3949	1.6588	1.9104
339910 Jewelry and silverware manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339920 Sporting and athletic goods manufacturing	2.0183	0.4440	13.1794	2.5090	2.9922
339930 Doll, toy, and game manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339940 Office supplies, except paper, manufacturing	1.7714	0.3808	10.4702	2.0960	2.6817
339950 Sign manufacturing	1.9198	0.5364	16.0668	1.8221	2.0665
339991 Gasket, packing, and sealing device manufacturing	1.7334	0.4449	11.8122	1.7822	2.3188
339992 Musical instrument manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339994 Broom, brush, and mop manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339995 Burial casket manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33999A Buttons, pins, and all other miscellaneous manufacturing	1.5760	0.4459	13.4265	2.0136	2.2865
420000 Wholesale trade	1.8265	0.5402	15.6649	1.7799	2.2470
4A0000 Retail trade	1.9182	0.5776	24.9804	1.8060	1.5955
481000 Air transportation	1.8416	0.4857	16.8266	2.0483	2.4170
482000 Rail transportation	1.8371	0.4765	11.9643	1.9065	2.9084
483000 Water transportation	1.8714	0.3959	13.4419	2.7558	2.7299
484000 Truck transportation	2.0227	0.5261	17.5418	2.1470	2.2559
485A00 Transit and ground passenger transportation	2.0647	0.6947	41.3150	1.7611	1.3400
486000 Pipeline transportation	1.9634	0.5209	13.9537	2.2238	3.9149
48A000 Scenic and sightseeing transportation and support activities for transportation	2.0993	0.6815	19.8469	1.8990	2.2961
492000 Couriers and messengers	1.8530	0.6026	23.8501	1.6605	1.6054
493000 Warehousing and storage	1.9846	0.7130	25.5130	1.5910	1.6390
511110 Newspaper publishers	1.9464	0.6143	20.2949	1.7246	1.7914
511120 Periodical publishers	1.8577	0.4797	14.5105	1.9367	2.1773
511130 Book publishers	1.6622	0.3832	11.4930	1.9282	2.2262
5111A0 Database, directory, and other publishers	1.7182	0.4001	10.5333	1.9477	2.6450
511200 Software publishers	1.8156	0.5858	14.9539	1.6749	2.5362
512100 Motion picture and video industries	1.7837	0.4691	26.3658	1.8582	1.4671
512200 Sound recording industries	1.5852	0.3045	10.7935	2.1729	2.1970
513100 Radio and television broadcasting	2.0635	0.5836	14.8394	2.0334	3.1879
513200 Cable networks and program distribution	1.9212	0.4516	12.8599	2.1436	2.7815
513300 Telecommunications	1.8048	0.4250	12.0829	2.0742	2.6470
514100 Information services	2.0896	0.8305	31.9938	1.5938	1.5839
514200 Data processing services	1.9739	0.7242	18.2542	1.6382	2.4278

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
52A000 Monetary authorities and depository credit intermediation	1.6438	0.3976	12.1159	1.8710	2.2824
522A00 Nondepository credit intermediation and related activities	1.7163	0.4232	12.6430	1.9804	2.5664
523000 Securities, commodity contracts, investments	2.0824	0.7889	25.0059	1.6909	1.8681
524100 Insurance carriers	2.2684	0.5895	17.6750	2.5498	2.9819
524200 Insurance agencies, brokerages, and related	1.7425	0.5181	15.9505	1.6933	1.9119
525000 Funds, trusts, and other financial vehicles	1.8900	0.4132	13.4000	3.6347	3.6563
531000 Real estate	1.5843	0.2576	10.8233	2.6132	2.2654
S00800 Owner-occupied dwellings	1.2727	0.0723	2.4682	0.0000	0.0000
532100 Automotive equipment rental and leasing	1.6035	0.3153	12.0233	2.1662	2.0993
532A00 General and consumer goods rental except video tapes and discs	1.7438	0.4902	17.3149	1.7613	1.8692
532230 Video tape and disc rental	1.6512	0.3666	22.3146	1.8221	1.3780
532400 Machinery and equipment rental and leasing	1.5908	0.3417	10.0925	1.9539	2.6175
533000 Lessors of nonfinancial intangible assets	1.0000	0.0000	0.0000	0.0000	0.0000
541100 Legal services	2.0455	0.8207	20.2101	1.5766	2.2447
541200 Accounting and bookkeeping services	2.0096	0.8108	30.9555	1.5483	1.5482
541300 Architectural and engineering services	1.9074	0.6811	20.3902	1.6491	2.0163
541400 Specialized design services	1.9094	0.6535	32.2291	1.6804	1.4573
541511 Custom computer programming services	1.9779	0.8074	19.6529	1.5488	2.3447
541512 Computer systems design services	2.0487	0.8294	21.5181	1.5910	2.2801
54151A Other computer related services, including facilities management	1.8360	0.5124	16.0297	1.9058	2.3667
541610 Management consulting services	2.0257	0.8010	28.5161	1.5811	1.6902
5416A0 Environmental and other technical consulting services	1.8614	0.6602	25.6961	1.6155	1.6167
541700 Scientific research and development services	2.0597	0.7809	21.7777	1.6261	2.0724
541800 Advertising and related services	1.7762	0.5173	17.8783	1.7521	1.9056
541920 Photographic services	1.8502	0.5906	18.3900	1.6782	1.9796
541940 Veterinary services	2.0581	0.6829	18.8926	1.7739	2.3799
5419A0 All other miscellaneous professional and technical services	1.5176	0.3159	7.7915	1.9285	3.8450
550000 Management of companies and enterprises	2.0483	0.7674	20.3504	1.6212	2.0448
561300 Employment services	1.7711	0.7403	41.6398	1.4244	1.2555
561500 Travel arrangement and reservation services	2.1206	0.6945	28.8033	1.8964	1.6739
561100 Office administrative services	1.9267	0.7165	21.5015	1.6215	2.0015
561200 Facilities support services	1.8286	0.6857	21.6754	1.5427	1.7702
561400 Business support services	1.8181	0.5703	26.3525	1.7087	1.5188
561600 Investigation and security services	1.9081	0.7806	35.9844	1.5020	1.3849
561700 Services to buildings and dwellings	1.9967	0.6389	35.1283	1.8062	1.4596
561900 Other support services	1.7762	0.5038	24.3352	1.7701	1.5087
562000 Waste management and remediation services	2.0835	0.5865	16.4713	2.0765	2.7465
611100 Elementary and secondary schools	2.2179	0.7840	41.9376	1.6935	1.4098
611A00 Colleges, universities, and junior colleges	2.1588	0.7709	34.5483	1.6462	1.5143
611B00 Other educational services	1.8772	0.5393	29.7652	1.8695	1.4793

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
621A00 Offices of physicians, dentists, and other health practitioners	1.9966	0.8069	20.1541	1.5498	2.1623
621600 Home health care services	1.9912	0.8129	37.3903	1.5457	1.4220
621B00 Other ambulatory health care services	2.1024	0.7345	22.6640	1.7890	2.1291
622000 Hospitals	2.0565	0.7282	23.2799	1.6932	1.9423
623000 Nursing and residential care facilities	2.1040	0.8071	37.4867	1.6190	1.4960
624400 Child day care services	1.9172	0.5906	44.0974	1.7165	1.2700
624A00 Social assistance, except child day care services	2.1193	0.7358	40.6383	1.7115	1.3907
711100 Performing arts companies	1.8952	0.6636	49.5642	1.6211	1.2526
711200 Spectator sports	1.9655	0.8098	46.4706	1.5137	1.3037
711A00 Promoters of performing arts and sports and agents for public figures	1.7957	0.5786	42.3936	1.6583	1.2871
711500 Independent artists, writers, and performers	1.9821	0.6374	30.5106	1.7996	1.6978
712000 Museums, historical sites, zoos, and parks	2.2197	0.6984	23.8904	1.9229	2.2421
713940 Fitness and recreational sports centers	2.0729	0.6575	39.6772	1.7592	1.3563
713950 Bowling centers	1.9265	0.6042	34.8254	1.7146	1.3572
713A00 Other amusement, gambling, and recreation industries	1.8842	0.6097	28.0663	1.6630	1.4689
7211A0 Hotels and motels, including casino hotels	1.8089	0.5719	25.9173	1.6475	1.4682
721A00 Other accommodations	1.7772	0.4361	18.2128	1.9555	1.7390
722000 Food services and drinking places	2.0017	0.6430	41.8385	1.6753	1.2965
8111A0 Automotive repair and maintenance, except car washes	1.9462	0.5249	22.0243	1.9137	1.6762
811192 Car washes	1.7436	0.5054	37.1981	1.7025	1.2625
811200 Electronic equipment repair and maintenance	1.8471	0.6288	23.6367	1.5986	1.5888
811300 Commercial machinery repair and maintenance	1.7486	0.5550	21.1094	1.5981	1.5766
811400 Household goods repair and maintenance	1.6510	0.4343	21.6928	1.7257	1.4632
812100 Personal care services	1.8861	0.6029	32.9484	1.6836	1.4006
812200 Death care services	1.8197	0.5350	21.8177	1.7501	1.6294
812300 Drycleaning and laundry services	1.8966	0.6135	31.5434	1.6724	1.4117
812900 Other personal services	1.7144	0.3271	15.9801	2.3457	1.7294
813100 Religious organizations	2.0152	0.7841	36.2603	1.5123	1.3899
813A00 Grantmaking and giving and social advocacy organizations	2.1725	0.6759	28.0253	2.0247	1.8832
813B00 Civic, social, professional and similar organizations	2.2232	0.7063	29.1152	1.8995	1.7230
491000 Postal service	1.8606	0.7414	19.3334	1.4739	1.8943
S00A00 Other government enterprises	1.8977	0.4800	15.2655	2.1020	2.3206
H00000 Households	1.2691	0.3557	13.8314	0.0000	0.0000

Region Definition. Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 2.4 Total Multipliers for Output, Earnings, and Employment by Industry Aggregation
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
1. Crop and animal production	1.7187	0.2617	11.9772	2.5859	1.9025
2. Forestry, fishing, and related activities	1.8683	0.3857	15.0079	2.1373	2.0491
3. Oil and gas extraction	1.4537	0.2934	6.1724	1.7889	3.3754
4. Mining, except oil and gas	1.7547	0.4546	12.2926	1.8335	2.3259
5. Support activities for mining	1.0000	0.0000	0.0000	0.0000	0.0000
6. Utilities*	1.5136	0.3259	7.8259	1.8222	3.0591
7. Construction	2.1278	0.6466	21.6326	1.9302	2.0427
8. Wood product manufacturing	2.3345	0.4560	15.7928	3.1263	3.4040
9. Nonmetallic mineral product manufacturing	1.8712	0.4513	12.6096	2.0927	2.6674
10. Primary metal manufacturing	1.7956	0.3409	9.2504	2.6074	3.7958
11. Fabricated metal product manufacturing	1.8555	0.4279	12.4897	2.0521	2.3815
12. Machinery manufacturing	1.7444	0.3761	10.5677	2.1010	2.5966
13. Computer and electronic product manufacturing	1.7069	0.3384	9.4088	2.2910	2.9191
14. Electrical equipment and appliance manufacturing	1.8121	0.3462	9.5850	2.4716	3.1736
15. Motor vehicle, body, trailer, and parts manufacturing	1.8753	0.3629	8.9056	2.5217	4.3407
16. Other transportation equipment manufacturing	1.9103	0.3729	10.0642	2.5339	3.4333
17. Furniture and related product manufacturing	1.9510	0.4885	17.2967	1.9884	1.9301
18. Miscellaneous manufacturing	1.9046	0.4773	13.6412	2.0029	2.4194
19. Food, beverage, and tobacco product manufacturing	2.1335	0.3539	12.4435	3.1521	3.4685
20. Textile and textile product mills	1.8960	0.3823	12.2476	2.3586	2.4410
21. Apparel, leather, and allied product manufacturing	1.7652	0.4033	14.4369	2.0039	1.9385
22. Paper manufacturing	1.9236	0.3404	9.1855	2.9174	4.8052
23. Printing and related support activities	2.0338	0.4959	14.4913	2.0604	2.3736
24. Petroleum and coal products manufacturing	1.7805	0.3572	8.4566	2.5761	5.7205
25. Chemical manufacturing	1.7152	0.3267	8.3360	2.5461	4.1660
26. Plastics and rubber products manufacturing	1.8315	0.3773	10.4071	2.2502	2.9658
27. Wholesale trade	1.8280	0.5386	15.4684	1.7747	2.2188
28. Retail trade	1.9153	0.5730	24.6948	1.7916	1.5766
29. Air transportation	1.8310	0.4847	17.0503	2.0439	2.4491
30. Rail transportation	1.8352	0.4767	12.0433	1.9073	2.9276
31. Water transportation	1.8655	0.3976	13.6084	2.7677	2.7637
32. Truck transportation	2.0265	0.5271	17.5391	2.1511	2.2556
33. Transit and ground passenger transportation*	2.0723	0.6944	41.1936	1.7606	1.3361
34. Pipeline transportation	1.9783	0.5270	13.8201	2.2501	3.8774
35. Other transportation and support activities*	1.8827	0.6817	20.3998	1.5637	1.8300
36. Warehousing and storage	1.9787	0.7058	25.1811	1.5749	1.6177
37. Publishing including software	1.8477	0.5156	15.6162	1.8205	2.0372
38. Motion picture and sound recording industries	1.7589	0.4468	24.4581	1.8662	1.4769
39. Broadcasting and telecommunications	1.8720	0.4584	12.6832	2.0838	2.7251
40. Information and data processing services	2.0088	0.7509	23.4748	1.6211	1.8676

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 2.4 Total Multipliers for Output, Earnings, and Employment by Industry Aggregation
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
41. Federal Reserve banks, credit intermediation and related services	1.6670	0.4036	12.0402	1.8955	2.3468
42. Securities, commodity contracts, investments	2.0811	0.7843	24.8076	1.6810	1.8532
43. Insurance carriers and related activities	2.3659	0.6005	17.9789	2.4659	2.8171
44. Funds, trusts, and other financial vehicles	1.8991	0.4113	13.2831	3.6180	3.6244
45. Real estate	1.4023	0.1489	5.9037	3.4518	2.8250
46. Rental and leasing services and lessors of intangible assets	1.6256	0.3501	12.8106	1.9834	2.0143
47. Professional, scientific, and technical services	1.9583	0.7214	20.8421	1.6073	1.9679
48. Management of companies and enterprises	2.0475	0.7628	20.2311	1.6115	2.0328
49. Administrative and support services	1.8893	0.6828	34.2226	1.5797	1.3877
50. Waste management and remediation services	2.0967	0.5894	16.6981	2.0867	2.7843
51. Educational services	2.0552	0.6791	32.7707	1.6907	1.4766
52. Ambulatory health care services	2.0186	0.7892	21.0428	1.5808	2.0696
53. Hospitals and nursing and residential care facilities	2.0620	0.7336	27.0932	1.6627	1.7003
54. Social assistance	2.0272	0.6651	41.9413	1.7004	1.3223
55. Performing arts, museums, and related activities	1.9762	0.6528	38.2826	1.7213	1.3928
56. Amusements, gambling, and recreation	1.9319	0.6164	30.5862	1.6780	1.4224
57. Accommodation	1.8082	0.5512	24.7710	1.6734	1.4876
58. Food services and drinking places	2.0134	0.6408	41.7117	1.6696	1.2926
59. Other services*	1.9220	0.5699	24.7743	1.7704	1.5684
60. Households	1.2816	0.3577	13.9321	0.0000	0.0000

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

Footnotes for Tables 1.4 and 2.4

*Includes Government enterprises.

1. Each entry in column 1 represents the total dollar change in output that occurs in all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

2. Each entry in column 2 represents the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

3. Each entry in column 3 represents the total change in number of jobs that occurs in all industries for each additional 1 million dollars of output delivered to final demand by the industry corresponding to the entry. Because the employment multipliers are based on 2003 data, the output delivered to final demand should be in 2003 dollars.

4. Each entry in column 4 represents the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry corresponding to the entry.

5. Each entry in column 5 represents the total change in number of jobs in all industries for each additional job in the industry corresponding to the entry.

NOTE.--Multipliers are based on the 1997 Benchmark Input-Output Table for the nation and 2003 regional accounts data.

SOURCE.--Regional Input-Output Modeling System (RIMS II), Regional Economic Analysis Division, Bureau of Economic Analysis.

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
AGRICULTURE, FORESTRY, FISHING, AND HUNTING	
1110 Crop production	
1111A0 Oilseed farming	11111, 11112
1111B0 Grain farming	11113, 11114, 11115, 11116, 11119
111200 Vegetable and melon farming	1112
1113A0 Fruit farming	11131, 11132, 111331-4, 111336, 111339
111335 Tree nut farming	111335
111400 Greenhouse and nursery production	1114
111910 Tobacco farming	11191
111920 Cotton farming	11192
1119A0 Sugarcane and sugar beet farming	11193, 111991
1119B0 All other crop farming	11194, 111992, 111998
1120 Animal production	
112100 Cattle ranching and farming	1121
112300 Poultry and egg production	1123
112A00 Animal production, except cattle and poultry and eggs	1122, 1124, 1125, 1129
1130 Forestry and logging	
113A00 Forest nurseries, forest products, and timber tracts	1131, 1132
113300 Logging	1133
1140 Fishing, hunting and trapping	
114100 Fishing	1141
114200 Hunting and trapping	1142
Agriculture and forestry support activities	
115000 Agriculture and forestry support activities	115
MINING	
2110 Oil and gas extraction	
211000 Oil and gas extraction	211
2121 Coal mining	
212100 Coal mining	2121
2122 Metal ores mining	
212210 Iron ore mining	21221
212230 Copper, nickel, lead, and zinc mining	21223
2122A0 Gold, silver, and other metal ore mining	21222, 21229
2123 Nonmetallic mineral mining and quarrying	
212310 Stone mining and quarrying	21231
212320 Sand, gravel, clay, and refractory mining	21232
212390 Other nonmetallic mineral mining	21239
2130 Support activities for mining	
213111 Drilling oil and gas wells	213111
213112 Support activities for oil and gas operations	213112
21311A Support activities for other mining	213113-5
UTILITIES	
2211 Power generation and supply	
2211A0 Power generation and supply	2211 (1)
2212 Natural gas distribution	
221200 Natural gas distribution	2212
2213 Water, sewage and other systems	
221300 Water, sewage and other systems	2213
CONSTRUCTION	
2300 Construction	
230000 Construction	23

Detailed industry code and title	Related 1997 NAICS codes
MANUFACTURING	
3110 Food manufacturing	
311111 Dog and cat food manufacturing	311111
311119 Other animal food manufacturing	311119
311211 Flour milling	311211
311212 Rice milling	311212
311213 Malt manufacturing	311213
311221 Wet corn milling	311221
311222 Soybean processing	311222
311223 Other oilseed processing	311223
311225 Fats and oils refining and blending	311225
311230 Breakfast cereal manufacturing	31123
311310 Sugar manufacturing	31131
311320 Confectionery manufacturing from cacao beans	31132
311330 Confectionery manufacturing from purchased chocolate	31133
311340 Nonchocolate confectionery manufacturing	31134
311410 Frozen food manufacturing	31141
311420 Fruit and vegetable canning and drying	31142
311511 Fluid milk manufacturing	311511
311512 Creamery butter manufacturing	311512
311513 Cheese manufacturing	311513
311514 Dry, condensed, and evaporated dairy products	311514
311520 Ice cream and frozen dessert manufacturing	31152
311611 Animal, except poultry, slaughtering	311611
311612 Meat processed from carcasses	311612
311613 Rendering and meat byproduct processing	311613
311615 Poultry processing	311615
311700 Seafood product preparation and packaging	3117
31181A Bread and bakery product, except frozen, manufacturing	311811-2
311813 Frozen cakes and other pastries manufacturing	311813
311821 Cookie and cracker manufacturing	311821
311822 Mixes and dough made from purchased flour	311822
311823 Dry pasta manufacturing	311823
311830 Tortilla manufacturing	31183
311911 Roasted nuts and peanut butter manufacturing	311911
311919 Other snack food manufacturing	311919
311920 Coffee and tea manufacturing	31192
311930 Flavoring syrup and concentrate manufacturing	31193
311941 Mayonnaise, dressing, and sauce manufacturing	311941
311942 Spice and extract manufacturing	311942
311990 All other food manufacturing	31199
3121 Beverage manufacturing	
312110 Soft drink and ice manufacturing	31211
312120 Breweries	31212
312130 Wineries	31213
312140 Distilleries	31214
3122 Tobacco manufacturing	
312210 Tobacco stemming and redrying	31221
312221 Cigarette manufacturing	312221
312229 Other tobacco product manufacturing	312229
3130 Textile mills	
313100 Fiber, yarn, and thread mills	3131
313210 Broadwoven fabric mills	31321
313220 Narrow fabric mills and schiffli embroidery	31322
313230 Nonwoven fabric mills	31323
313240 Knit fabric mills	31324
313310 Textile and fabric finishing mills	31331
313320 Fabric coating mills	31332
3140 Textile product mills	
314110 Carpet and rug mills	31411
314120 Curtain and linen mills	31412
314910 Textile bag and canvas mills	31491
314992 Tire cord and tire fabric mills	314992
31499A Other miscellaneous textile product mills	314991, 314999
3150 Apparel manufacturing	
315111 Sheer hosiery mills	315111

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
315119 Other hosiery and sock mills	315119
315190 Other apparel knitting mills	31519
315200 Cut and sew apparel manufacturing	3152
315900 Accessories and other apparel manufacturing	3159
3160 Leather and allied product manufacturing	
316100 Leather and hide tanning and finishing	3161
316200 Footwear manufacturing	3162
316900 Other leather product manufacturing	3169
3210 Wood product manufacturing	
321113 Sawmills	321113
321114 Wood preservation	321114
32121A Veneer and plywood manufacturing	321211-2
32121B Engineered wood member and truss manufacturing	321213-4
321219 Reconstituted wood product manufacturing	321219
321911 Wood windows and door manufacturing	321911
321912 Cut stock, resawing lumber, and planing	321912
321918 Other millwork, including flooring	321918
321920 Wood container and pallet manufacturing	32192
321991 Manufactured home, mobile home, manufacturing	321991
321992 Prefabricated wood building manufacturing	321992
321999 Miscellaneous wood product manufacturing	321999
3221 Pulp, paper, and paperboard mills	
322110 Pulp mills	32211
3221A0 Paper and paperboard mills	32212, 32213
3222 Converted paper product manufacturing	
322210 Paperboard container manufacturing	32221
32222A Coated and laminated paper and packaging materials	322221-2
32222B Coated and uncoated paper bag manufacturing	322223-4
322225 Flexible packaging foil manufacturing	322225
322226 Surface-coated paperboard manufacturing	322226
322231 Die-cut paper office supplies manufacturing	322231
322232 Envelope manufacturing	322232
322233 Stationery and related product manufacturing	322233
322291 Sanitary paper product manufacturing	322291
322299 All other converted paper product manufacturing	322299
3230 Printing and related support activities	
32311A Commercial printing	323110-5, 323119
323116 Manifold business forms printing	323116
323117 Books printing	323117
323118 Blankbook and looseleaf binder manufacturing	323118
323121 Tradebinding and related work	323121
323122 Prepress services	323122
3240 Petroleum and coal products manufacturing	
324110 Petroleum refineries	32411
324121 Asphalt paving mixture and block manufacturing	324121
324122 Asphalt shingle and coating materials manufacturing	324122
324191 Petroleum lubricating oil and grease manufacturing	324191
324199 All other petroleum and coal products manufacturing	324199
3251 Basic chemical manufacturing	
325110 Petrochemical manufacturing	32511
325120 Industrial gas manufacturing	32512
325130 Synthetic dye and pigment manufacturing	32513
325180 Other basic inorganic chemical manufacturing	32518
325190 Other basic organic chemical manufacturing	32519
3252 Resin, rubber, and artificial fibers manufacturing	
325211 Plastics material and resin manufacturing	325211
325212 Synthetic rubber manufacturing	325212
325221 Cellulosic organic fiber manufacturing	325221
325222 Noncellulosic organic fiber manufacturing	325222
3253 Agricultural chemical manufacturing	
325311 Nitrogenous fertilizer manufacturing	325311
325312 Phosphatic fertilizer manufacturing	325312
325314 Fertilizer, mixing only, manufacturing	325314
325320 Pesticide and other agricultural chemical manufacturing	32532
3254 Pharmaceutical and medicine manufacturing	
325400 Pharmaceutical and medicine manufacturing	3254
3255 Paint, coating, and adhesive manufacturing	
325510 Paint and coating manufacturing	32551
325520 Adhesive manufacturing	32552
3256 Soap, cleaning compound, and toiletry manufacturing	
325611 Soap and other detergent manufacturing	325611
325612 Polish and other sanitation good manufacturing	325612
325613 Surface active agent manufacturing	325613
325620 Toilet preparation manufacturing	32562
3259 Other chemical product and preparation manufacturing	
325910 Printing ink manufacturing	32591
325920 Explosives manufacturing	32592
325991 Custom compounding of purchased resins	325991
325992 Photographic film and chemical manufacturing	325992
325998 Other miscellaneous chemical product manufacturing	325998
3260 Plastics and rubber products manufacturing	
326110 Plastics packaging materials, film and sheet	32611
326120 Plastics pipe, fittings, and profile shapes	32612
326130 Laminated plastics plate, sheet, and shapes	32613
3261A0 Foam product manufacturing	32614, 32615
326160 Plastics bottle manufacturing	32616
326192 Resilient floor covering manufacturing	326192
32619A Plastics plumbing fixtures and all other plastics products	326191, 326199
326210 Tire manufacturing	32621
326220 Rubber and plastics hose and belting manufacturing	32622
326290 Other rubber product manufacturing	32629
3270 Nonmetallic mineral product manufacturing	
327111 Vitreous china plumbing fixture manufacturing	327111
327112 Vitreous china and earthenware articles manufacturing	327112
327113 Porcelain electrical supply manufacturing	327113
327121 Brick and structural clay tile manufacturing	327121
327122 Ceramic wall and floor tile manufacturing	327122
32712A Clay refractory and other structural clay products	327123-4
327125 Nonclay refractory manufacturing	327125
327213 Glass container manufacturing	327213
32721A Glass and glass products, except glass containers	327211-2, 327215
327310 Cement manufacturing	32731
327320 Ready-mix concrete manufacturing	32732
327331 Concrete block and brick manufacturing	327331
327332 Concrete pipe manufacturing	327332
327390 Other concrete product manufacturing	32739
327410 Lime manufacturing	32741
327420 Gypsum product manufacturing	32742
327910 Abrasive product manufacturing	32791
327991 Cut stone and stone product manufacturing	327991
327992 Ground or treated minerals and earths manufacturing	327992
327993 Mineral wool manufacturing	327993
327999 Miscellaneous nonmetallic mineral products	327999
331A Iron and steel mills and manufacturing from purchased steel	
331111 Iron and steel mills	331111
331112 Ferroalloy and related product manufacturing	331112
331210 Iron, steel pipe and tube from purchased steel	33121
331221 Rolled steel shape manufacturing	331221
331222 Steel wire drawing	331222
331B Nonferrous metal production and processing	
331311 Alumina refining	331311
331312 Primary aluminum production	331312
331314 Secondary smelting and alloying of aluminum	331314
331315 Aluminum sheet, plate, and foil manufacturing	331315
331316 Aluminum extruded product manufacturing	331316
331319 Other aluminum rolling and drawing	331319
331411 Primary smelting and refining of copper	331411

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
331419 Primary nonferrous metal, except copper and aluminum	331419
331421 Copper rolling, drawing, and extruding	331421
331422 Copper wire, except mechanical, drawing	331422
331423 Secondary processing of copper	331423
331491 Nonferrous metal, except copper and aluminum, shaping	331491
331492 Secondary processing of other nonferrous	331492
3315 Foundries	
331510 Ferrous metal foundries	33151
33152A Aluminum foundries	331521, 331524
33152B Nonferrous foundries, except aluminum	331522, 331525, 331528
3321 Forging and stamping	
332111 Iron and steel forging	332111
332112 Nonferrous forging	332112
332114 Custom roll forming	332114
33211A All other forging and stamping	332115-7
3322 Cutlery and handtool manufacturing	
332211 Cutlery and flatware, except precious, manufacturing	332211
332212 Hand and edge tool manufacturing	332212
332213 Saw blade and handsaw manufacturing	332213
332214 Kitchen utensil, pot, and pan manufacturing	332214
3323 Architectural and structural metals manufacturing	
332311 Prefabricated metal buildings and components	332311
332312 Fabricated structural metal manufacturing	332312
332313 Plate work manufacturing	332313
332321 Metal window and door manufacturing	332321
332322 Sheet metal work manufacturing	332322
332323 Ornamental and architectural metal work manufacturing	332323
Boiler, tank, and shipping container manufacturing	
332410 Power boiler and heat exchanger manufacturing	33241
332420 Metal tank, heavy gauge, manufacturing	33242
332430 Metal can, box, and other container manufacturing	33243
332A Ordnance and accessories manufacturing	
33299A Ammunition manufacturing	332992-3
332994 Small arms manufacturing	332994
332995 Other ordnance and accessories manufacturing	332995
332B Other fabricated metal product manufacturing	
332500 Hardware manufacturing	3325
332600 Spring and wire product manufacturing	3326
332710 Machine shops	33271
332720 Turned product and screw, nut, and bolt manufacturing	33272
332811 Metal heat treating	332811
332812 Metal coating and nonprecious engraving	332812
332813 Electroplating, anodizing, and coloring metal	332813
332910 Metal valve manufacturing	33291
332991 Ball and roller bearing manufacturing	332991
332996 Fabricated pipe and pipe fitting manufacturing	332996
332997 Industrial pattern manufacturing	332997
332998 Enameled iron and metal sanitary ware manufacturing	332998
332999 Miscellaneous fabricated metal product manufacturing	332999
3331 Agriculture, construction, and mining machinery	
333111 Farm machinery and equipment manufacturing	333111
333112 Lawn and garden equipment manufacturing	333112
333120 Construction machinery manufacturing	33312
333131 Mining machinery and equipment manufacturing	333131
333132 Oil and gas field machinery and equipment	333132
2 Industrial machinery manufacturing	
333210 Sawmill and woodworking machinery	33321
333220 Plastics and rubber industry machinery	33322
333291 Paper industry machinery manufacturing	333291
333292 Textile machinery manufacturing	333292
333293 Printing machinery and equipment manufacturing	333293
333294 Food product machinery manufacturing	333294
333295 Semiconductor machinery manufacturing	333295
333298 All other industrial machinery manufacturing	333298
3333 Commercial and service industry machinery	
33331A Automatic vending, commercial laundry and drycleaning machinery	333311-2
333313 Office machinery manufacturing	333313
333314 Optical instrument and lens manufacturing	333314
333315 Photographic and photocopying equipment manufacturing	333315
333319 Other commercial and service machinery manufacturing	333319
3334 HVAC and commercial refrigeration equipment	
333411 Air purification equipment manufacturing	333411
333412 Industrial and commercial fan and blower manufacturing	333412
333414 Heating equipment, except warm air furnaces	333414
333415 AC, refrigeration, and forced air heating	333415
3335 Metalworking machinery manufacturing	
333511 Industrial mold manufacturing	333511
333512 Metal cutting machine tool manufacturing	333512
333513 Metal forming machine tool manufacturing	333513
333514 Special tool, die, jig, and fixture manufacturing	333514
333515 Cutting tool and machine tool accessory manufacturing	333515
33351A Rolling mill and other metalworking machinery	333516, 333518
3336 Turbine and power transmission equipment manufacturing	
333611 Turbine and turbine generator set units manufacturing	333611
33361A Speed changers and mechanical power transmission equipment	333612-3
333618 Other engine equipment manufacturing	333618
3339 Other general purpose machinery manufacturing	
333911 Pump and pumping equipment manufacturing	333911
333912 Air and gas compressor manufacturing	333912
333913 Measuring and dispensing pump manufacturing	333913
333921 Elevator and moving stairway manufacturing	333921
333922 Conveyor and conveying equipment manufacturing	333922
333923 Overhead cranes, hoists, and monorail systems	333923
333924 Industrial truck, trailer, and stacker manufacturing	333924
333991 Power-driven handtool manufacturing	333991
333992 Welding and soldering equipment manufacturing	333992
333993 Packaging machinery manufacturing	333993
333994 Industrial process furnace and oven manufacturing	333994
333995 Fluid power cylinder and actuator manufacturing	333995
333996 Fluid power pump and motor manufacturing	333996
33399A Scales, balances, and miscellaneous general purpose machinery	333997, 333999
3341 Computer and peripheral equipment manufacturing	
334111 Electronic computer manufacturing	334111
334112 Computer storage device manufacturing	334112
334113 Computer terminal manufacturing	334113
334119 Other computer peripheral equipment manufacturing	334119
334A Audio, video, and communications equipment manufacturing	
334210 Telephone apparatus manufacturing	33421
334220 Broadcast and wireless communications equipment	33422
334290 Other communications equipment manufacturing	33429
334300 Audio and video equipment manufacturing	3343
3344 Semiconductor and electronic component manufacturing	
334411 Electron tube manufacturing	334411
334413 Semiconductors and related device manufacturing	334413
33441A All other electronic component manufacturing	334412, 334414-9
3345 Electronic instrument manufacturing	
334510 Electromedical apparatus manufacturing	334510
334511 Search, detection, and navigation instruments	334511
334512 Automatic environmental control manufacturing	334512
334513 Industrial process variable instruments	334513
334514 Totalizing fluid meters and counting devices	334514
334515 Electricity and signal testing instruments	334515

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
334516 Analytical laboratory instrument manufacturing	334516
334517 Irradiation apparatus manufacturing	334517
33451A Watch, clock, and other measuring and controlling device manufacturing	334518-9
3346 Magnetic media manufacturing and reproducing	
334611 Software reproducing	334611
334612 Audio and video media reproduction	334612
334613 Magnetic and optical recording media manufacturing	334613
3351 Electric lighting equipment manufacturing	
335110 Electric lamp bulb and part manufacturing	33511
335120 Lighting fixture manufacturing	33512
3352 Household appliance manufacturing	
335211 Electric housewares and household fan manufacturing	335211
335212 Household vacuum cleaner manufacturing	335212
335221 Household cooking appliance manufacturing	335221
335222 Household refrigerator and home freezer manufacturing	335222
335224 Household laundry equipment manufacturing	335224
335228 Other major household appliance manufacturing	335228
3353 Electrical equipment manufacturing	
335311 Electric power and specialty transformer manufacturing	335311
335312 Motor and generator manufacturing	335312
335313 Switchgear and switchboard apparatus manufacturing	335313
335314 Relay and industrial control manufacturing	335314
3359 Other electrical equipment and component manufacturing	
335911 Storage battery manufacturing	335911
335912 Primary battery manufacturing	335912
335921 Fiber optic cable manufacturing	335921
335929 Other communication and energy wire manufacturing	335929
335930 Wiring device manufacturing	33593
335991 Carbon and graphite product manufacturing	335991
335999 Miscellaneous electrical equipment manufacturing	335999
3361 Motor vehicle manufacturing	
336110 Automobile and light truck manufacturing	33611
336120 Heavy duty truck manufacturing	33612
336A Motor vehicle body, trailer, and parts manufacturing	
336211 Motor vehicle body manufacturing	336211
336212 Truck trailer manufacturing	336212
336213 Motor home manufacturing	336213
336214 Travel trailer and camper manufacturing	336214
336300 Motor vehicle parts manufacturing	3363
3364 Aerospace product and parts manufacturing	
336411 Aircraft manufacturing	336411
336412 Aircraft engine and engine parts manufacturing	336412
336413 Other aircraft parts and equipment	336413
336414 Guided missile and space vehicle manufacturing	336414
33641A Propulsion units and parts for space vehicles and guided missiles	336415, 336419
336B Other transportation equipment manufacturing	
336500 Railroad rolling stock manufacturing	3365
336611 Ship building and repairing	336611
336612 Boat building	336612
336991 Motorcycle, bicycle, and parts manufacturing	336991
336992 Military armored vehicles and tank parts manufacturing	336992
336999 All other transportation equipment manufacturing	336999
3370 Furniture and related product manufacturing	
337110 Wood kitchen cabinet and countertop manufacturing	33711
337121 Upholstered household furniture manufacturing	337121
337122 Nonupholstered wood household furniture manufacturing	337122
337124 Metal household furniture manufacturing	337124
337127 Institutional furniture manufacturing	337127
33712A Other household and institutional furniture	337125, 337129
337211 Wood office furniture manufacturing	337211
337212 Custom architectural woodwork and millwork	337212
337214 Office furniture, except wood, manufacturing	337214
337215 Showcases, partitions, shelving, and lockers	337215
337910 Mattress manufacturing	33791
337920 Blind and shade manufacturing	33792
3391 Medical equipment and supplies manufacturing	
339111 Laboratory apparatus and furniture manufacturing	339111
339112 Surgical and medical instrument manufacturing	339112
339113 Surgical appliance and supplies manufacturing	339113
339114 Dental equipment and supplies manufacturing	339114
339115 Ophthalmic goods manufacturing	339115
339116 Dental laboratories	339116
3399 Other miscellaneous manufacturing	
339910 Jewelry and silverware manufacturing	33991
339920 Sporting and athletic goods manufacturing	33992
339930 Doll, toy, and game manufacturing	33993
339940 Office supplies, except paper, manufacturing	33994
339950 Sign manufacturing	33995
339991 Gasket, packing, and sealing device manufacturing	339991
339992 Musical instrument manufacturing	339992
339994 Broom, brush, and mop manufacturing	339994
339995 Burial casket manufacturing	339995
33999A Buttons, pins, and all other miscellaneous manufacturing	339993, 339999
WHOLESALE TRADE	
4200 Wholesale trade	
420000 Wholesale trade	42
RETAIL TRADE	
4A00 Retail trade	
4A0000 Retail trade	44, 45
TRANSPORTATION AND WAREHOUSING, EXCLUDING POSTAL SERVICE	
4810 Air transportation	
481000 Air transportation	481
4820 Rail transportation	
482000 Rail transportation	482
4830 Water transportation	
483000 Water transportation	483
4840 Truck transportation	
484000 Truck transportation	484
4850 Transit and ground passenger transportation	
485A00 Transit and ground passenger transportation	485 (1)
4860 Pipeline transportation	
486000 Pipeline transportation	486
48A0 Scenic and sightseeing transportation and support activities for transportation	
48A000 Scenic and sightseeing transportation and support activities for transportation	487, 488
4920 Couriers and messengers	
492000 Couriers and messengers	492
4930 Warehousing and storage	
493000 Warehousing and storage	493
INFORMATION	
5111 Newspaper, book, and directory publishers	
511110 Newspaper publishers	51111
511120 Periodical publishers	51112

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
511130 Book publishers	51113
5111A0 Database, directory, and other publishers	51114, 51119
5112 Software publishers	
511200 Software publishers	5112
5120 Motion picture and sound recording industries	
512100 Motion picture and video industries	5121
512200 Sound recording industries	5122
5131 Radio and television broadcasting	
513100 Radio and television broadcasting	5131
5132 Cable networks and program distribution	
513200 Cable networks and program distribution	5132
5133 Telecommunications	
513300 Telecommunications	5133
5141 Information services	
514100 Information services	5141
5142 Data processing services	
514200 Data processing services	5142
FINANCE AND INSURANCE	
52A0 Monetary authorities, credit intermediation and related activities	
52A000 Monetary authorities and depository credit intermediation.	521, 5221
522A00 Nondepository credit intermediation and related activities.	5222, 5223
Securities, commodity contracts, investments	
523000 Securities, commodity contracts, investments	523
5240 Insurance carriers and related activities	
524100 Insurance carriers	5241
524200 Insurance agencies, brokerages, and related	5242
5250 Funds, trusts, and other financial vehicles	
525000 Funds, trusts, and other financial vehicles	525
REAL ESTATE AND RENTAL AND LEASING	
5310 Real estate	
531000 Real estate	531
S008 Owner-occupied dwellings	
S00800 Owner-occupied dwellings	
5321 Automotive equipment rental and leasing	
532100 Automotive equipment rental and leasing	5321
532A Consumer goods and general rental centers	
532A00 General and consumer goods rental except video tapes and discs	53221, 53222, 53229, 5323
532230 Video tape and disc rental	53223
5324 Machinery and equipment rental and leasing	
532400 Machinery and equipment rental and leasing	5324
5330 Lessors of nonfinancial intangible assets	
533000 Lessors of nonfinancial intangible assets	533
PROFESSIONAL, SCIENTIFIC, AND TECHNICAL SERVICES	
[illegible]11 Legal services	
541100 Legal services	5411
Accounting and bookkeeping services	
541200 Accounting and bookkeeping services	5412
5413 Architectural and engineering services	
541300 Architectural and engineering services	5413
5414 Specialized design services	
541400 Specialized design services	5414
5415 Computer systems design and related services	
541511 Custom computer programming services	541511
541512 Computer systems design services	541512
54151A Other computer related services, including facilities management	541513, 541519
5416 Management and technical consulting services	
541610 Management consulting services	54161
5416A0 Environmental and other technical consulting services	54162, 54169
5417 Scientific research and development services	
541700 Scientific research and development services	5417
5418 Advertising and related services	
541800 Advertising and related services	5418
5419 Other professional and technical services	
541920 Photographic services	54192
541940 Veterinary services	54194
5419A0 All other miscellaneous professional and technical services	54191, 54193, 54199
MANAGEMENT OF COMPANIES AND ENTERPRISES	
5500 Management of companies and enterprises	
550000 Management of companies and enterprises	55
ADMINISTRATIVE AND WASTE MANGEMENT SERVICES	
5613 Employment services	
561300 Employment services	5613
5615 Travel arrangement and reservation services	
561500 Travel arrangement and reservation services	5615
561A All other administrative and support services	
561100 Office administrative services	5611
561200 Facilities support services	5612
561400 Business support services	5614
561600 Investigation and security services	5616
561700 Services to buildings and dwellings	5617
561900 Other support services	5619
5620 Waste management and remediation services	
562000 Waste management and remediation services	562
EDUCATIONAL SERVICES	
6100 Educational services	
611100 Elementary and secondary schools	6111
611A00 Colleges, universities, and junior colleges	6112, 6113
611B00 Other educational services	6114, 6115, 6116, 6117
HEALTH CARE AND SOCIAL ASSISTANCE	
6210 Ambulatory health care services	
621A00 Offices of physicians, dentists, and other health practitioners	6211, 6212, 6213
621600 Home health care services	6216
621B00 Other ambulatory health care services	6214, 6215, 6219
6220 Hospitals	
622000 Hospitals	622
6230 Nursing and residential care facilities	
623000 Nursing and residential care facilities	623
6240 Social assistance	
624400 Child day care services	6244

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
624A00 Social assistance, except child day care services	6241, 6242, 6243
ARTS, ENTERTAINMENT, AND RECREATION	
71A0 Performing arts, spectator sports, museums, zoos, and parks	
711100 Performing arts companies	7111
711200 Spectator sports	7112
711A00 Promoters of performing arts and sports and agents for public figures	7113, 7114
711500 Independent artists, writers, and performers	7115
712000 Museums, historical sites, zoos, and parks	712
7130 Amusements, gambling, and recreation	
713940 Fitness and recreational sports centers	71394
713950 Bowling centers	71395
713A00 Other amusement, gambling, and recreation industries	7131, 7132, 71391, 71392, 71393, 71399
ACCOMMODATION AND FOOD SERVICES	
7210 Accommodation	
7211A0 Hotels and motels, including casino hotels	72111, 72112
721A00 Other accommodations	72119, 7212, 7213
7220 Food services and drinking places	
722000 Food services and drinking places	722
OTHER SERVICES, EXCEPT PUBLIC ADMINISTRATION	
8111 Automotive repair and maintenance	
8111A0 Automotive repair and maintenance, except car washes	81111, 81112, 811191, 811198
811192 Car washes	811192
Electronic, commercial, and household goods repair	
811200 Electronic equipment repair and maintenance	8112
811300 Commercial machinery repair and maintenance	8113
811400 Household goods repair and maintenance	8114
8120 Personal and laundry services	
812100 Personal care services	8121
812200 Death care services	8122
812300 Drycleaning and laundry services	8123
812900 Other personal services	8129
813A Religious, grantmaking and giving, and social advocacy organizations	
813100 Religious organizations	8131
813A00 Grantmaking and giving and social advocacy organizations	8132, 8133
813B Civic, social, professional and similar organizations	
813B00 Civic, social, professional and similar organizations	8134, 8139
SPECIAL INDUSTRIES	
S001 Federal and state and local government enterprises	
491000 Postal service	491
S00A00 Other government enterprises	
S002 Households	
H00000 Households	

1. Includes Federal Government enterprises.

Appendix C.—RIMS II Industry Aggregations

	Aggregate industry code and title	RIMS II detailed industry codes[1]
	Agriculture, forestry, fishing, and hunting	
1	Crop and animal production	1111A0-112A00
2	Forestry, fishing, and related activities	113A00-115000
	Mining	
3	Oil and gas extraction	211000
4	Mining, except oil and gas	212100-212390
5	Support activities for mining	213111-21311A
	Utilities*	
6	Utilities*	2211A0-221300
	Construction	
7	Construction	230000
	Manufacturing	
8	Wood product manufacturing	321113-321999
9	Nonmetallic mineral product manufacturing	327111-327999
10	Primary metal manufacturing	331111-33152B
11	Fabricated metal product manufacturing	332111-332999
12	Machinery manufacturing	333111-33399A
13	Computer and electronic product manufacturing	334111-334613
14	Electrical equipment and appliance manufacturing	335110-335999
15	Motor vehicle, body, trailer, and parts manufacturing	336110-336300
16	Other transportation equipment manufacturing	336411-336999
17	Furniture and related product manufacturing	337110-337920
18	Miscellaneous manufacturing	339111-33999A
19	Food, beverage, and tobacco product manufacturing	311111-312229
20	Textile and textile product mills	313100-31499A
21	Apparel, leather, and allied product manufacturing	315111-316900
22	Paper manufacturing	322110-322299
23	Printing and related support activities	32311A-323122
24	Petroleum and coal products manufacturing	324110-324199
25	Chemical manufacturing	325110-325998
26	Plastics and rubber products manufacturing	326110-326290
	Wholesale trade	
27	Wholesale trade	420000
	Retail trade	
28	Retail trade	4A0000
	Transportation and warehousing*	
29	Air transportation	481000
30	Rail transportation	482000
31	Water transportation	483000
32	Truck transportation	484000
33	Transit and ground passenger transportation*	485A00
34	Pipeline transportation	486000
35	Other transportation and support activities*	48A000-492000, 491000
36	Warehousing and storage	493000

Appendix C.—RIMS II Industry Aggregations

Aggregate industry code and title		RIMS II detailed industry codes[1]
	Information	
37	Publishing including software	511110-511200
38	Motion picture and sound recording industries	512100-512200
39	Broadcasting and telecommunications	513100-513300
40	Information and data processing services	514100-514200
	Finance and insurance	
41	Federal Reserve banks, credit intermediation and related services	52A000-522A00
42	Securities, commodity contracts, investments	523000
43	Insurance carriers and related activities	524100-524200
44	Funds, trusts, and other financial vehicles	525000
	Real estate and rental and leasing	
45	Real estate	531000, S00800
46	Rental and leasing services and lessors of intangible assets	532100-533000
	Professional, scientific, and technical services	
47	Professional, scientific, and technical services	541100-5419A0
	Management of companies and enterprises	
48	Management of companies and enterprises	550000
	Administrative and waste management services	
49	Administrative and support services	561300-561900
50	Waste management and remediation services	562000
	Educational services	
51	Educational services	611100-611B00
	Health care and social assistance	
52	Ambulatory health care services	621A00-621B00
53	Hospitals and nursing and residential care facilities	622000-623000
54	Social assistance	624400-624A00
	Arts, entertainment, and recreation	
55	Performing arts, museums, and related activities	711100-712000
56	Amusements, gambling, and recreation	713940-713A00
	Accommodation and food services	
57	Accommodation	7211A0-721A00
58	Food services and drinking places	722000
	Other services*	
59	Other services*	8111A0-813B00, S00A00
	Households	
60	Households	H00000

* Includes Federal Government enterprises.
1. Appendix B identifies the RIMS II detailed industry codes.

Appendix D.—RIMS II Industry Groups

Group industry code and title		RIMS II detailed industry codes[1]	RIMS II aggregate industry codes[2]
1	Agriculture, forestry, fishing, and hunting	1111A0-115000	1-2
2	Mining	211000-21311A	3-5
3	Utilities*	2211A0-221300	6
4	Construction	230000	7
5	Manufacturing	311111-33999A	8-26
6	Wholesale trade	420000	27
7	Retail trade	4A0000	28
8	Transportation and warehousing*	481000-493000	29-36
9	Information	511110-514200	37-40
10	Finance and insurance	52A000-525000	41-44
11	Real estate and rental and leasing	531000-533000	45-46
12	Professional, scientific, and technical services	541100-5419A0	47
13	Management of companies and enterprises	550000	48
14	Administrative and waste management services	561300-562000	49-50
15	Educational services	611100-611B00	51
16	Health care and social assistance	621A00-624A00	52-54
17	Arts, entertainment, and recreation	711100-713A00	55-56
18	Accommodation and food services	7211A0-722000	57-58
19	Other services*	8111A0-813B00, S00A00	59
20	Households	H00000	60

* Includes Federal Government enterprises.
1. Appendix C identifies the RIMS II detailed industry codes.
2. Appendix B identifies the RIMS II aggregate industry codes.

Description of files README.DOC October 1, 2005

Source

The Regional Input-Output Modeling System (RIMS II) multipliers on these files were prepared by the Regional Economic Analysis Division, Bureau of Economic Analysis, BE-61, U.S. Department of Commerce. For questions about the multipliers please call (202-606-5343), or FAX (202-606-5321), or e-mail (rimsread@bea.gov).

Ordering information

For your convenience there is an order form on the RIMS II web site for submitting orders for RIMS II multipliers, http://www.bea.gov/bea/regional/rims/orderform.htm. Customized RIMS II multipliers are available for any region comprised of one or more counties at a cost of $275 per region.

Description of RIMS II

The RIMS II multipliers presented here are based on BEA's 1997 national benchmark input-output (I-O) accounts and BEA's 2003 regional economic accounts. RIMS II multipliers based on these sources were first released October 2005.

For more information on the RIMS II model, please consult the RIMS II handbook, "Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (Third Edition, March 1997)." A PDF version of the handbook can be downloaded from the RIMS II web site, http://www.bea.gov/bea/regional/rims/

Description of files

The CD contains the RIMS II Viewer, a JAVA-based data retrieval program that can be used to read and write RIMS II data to file(s) for further analysis with software packages. It also contains distribution costs data.

The retrieval program must be installed by running the setup program setupwin32.exe (stored on the CD) from within Windows. Running this program opens the Installation Wizard, which acts as a guide in opening and storing all the necessary files for the RIMS II Viewer and the requested region(s). For help using the RIMS II Viewer, enter the program by clicking the icon created on your desktop by the setup program, then press F1 for detailed help information or F2 for help on getting started.

Files included on CD:

File	Description
README.doc	Description of the data product
COUNTIES.txt	County name and corresponding region number
REGIONS.txt	Region name, region number, and year of regional data used in estimating multipliers
IO473.txt	I-O industries and descriptions
Colrow60.txt	RIMS II aggregate industries and descriptions
Row20.txt	RIMS II aggregate row industries and descriptions
FINALUSE.txt	I-O final use codes and descriptions
FTABC60X.txt	File layout for TABC60X.txt
FTABD60X.txt	File layout for TABD60X.txt
FTABE60X.txt	File layout for TABE60X.txt
FTABF60X.txt	File layout for TABF60X.txt
FTABC473X.txt	File layout for TABC473X.txt
FTABD473X.txt	File layout for TABD473X.txt
FTABE473X.txt	File layout for TABE473X.txt
FTABF473X.txt	File layout for TABF473X.txt

Distribution Cost Files

File	Description
TABC60X.txt	Commodity composition of NIPA final demand for the RIMS II industry aggregations
TABD60X.txt	Commodity composition of Personal Consumption Expenditures by PCE Category for the RIMS II industry aggregations
TABE60X.txt	Commodity composition of Producers' Durable Equipment Expenditures by PDE category for the RIMS II industry aggregations
TABF60X.txt	Commodity composition of intermediate purchases for the RIMS II industry aggregations
TABC473X.txt	Commodity composition of NIPA final demand for the RIMS II detailed industries
TABD473X.txt	Commodity composition of Personal Consumption Expenditures by PCE Category for the RIMS II detailed industries
TABE473X.txt	Commodity composition of Producers' Durable Equipment Expenditures by PDE category for the RIMS II detailed industries
TABF473X.txt	Commodity composition of intermediate purchases for the RIMS II detailed industries

RG##.exe Files

File	Description
TOTLRG##.dat	20-by-473 final-demand output multipliers for region ##
EARNRG##.dat	20-by-473 final-demand earnings multipliers for region ##
EMPLRG##.dat	20-by-473 final-demand employment multipliers for region ##
TLSQRG##.dat	20-by-60 final-demand output multipliers for region ##
ERSQRG##.dat	20-by-60 final-demand earnings multipliers for region ##
JBSQRG##.dat	20-by-60 final-demand employment multipliers for region ##
M473RG##.dat	Summary multipliers for 473 detailed I-O industries for region ##
M_60RG##.dat	Summary multipliers for 60 RIMS II aggregate industries for region ##

File Layout for Data Files: TOTLRG##.dat, EARNRG##.dat, EMPLRG##.dat, TLSQRG##.dat, ERSQRG##.dat, and JBSQRG##.dat

Columns	Description
1 - 2	Row number
3 - 6	Column number
7 - 5	Multiplier

File Layout for Data File: M473RG##.dat

Columns	Description
1 - 8	Detailed industry number
9 - 19	Total final-demand multiplier for output
20 - 30	Total final-demand multiplier for earnings
31 - 41	Total final-demand multiplier for employment
42 - 52	Total direct-effect multiplier for earnings
53 - 63	Total direct-effect multiplier for employment

File Layout for Data File: M_60RG##.dat

Columns	Description
1 - 6	RIMS II aggregate industry number
7 - 17	Total final-demand multiplier for output
18 - 28	Total final-demand multiplier for earnings
29 - 39	Total final-demand multiplier for employment
40 - 50	Total direct-effect multiplier for earnings
51 - 61	Total direct-effect multiplier for employment

File Layout for Data File: IO473.txt

Columns	Description
1 - 3	Column number for 473 detailed industries
5 - 11	I-O industry code
12 - 13	Column number for 60 aggregate industries
15 - 20	Column number for 473 detailed industries
22 - 98	I-O industry description

File Layout for Data File: Colrow60.txt

Columns	Description
1 - 2	Column number for 60 aggregate industries
6 - 98	I-O industry description

File Layout for Data File: Row20.txt

Columns	Description
1 - 2	Column number for 20 aggregate industries
5 - 98	I-O industry description

File Layout for Data File: COUNTIES.txt

Columns	Description
1 - 2	Region number
4 - 51	County name

File Layout for Data File: REGIONS.txt

Columns	Description
1 - 2	Region number
4 - 52	Region name, Regional data year, National input-output data year

RIMS II Multipliers

Each entry in TOTLRG##.dat (the file containing the 20-by-473 total final-demand output multipliers) represents the dollar change in output that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-19 represents the dollar change in output that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M473RG##.dat as the second entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in TLSQRG##.dat (the file containing the 20-by-60 total final-demand output multipliers) represents the dollar change in output that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-19 represents the dollar change in output that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M_60RG##.dat as the second entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in EARNRG##.dat (the file containing the 20-by-473 total final-demand earnings multipliers) represents the dollar change in earnings that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-20 represents the dollar change in earnings that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M473RG##.dat as the third entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in ERSQRG##.dat (the file containing the 20-by-60 total final-demand earnings multipliers) represents the dollar change in earnings that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-20 represents the dollar change in earnings that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M_60RG##.dat as the third entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in EMPLRG##.dat (the file containing the 20-by-473 total final-demand employment multipliers) represents the change in the number of jobs that occurs in the row industry for each additional 1 million dollars of output delivered to final demand by the column industry. Because the employment multipliers are based on 2003 data, the output delivered to final demand should be in 2003 dollars. For each column, the sum of the entries in rows 1-20 represents the change in the number of jobs that occurs in all row industries for each additional 1 million dollars of output delivered to final demand by the column industry. This value appears in M473RG##.dat as the fourth entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in JBSQRG##.dat (the file containing the 20-by-60 total final-demand employment multipliers) represents the change in the number of jobs that occurs in the row industry for each additional 1 million dollars of output delivered to final demand by the column industry. Because the employment multipliers are based on 2003 data, the output delivered to final demand should be in 2003 dollars. For each column, the sum of the entries in rows 1-20 represents the change in the number of jobs that occurs in all row industries for each additional 1 million dollars of output delivered to final demand by the column industry. This value appears in M_60RG##.dat as the fourth entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

The fifth entry on each record in M473RG##.dat or M_60RG##.dat represents the total dollar change in earnings of households employed by all row industries for each additional dollar of earnings paid directly to households employed by the industry corresponding to the industry on the record.

The sixth entry on each record in M473RG##.dat or M_60RG##.dat represents the total change in number of jobs in all row industries for each additional job in the industry corresponding to the industry on the record.

Table 1.4 is a printed version of M473RG##.dat and Table 2.4 is a printed version of M_60RG##.dat. In M473RG### and M_60RG##, zero entries appears for the total direct-effect multipliers for the households industry. Only in these cases, does a zero entry represent a null value.

Distribution Costs Tables

RIMS II provides final-use and intermediate-use distribution costs (wholesale and retail trade margins and transportation costs) tables for both the 473 detailed industries and the 60 industry aggregations. These tables can assist RIMS II users in converting final-demand changes into producers' prices.

The distribution costs tables for final purchases are based on BEA's 1997 national benchmark Input-Output Supplementary Tables. The supplementary tables are bridges between the I-O accounts and the NIPA's. They present the I-O commodity composition of NIPA final demand in producers' and purchasers' prices. Specifically, Table C presents the composition of all NIPA final-demand components; Table D, the composition of personal consumption expenditure categories; Table E, the composition of NIPA producers' durable equipment expenditure categories. Table F, the distribution costs tables for intermediate purchases, is based on data from BEA's 1997 national benchmark Use table.

Section 5.8
Ref 8

U.S. Census Bureau
American FactFinder

DP-1. Profile of General Demographic Characteristics: 2000 - US Census Bureau (2000
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Chapin town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	628	100.0
SEX AND AGE		
Male	298	47.5
Female	330	52.5
Under 5 years	49	7.8
5 to 9 years	41	6.5
10 to 14 years	48	7.6
15 to 19 years	34	5.4
20 to 24 years	26	4.1
25 to 34 years	110	17.5
35 to 44 years	103	16.4
45 to 54 years	77	12.3
55 to 59 years	26	4.1
60 to 64 years	24	3.8
65 to 74 years	44	7.0
75 to 84 years	35	5.6
85 years and over	11	1.8
Median age (years)	35.6	(X)
18 years and over	466	74.2
Male	219	34.9
Female	247	39.3
21 years and over	453	72.1
62 years and over	103	16.4
65 years and over	90	14.3
Male	37	5.9
Female	53	8.4
RACE		
One race	623	99.2
White	578	92.0
Black or African American	40	6.4
American Indian and Alaska Native	1	0.2
Asian	1	0.2
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	1	0.2
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0

SCEG-089

Subject	Number	Percent
Some other race	3	0.5
Two or more races	5	0.8
Race alone or in combination with one or more other races [3]		
White	583	92.8
Black or African American	40	6.4
American Indian and Alaska Native	3	0.5
Asian	1	0.2
Native Hawaiian and Other Pacific Islander	2	0.3
Some other race	4	0.6
HISPANIC OR LATINO AND RACE		
Total population	**628**	**100.0**
Hispanic or Latino (of any race)	4	0.6
Mexican	0	0.0
Puerto Rican	1	0.2
Cuban	0	0.0
Other Hispanic or Latino	3	0.5
Not Hispanic or Latino	624	99.4
White alone	577	91.9
RELATIONSHIP		
Total population	**628**	**100.0**
In households	628	100.0
Householder	249	39.6
Spouse	151	24.0
Child	192	30.6
Own child under 18 years	153	24.4
Other relatives	21	3.3
Under 18 years	6	1.0
Nonrelatives	15	2.4
Unmarried partner	8	1.3
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Total households	**249**	**100.0**
Family households (families)	193	77.5
With own children under 18 years	89	35.7
Married-couple family	151	60.6
With own children under 18 years	68	27.3
Female householder, no husband present	31	12.4
With own children under 18 years	17	6.8
Nonfamily households	56	22.5
Householder living alone	49	19.7
Householder 65 years and over	23	9.2
Households with individuals under 18 years	94	37.8
Households with individuals 65 years and over	67	26.9
Average household size	2.52	(X)
Average family size	2.89	(X)
HOUSING OCCUPANCY		
Total housing units	**261**	**100.0**
Occupied housing units	249	95.4
Vacant housing units	12	4.6
For seasonal, recreational, or occasional use	0	0.0
Homeowner vacancy rate (percent)	2.7	(X)
Rental vacancy rate (percent)	6.5	(X)

Subject HOUSING TENURE	Number	Percent
Occupied housing units	**249**	**100.0**
Owner-occupied housing units	220	88.4
Renter-occupied housing units	29	11.6
Average household size of owner-occupied unit	2.49	(X)
Average household size of renter-occupied unit	2.79	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

DP-1. **Profile of General Demographic Characteristics: 2000**
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Little Mountain town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**255**	**100.0**
SEX AND AGE		
Male	124	48.6
Female	131	51.4
Under 5 years	11	4.3
5 to 9 years	18	7.1
10 to 14 years	10	3.9
15 to 19 years	14	5.5
20 to 24 years	10	3.9
25 to 34 years	34	13.3
35 to 44 years	47	18.4
45 to 54 years	45	17.6
55 to 59 years	17	6.7
60 to 64 years	16	6.3
65 to 74 years	19	7.5
75 to 84 years	11	4.3
85 years and over	3	1.2
Median age (years)	41.6	(X)
18 years and over	207	81.2
Male	102	40.0
Female	105	41.2
21 years and over	200	78.4
62 years and over	46	18.0
65 years and over	33	12.9
Male	13	5.1
Female	20	7.8
RACE		
One race	255	100.0
White	221	86.7
Black or African American	33	12.9
American Indian and Alaska Native	0	0.0

Subject	Number	Percent
Asian	0	0.0
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0
Some other race	1	0.4
Two or more races	0	0.0
Race alone or in combination with one or more other races [3]		
White	221	86.7
Black or African American	33	12.9
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Some other race	1	0.4
HISPANIC OR LATINO AND RACE		
Total population	**255**	**100.0**
Hispanic or Latino (of any race)	1	0.4
Mexican	1	0.4
Puerto Rican	0	0.0
Cuban	0	0.0
Other Hispanic or Latino	0	0.0
Not Hispanic or Latino	254	99.6
White alone	221	86.7
RELATIONSHIP		
Total population	**255**	**100.0**
In households	255	100.0
Householder	121	47.5
Spouse	59	23.1
Child	58	22.7
Own child under 18 years	45	17.6
Other relatives	8	3.1
Under 18 years	2	0.8
Nonrelatives	9	3.5
Unmarried partner	5	2.0
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Total households	**121**	**100.0**
Family households (families)	75	62.0
With own children under 18 years	30	24.8
Married-couple family	59	48.8
With own children under 18 years	23	19.0
Female householder, no husband present	12	9.9
With own children under 18 years	4	3.3
Nonfamily households	46	38.0
Householder living alone	42	34.7
Householder 65 years and over	17	14.0
Households with individuals under 18 years	32	26.4
Households with individuals 65 years and over	29	24.0

Subject	Number	Percent
Average household size	2.11	(X)
Average family size	2.67	(X)
HOUSING OCCUPANCY		
Total housing units	**132**	**100.0**
Occupied housing units	121	91.7
Vacant housing units	11	8.3
For seasonal, recreational, or occasional use	2	1.5
Homeowner vacancy rate (percent)	0.0	(X)
Rental vacancy rate (percent)	7.7	(X)
HOUSING TENURE		
Occupied housing units	**121**	**100.0**
Owner-occupied housing units	73	60.3
Renter-occupied housing units	48	39.7
Average household size of owner-occupied unit	2.18	(X)
Average household size of renter-occupied unit	2.00	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

DP-1. Profile of General Demographic Characteristics: 2000

Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Peak town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**61**	**100.0**
SEX AND AGE		
Male	23	37.7
Female	38	62.3
Under 5 years	1	1.6
5 to 9 years	4	6.6
10 to 14 years	5	8.2
15 to 19 years	3	4.9
20 to 24 years	1	1.6
25 to 34 years	7	11.5
35 to 44 years	12	19.7
45 to 54 years	6	9.8
55 to 59 years	4	6.6
60 to 64 years	3	4.9
65 to 74 years	9	14.8
75 to 84 years	5	8.2
85 years and over	1	1.6
Median age (years)	43.2	(X)
18 years and over	50	82.0

Subject	Number	Percent
Male	18	29.5
Female	32	52.5
21 years and over	48	78.7
62 years and over	18	29.5
65 years and over	15	24.6
Male	4	6.6
Female	11	18.0
RACE		
One race	61	100.0
White	42	68.9
Black or African American	19	31.1
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0
Some other race	0	0.0
Two or more races	0	0.0
Race alone or in combination with one or more other races [3]		
White	42	68.9
Black or African American	19	31.1
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Some other race	0	0.0
HISPANIC OR LATINO AND RACE		
Total population	**61**	**100.0**
Hispanic or Latino (of any race)	1	1.6
Mexican	0	0.0
Puerto Rican	0	0.0
Cuban	1	1.6
Other Hispanic or Latino	0	0.0
Not Hispanic or Latino	60	98.4
White alone	42	68.9
RELATIONSHIP		
Total population	**61**	**100.0**
In households	61	100.0
Householder	28	45.9
Spouse	12	19.7
Child	17	27.9
Own child under 18 years	11	18.0
Other relatives	2	3.3
Under 18 years	0	0.0
Nonrelatives	2	3.3
Unmarried partner	2	3.3
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		

Subject	Number	Percent
Total households	**28**	**100.0**
Family households (families)	17	60.7
With own children under 18 years	6	21.4
Married-couple family	12	42.9
With own children under 18 years	4	14.3
Female householder, no husband present	5	17.9
With own children under 18 years	2	7.1
Nonfamily households	11	39.3
Householder living alone	11	39.3
Householder 65 years and over	6	21.4
Households with individuals under 18 years	6	21.4
Households with individuals 65 years and over	12	42.9
Average household size	2.18	(X)
Average family size	2.82	(X)
HOUSING OCCUPANCY		
Total housing units	**36**	**100.0**
Occupied housing units	28	77.8
Vacant housing units	8	22.2
For seasonal, recreational, or occasional use	3	8.3
Homeowner vacancy rate (percent)	0.0	(X)
Rental vacancy rate (percent)	0.0	(X)
HOUSING TENURE		
Occupied housing units	**28**	**100.0**
Owner-occupied housing units	27	96.4
Renter-occupied housing units	1	3.6
Average household size of owner-occupied unit	2.22	(X)
Average household size of renter-occupied unit	1.00	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] *Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.*
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

DP-1. **Profile of General Demographic Characteristics: 2000**
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Pomaria town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	*Number*	*Percent*
Total population	177	100.0
SEX AND AGE		
Male	98	55.4
Female	79	44.6
Under 5 years	18	10.2
5 to 9 years	8	4.5
10 to 14 years	6	3.4
15 to 19 years	13	7.3

Subject	Number	Percent
20 to 24 years	13	7.3
25 to 34 years	25	14.1
35 to 44 years	28	15.8
45 to 54 years	21	11.9
55 to 59 years	8	4.5
60 to 64 years	6	3.4
65 to 74 years	17	9.6
75 to 84 years	7	4.0
85 years and over	7	4.0
Median age (years)	37.5	(X)
18 years and over	136	76.8
Male	70	39.5
Female	66	37.3
21 years and over	129	72.9
62 years and over	34	19.2
65 years and over	31	17.5
Male	13	7.3
Female	18	10.2
RACE		
One race	173	97.7
White	97	54.8
Black or African American	73	41.2
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0
Some other race	3	1.7
Two or more races	4	2.3
Race alone or in combination with one or more other races [3]		
White	98	55.4
Black or African American	77	43.5
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Some other race	6	3.4
HISPANIC OR LATINO AND RACE		
Total population	177	100.0
Hispanic or Latino (of any race)	4	2.3
Mexican	3	1.7
Puerto Rican	0	0.0
Cuban	0	0.0
Other Hispanic or Latino	1	0.6
Not Hispanic or Latino	173	97.7
White alone	96	54.2
RELATIONSHIP		
Total population	177	100.0
In households	177	100.0

Subject	Number	Percent
Householder	70	39.5
Spouse	32	18.1
Child	48	27.1
Own child under 18 years	37	20.9
Other relatives	10	5.6
Under 18 years	3	1.7
Nonrelatives	17	9.6
Unmarried partner	8	4.5
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Total households	**70**	**100.0**
Family households (families)	47	67.1
With own children under 18 years	21	30.0
Married-couple family	32	45.7
With own children under 18 years	12	17.1
Female householder, no husband present	11	15.7
With own children under 18 years	7	10.0
Nonfamily households	23	32.9
Householder living alone	17	24.3
Householder 65 years and over	7	10.0
Households with individuals under 18 years	23	32.9
Households with individuals 65 years and over	23	32.9
Average household size	2.53	(X)
Average family size	2.91	(X)
HOUSING OCCUPANCY		
Total housing units	84	**100.0**
Occupied housing units	70	83.3
Vacant housing units	14	16.7
For seasonal, recreational, or occasional use	1	1.2
Homeowner vacancy rate (percent)	0.0	(X)
Rental vacancy rate (percent)	21.1	(X)
HOUSING TENURE		
Occupied housing units	70	**100.0**
Owner-occupied housing units	55	78.6
Renter-occupied housing units	15	21.4
Average household size of owner-occupied unit	2.44	(X)
Average household size of renter-occupied unit	2.87	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

U.S. Census Bureau
American FactFinder

DP-1. **Profile of General Demographic Characteristics: 2000**
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Columbia city, South Carolina**

NOTE: Corrected counts are available for one or more geographies displayed in this table.

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	116,278	100.0
SEX AND AGE		
Male	56,999	49.0
Female	59,279	51.0
Under 5 years	6,478	5.6
5 to 9 years	6,495	5.6
10 to 14 years	6,195	5.3
15 to 19 years	13,248	11.4
20 to 24 years	17,556	15.1
25 to 34 years	19,541	16.8
35 to 44 years	15,466	13.3
45 to 54 years	12,381	10.6
55 to 59 years	3,948	3.4
60 to 64 years	2,988	2.6
65 to 74 years	5,845	5.0
75 to 84 years	4,595	4.0
85 years and over	1,541	1.3
Median age (years)	28.6	(X)
18 years and over	92,908	79.9
Male	44,864	38.6
Female	48,044	41.3
21 years and over	79,204	68.1
62 years and over	13,735	11.8
65 years and over	11,982	10.3
Male	4,377	3.8
Female	7,605	6.5
RACE		
One race	114,691	98.6
White	57,236	49.2
Black or African American	53,465	46.0
American Indian and Alaska Native	296	0.3
Asian	2,008	1.7
Asian Indian	570	0.5
Chinese	453	0.4
Filipino	216	0.2
Japanese	109	0.1
Korean	353	0.3
Vietnamese	118	0.1
Other Asian [1]	189	0.2
Native Hawaiian and Other Pacific Islander	104	0.1
Native Hawaiian	29	0.0
Guamanian or Chamorro	30	0.0
Samoan	21	0.0

Subject	Number	Percent
Other Pacific Islander [2]	24	0.0
Some other race	1,582	1.4
Two or more races	1,587	1.4
Race alone or in combination with one or more other races [3]		
White	58,295	50.1
Black or African American	54,256	46.7
American Indian and Alaska Native	717	0.6
Asian	2,469	2.1
Native Hawaiian and Other Pacific Islander	217	0.2
Some other race	2,121	1.8
HISPANIC OR LATINO AND RACE		
Total population	**116,278**	**100.0**
Hispanic or Latino (of any race)	3,520	3.0
Mexican	1,387	1.2
Puerto Rican	886	0.8
Cuban	125	0.1
Other Hispanic or Latino	1,122	1.0
Not Hispanic or Latino	112,758	97.0
White alone	55,993	48.2
RELATIONSHIP		
Total population	**116,278**	**100.0**
In households	93,288	80.2
Householder	42,245	36.3
Spouse	13,304	11.4
Child	24,597	21.2
Own child under 18 years	19,161	16.5
Other relatives	5,711	4.9
Under 18 years	2,586	2.2
Nonrelatives	7,431	6.4
Unmarried partner	2,093	1.8
In group quarters	22,990	19.8
Institutionalized population	6,053	5.2
Noninstitutionalized population	16,937	14.6
HOUSEHOLDS BY TYPE		
Total households	**42,245**	**100.0**
Family households (families)	22,136	52.4
With own children under 18 years	10,732	25.4
Married-couple family	13,304	31.5
With own children under 18 years	5,633	13.3
Female householder, no husband present	7,456	17.6
With own children under 18 years	4,548	10.8
Nonfamily households	20,109	47.6
Householder living alone	15,633	37.0
Householder 65 years and over	4,140	9.8
Households with individuals under 18 years	12,130	28.7
Households with individuals 65 years and over	8,580	20.3
Average household size	2.21	(X)
Average family size	2.97	(X)
HOUSING OCCUPANCY		
Total housing units	**46,142**	**100.0**
Occupied housing units	42,245	91.6
Vacant housing units	3,897	8.4
For seasonal, recreational, or occasional use	213	0.5
Homeowner vacancy rate (percent)	2.2	(X)
Rental vacancy rate (percent)	7.7	(X)

Subject	Number	Percent
HOUSING TENURE		
Occupied housing units	42,245	100.0
Owner-occupied housing units	19,282	45.6
Renter-occupied housing units	22,963	54.4
Average household size of owner-occupied unit	2.29	(X)
Average household size of renter-occupied unit	2.14	(X)

(X) Not applicable

[1] Other Asian alone, or two or more Asian categories.

[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.

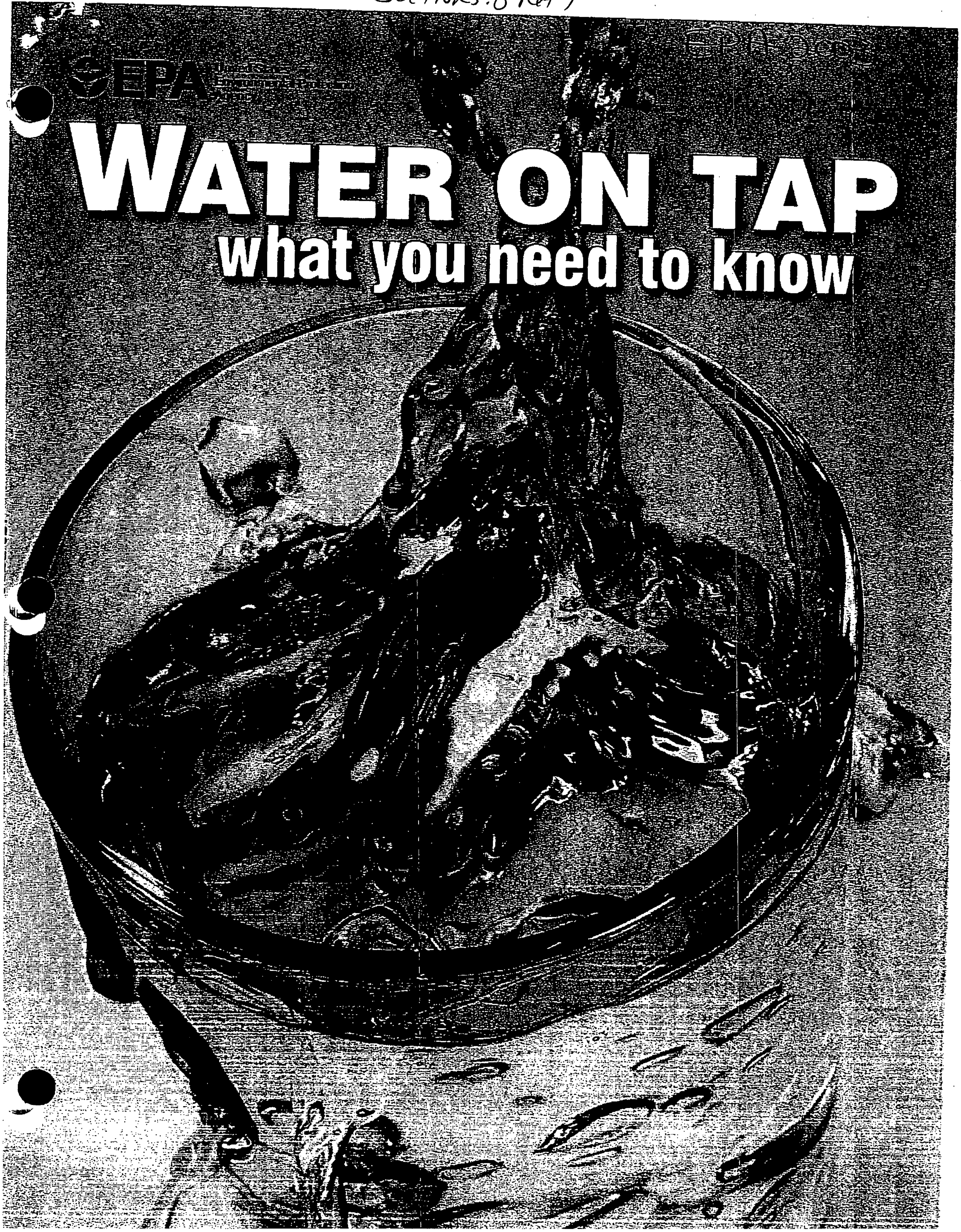
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.

Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

Section 5.8 Ref 9

EPA

WATER ON TAP
what you need to know



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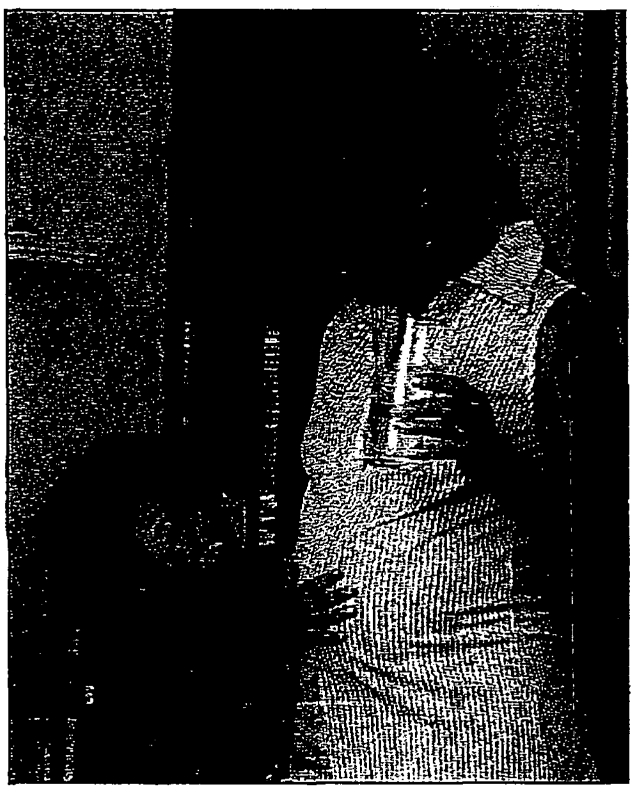
Office of Water (4601)
EPA 816-K-03-007
www.epa.gov/safewater
October 2003

Printed on Recycled Paper

1. A Consumer's Guide To The Nation's Drinking Water

The United States enjoys one of the best supplies of drinking water in the world. Nevertheless, many of us who once gave little or no thought to the water that comes from our taps are now asking the question: "Is my water safe to drink?" While tap water that meets federal and state standards is generally safe to drink, threats to drinking water are increasing. Short-term disease outbreaks and water restrictions during droughts have demonstrated that we can no longer take our drinking water for granted.



Consumers have many questions about their drinking water. How safe is my drinking water? What is being done to improve security of public water systems? Where does my drinking water come from, and how is it treated? Do private **wells** receive the same protection as public water systems? What can I do to help protect my drinking water?

This booklet provides the answers to these and other frequently asked questions.

This booklet also directs you to more detailed sources of information. Often, you will be directed to a page on the EPA website. Additionally, the Safe Drinking Water Hotline is available to answer your questions. Please also see Appendix C for more resources. Refer to the Glossary (Appendix D) for definitions of words in bold font.

What you need to know to protect your family

Sensitive Subpopulations

Some people may be more vulnerable to **contaminants** in drinking water than the general population. People undergoing chemotherapy or living with HIV/AIDS, transplant patients, children and infants, the frail elderly, and pregnant women and their fetuses can be particularly at risk for infections.

If you have special health care needs, consider taking additional precautions with your drinking water, and seek advice from your health care provider. For more information, see *www.epa.gov/safewater/healthcare/special.html*.

You will find information on bottled water and home water treatment units on page 16 of this booklet. You may also contact NSF International, Underwriter's Laboratory, or the Water Quality Association. Contact information is located in Appendix C.

2. How Safe Is My Drinking Water?

What Law Keeps My Drinking Water Safe?

Congress passed the Safe Drinking Water Act (SDWA) in 1974 to protect public health by regulating the nation's public drinking water supply and protecting sources of drinking water. SDWA is administered by the U.S. Environmental Protection Agency (EPA) and its state partners.

Highlights of the Safe Drinking Water Act

- Authorizes EPA to set enforceable health standards for contaminants in drinking water
- Requires public notification of water systems violations and annual reports (Consumer Confidence Reports) to customers on contaminants found in their drinking water - *www.epa.gov/safewater/ccr*
- Establishes a federal-state partnership for regulation enforcement
- Includes provisions specifically designed to protect underground sources of drinking water - www.epa.gov/safewater/uic
- Requires disinfection of surface water supplies, except those with pristine, protected sources
- Establishes a multi-billion-dollar state revolving loan fund for water system upgrades - www.epa.gov/safewater/dwsrf
- Requires an assessment of the vulnerability of all drinking water sources to contamination - *www.epa.gov/safewater/protect*

— *Drinking Water: Past, Present, and Future EPA-816-F-00-002*

What Is A Public Water System?

The Safe Drinking Water Act (SDWA) defines a **public water system (PWS)** as one that serves piped water to at least 25 persons or 15 service connections for at least 60 days each year. There are approximately 161,000 public water systems in the United States.[1] Such systems may be publicly or privately owned. **Community water systems (CWSs)** are public water systems that serve people year-round in their homes. Most people in the U.S. (268 million) get their water from a community water system. EPA also regulates other kinds of public water systems,

Public Water Systems

Community Water System (54,000 systems)—A public water system that serves the same people year-round. Most residences are served by Community Water Systems.

Non-Community Water System (approximately 108,000 systems)—A public water system that does not serve the same people year-round. There are two types of non-community systems:

- *Non-Transient Non-Community Water System (almost 19,000 systems)*—A non-community water system that serves the same people more than six months of the year, but not year-round. For example, a school with its own water supply is considered a non-transient system.
- *Transient Non-Community Water System (more than 89,000 systems)*—A non-community water system that serves the public but not the same individuals for more than six months. For example, a rest area or a campground may be considered a transient system.

such as those at schools, campgrounds, factories, and restaurants. Private water supplies, such as household wells that serve one or a few homes, are not regulated by EPA. For information on household wells, see "How Safe Is The Drinking Water In My Household Well?" on page 18 of this booklet.

Cost of Making Water Safe Continues to Rise

Much of the existing water infrastructure (underground pipes, treatment plants, and other facilities) was built many years ago. In 1999, EPA conducted the second Drinking Water Infrastructure Needs Survey, and found that drinking water systems will need to invest $150 billion over a 20-year period to ensure clean and safe drinking water.

Will Water Systems Have Adequate Funding In The Future?

Nationwide, drinking water systems have spent hundreds of billions of dollars to build drinking water treatment and **distribution systems**. From 1995 to 2000, more than $50 billion was spent on capital investments to fund water quality improvements.[2]

With the aging of the nation's infrastructure, the clean water and drinking water industries face a significant challenge to sustain and advance their achievements in protecting public health. EPA's *Clean Water & Drinking Water Infrastructure Gap Analysis*[3] has found that if present levels of spending do not increase, there will be a significant funding gap by the year 2019.

Where Can I Find Information About My Local Water System?

Since 1999, water suppliers have been required to provide annual Consumer Confidence Reports to their customers. These reports are due by July 1 each year, and contain information on contaminants found in the drinking water, possible health effects, and the water's source. Some Consumer Confidence Reports are available at *www.epa.gov/safewater/dwinfo.htm.*

Water suppliers must promptly inform you if your water has become contaminated by something that can cause immediate illness. Water suppliers have 24 hours to inform their customers of **violations** of EPA standards "that have the potential to have serious adverse effects on human health as a result of short-term exposure." If such a violation occurs, the water system will announce it through the media, and must provide information about the potential adverse effects on human health, steps the system is taking to correct the violation, and the need to use alternative water supplies (such as boiled or bottled water) until the problem is corrected.

Systems will inform customers about violations of less immediate concern in the first water bill sent after the violation, in a Consumer Confidence Report, or by mail within a year. In 1998, states began compiling information on individual systems, so you can evaluate the overall quality of drinking water in your state. Additionally, EPA must compile and summarize the state reports into an annual report on the condition of the nation's drinking water. To view the most recent annual report, see *www.epa.gov/safewater/annual.*

How Often Is My Water Supply Tested?

EPA has established pollutant-specific minimum testing schedules for public water systems. To find out how frequently your drinking water is tested, contact your water system or the agency in your state in charge of drinking water.

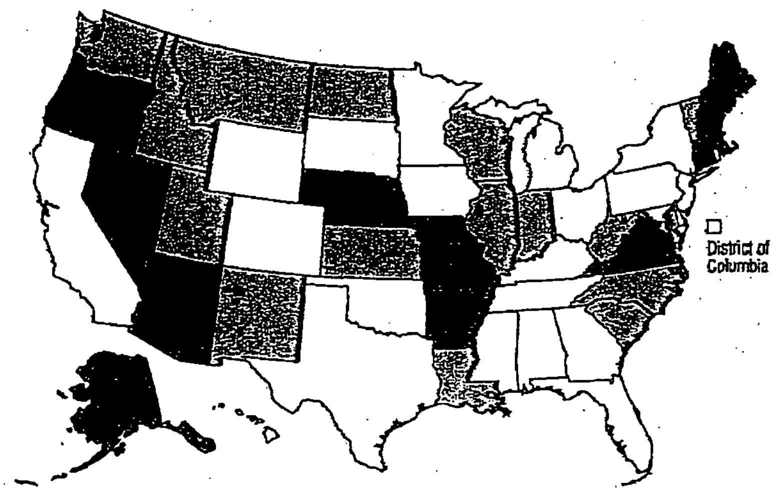
If a problem is detected, immediate retesting requirements go into effect along with strict instructions about how the system informs the public. Until the system can reliably demonstrate that it is free of problems, the retesting is continued.

In 2001, one out of every four community water systems did not conduct testing or report the results for all of the monitoring required to verify the safety of their drinking water.[4] Although failure to monitor does not necessarily suggest safety problems, conducting the required reporting is crucial to ensure that problems will be detected. Consumers can help make sure certain monitoring and reporting requirements are met by first contacting their state drinking water agency to determine if their water supplier is in compliance. If the water system is not meeting the requirements, consumers can work with local and state officials and the water supplier to make sure the required monitoring and reporting occurs.

4

A network of government agencies monitor tap water suppliers and enforce drinking water standards to ensure the safety of public water supplies. These agencies include EPA; state departments of health and environment, and local public health departments.

Reported Community Water Systems Violating Maximum Contaminant Levels or Treatment Standards in FY 2002



Common Sources of Pollution

Naturally Occurring: microorganisms (wildlife and soils), radionuclides (underlying rock), nitrates and nitrites (nitrogen compounds in the soil), heavy metals (underground rocks containing arsenic, cadmium, chromium, lead, and selenium), fluoride.

Human Activities: bacteria and nitrates (human and animal wastes—septic tanks and large farms), heavy metals (mining construction, older fruit orchards), fertilizers and pesticides (used by you and others (anywhere crops or lawns are maintained)), industrial products and wastes (local factories, industrial plants, gas stations, dry cleaners, leaking underground storage tanks, landfills, and waste dumps), household wastes (cleaning solvents, used motor oil, paint, paint thinner), lead and copper (household plumbing materials), water treatment chemicals (wastewater treatment plants).

Nevertheless, problems with local drinking water can, and do, occur.

What Problems Can Occur?

Actual events of drinking water contamination are rare, and typically do not occur at levels likely to pose health concerns. However, as development in our modern society increases, there are growing numbers of activities that can contaminate our drinking water. Improperly disposed-of chemicals, animal and human wastes, wastes injected underground, and naturally occurring substances have the potential to contaminate drinking water. Likewise, drinking water that is not properly treated or disinfected, or that travels through an improperly maintained distribution system, may also pose a health risk. Greater vigilance by you, your water supplier, and your government can help prevent such events in your water supply.

Contaminants can enter water supplies either as a result of human and animal activities, or because they occur naturally in the environment. Threats to your drinking water may exist in your neighborhood, or may occur many miles away. For more information on drinking water threats, see *www.epa.gov/safewater/*

publicoutreach/landscapeposter.html. Some typical examples are microbial contamination, chemical contamination from fertilizers, and lead contamination.

Boil Water Notices for Microbial Contaminants

When microorganisms such as those that indicate fecal contamination are found in drinking water, water suppliers are required to issue "Boil Water Notices." Boiling water for one minute kills the microorganisms that cause disease. Therefore, these notices serve as a precaution to the public. *www.epa.gov/safewater/faq/emerg.html*

Microbial Contamination:

The potential for health problems from microbial-contaminated drinking water is demonstrated by localized outbreaks of waterborne disease. Many of these outbreaks have been linked to contamination by bacteria or viruses, probably from human or animal wastes. For example, in 1999 and 2000, there were 39 reported disease outbreaks associated with drinking water, some of which were linked to public drinking water supplies.[5]

Certain **pathogens** (disease-causing **microorganisms**), such as ***Cryptosporidium***, may occasionally pass through water filtration and disinfection processes in numbers high enough to cause health problems, particularly in vulnerable members of the population. *Cryptosporidium* causes the gastrointestinal disease, cryptosporidiosis, and can cause serious, sometimes fatal, symptoms, especially among sensitive members of the population. (See box on Sensitive Subpopulations on page 1.) A serious outbreak of cryptosporidiosis occurred in 1993 in Milwaukee, Wisconsin, causing more than 400,000 persons to be infected with the disease, and resulting in at least 50 deaths. This was the largest recorded outbreak of waterborne disease in United States history.[6]

Excessive levels of nitrates can cause "blue baby syndrome," which can be fatal without immediate medical attention.

Chemical Contamination From Fertilizers:

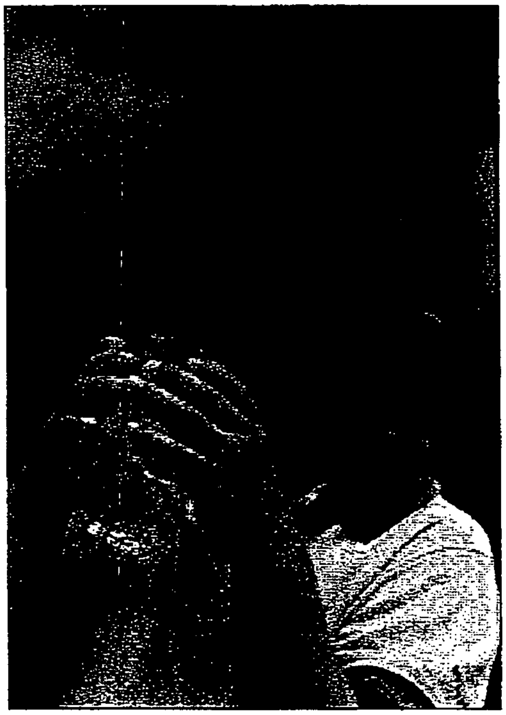
Nitrate, a chemical most commonly used as a fertilizer, poses an immediate threat to infants when it is found in drinking water at levels above the national standard. Nitrates are converted to nitrites in the intestines. Once absorbed into the bloodstream, nitrites prevent hemoglobin from transporting oxygen. (Older children have an enzyme that restores hemoglobin.) Excessive levels can cause "blue baby syndrome," which can be fatal without immediate medical attention. Infants most at risk for blue baby syndrome are those who are already sick, and while they are sick, consume food that is high in nitrates or drink water or formula mixed with water that is high in nitrates. Avoid using water with high nitrate levels for drinking. This is especially important for infants and young children, nursing mothers, pregnant women and certain elderly people.

Nitrates: Do NOT Boil

Do NOT boil water to attempt to reduce nitrates. Boiling water contaminated with nitrates increases its concentration and potential risk. If you are concerned about nitrates, talk to your health care provider about alternatives to boiling water for baby formula.

Lead Contamination:

Lead, a metal found in natural deposits, is commonly used in household plumbing materials and water service lines. The greatest exposure to lead is swallowing lead paint chips or breathing in lead dust. But lead in drinking water can also cause a variety of adverse health effects. In babies and children, exposure to lead in drinking water above the **action level** of lead (0.015 milligram per liter) can result in delays in physical and mental development, along with slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure. Lead is rarely found in source water, but enters tap water through corrosion of plumbing materials. Very old and poorly maintained homes may be more likely to have lead pipes, joints, and solder. However, new homes are also at risk: pipes legally considered to be "lead-free" may contain up to eight percent lead. These pipes can leach significant amounts of lead in the water for the first several months after their installation. For more information on lead contamination, see *www.epa.gov/safewater/contaminants/dw_contamfs/lead.html.*



Lead: Do NOT Boil

Do NOT boil water to attempt to reduce lead. Boiling water increases lead concentration. Always use water from the cold tap for preparing baby formula, cooking, and drinking. Flush pipes first by running the water before using it. Allow the water to run until it's cold. If you have high lead levels in your tap water, talk to your health care provider about alternatives to using boiled water in baby formula.

For more information on drinking water contaminants that are regulated by EPA, see Appendix A, or visit *www.epa.gov/safewater/mcl.html.*

Where Can I Find More Information About My Drinking Water?

Drinking water varies from place to place, depending on the water's source and the treatment it receives. If your drinking water comes from a community water system, the system will deliver to its customers annual drinking water quality reports (or Consumer Confidence Reports). These reports will tell consumers what contaminants have been detected in their drinking water, how these detection levels compare to drinking water standards, and where their water comes from. The reports must be provided annually before July 1, and, in most cases, are mailed directly to customers' homes. Contact your water supplier to get a copy of your report, or see if your report is posted online at *www.epa.gov/safewater/dwinfo.htm.* Your state's department of health or environment can also be a valuable source of information. For help in locating these agencies, call the Safe Drinking Water Hotline. Further resources can be found in Appendix C. Information on testing household wells is on page 19.

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1 *Factoids: Drinking Water & Ground Water Statistics for 2002, 2003.*

2 *Community Water Systems Survey 2000, Volume I, 2001.*

3 *The Clean Water and Drinking Water Infrastructure Gap Analysis,* EPA 816-R-02-020.

4 *Factoids: Drinking Water and Ground Water Statistics for 2001,* EPA 816-K-02-004.

5 *Morbidity and Mortality Weekly Report: Surveillance for Waterborne Disease Outbreaks, United States 1999-2000, 2002.*

6 *25 Years of the Safe Drinking Water Act, 1999.*

3. Where Does My Drinking Water Come From And How Is It Treated?

Your drinking water comes from **surface water** or **ground water**. The water that systems pump and treat from sources open to the atmosphere, such as rivers, lakes, and reservoirs is known as surface water. Water pumped from wells drilled into underground **aquifers**, geologic formations containing water, is called ground water. The quantity of water produced by a well depends on the nature of the rock, sand, or soil in the aquifer from which the water is drawn. Drinking water wells may be shallow (50 feet or less) or deep (more than 1,000 feet). More water systems have ground water than surface water as a source (approx. 147,000 v. 14,500), but more people drink from a surface water system (195 million v. 101,400). Large-scale water supply systems tend to rely on surface water resources, while smaller water systems tend to use ground water. Your water utility or public works department can tell you the source of your public water supply.

How Does Water Get To My Faucet?

An underground network of pipes typically delivers drinking water to the homes and businesses served by the water system. Small systems serving just a handful of households may be relatively simple, while large metropolitan systems can be extremely complex—sometimes consisting of thousands of miles of pipes serving millions of people. Drinking water must meet required health standards when it leaves the treatment plant. After treated water leaves the plant, it is monitored within the distribution system to identify and remedy any problems such as water main breaks, pressure variations, or growth of microorganisms.

How Is My Water Treated To Make It Safe?

Water utilities treat nearly 34 billion gallons of water every day.[1] The amount and type of treatment applied varies with the source and quality of the water. Generally, surface water systems require more treatment than ground water systems because they are directly exposed to the atmosphere and runoff from rain and melting snow.

Water suppliers use a variety of treatment processes to remove contaminants from drinking water. These individual processes can be arranged in a "treatment train" (a series of processes applied in a sequence). The most commonly used processes include coagulation (flocculation and sedimentation), filtration, and disinfection. Some water systems also use ion exchange and adsorption. Water utilities select the treatment combination most appropriate to treat the contaminants found in the **source water** of that particular system.

Coagulation (Flocculation & Sedimentation):

Flocculation: This step removes dirt and other particles suspended in the water. Alum and iron salts or synthetic organic polymers are added to the water to form tiny sticky particles called "floc," which attract the dirt particles.

All sources of drinking water contain some naturally occurring contaminants. At low levels, these contaminants generally are not harmful in our drinking water. Removing all contaminants would be extremely expensive, and in most cases, would not provide increased protection of public health. A few naturally occurring minerals may actually improve the taste of drinking water and may even have nutritional value at low levels.

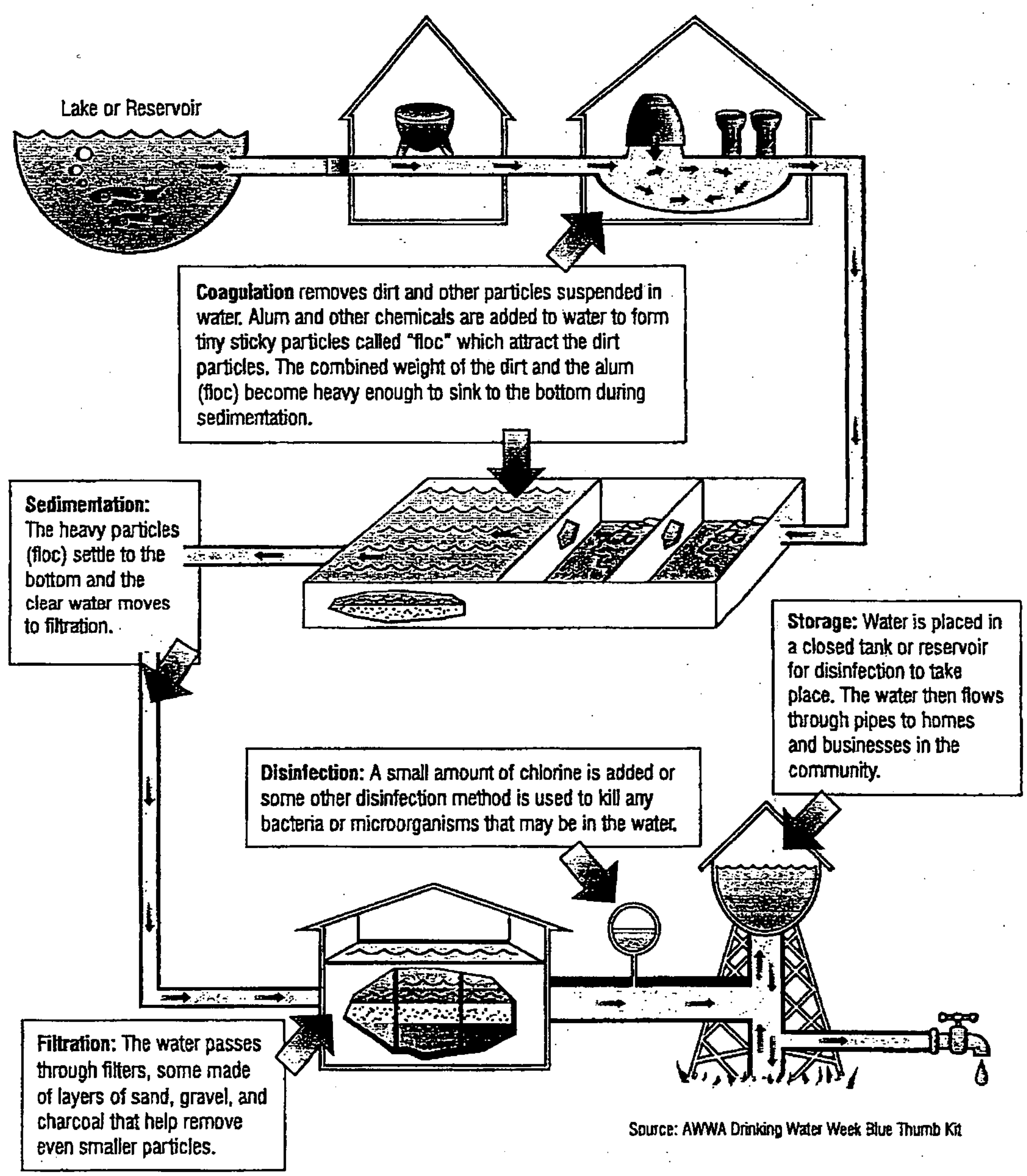
Sedimentation: The flocculated particles then settle naturally out of the water.

Filtration:

Many water treatment facilities use filtration to remove all particles from the water. Those particles include clays and silts, natural organic matter, precipitates from other treatment processes in the facility, iron and manganese, and microorganisms. Filtration clarifies the water and enhances the effectiveness of disinfection.

Water Treatment Plant

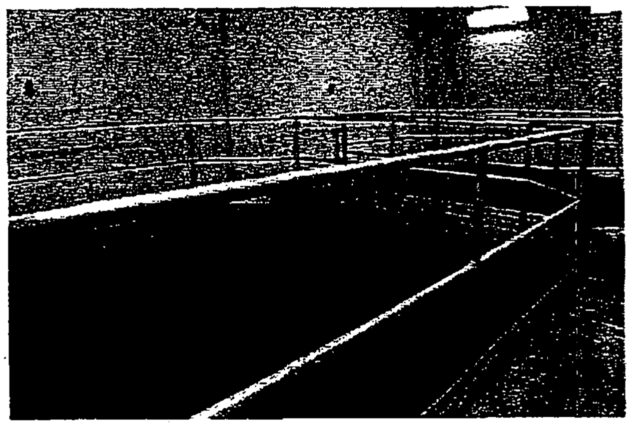
Follow a drop of water from the source through the treatment process. Water may be treated differently in different communities depending on the quality of the water which enters the plant. Groundwater is located underground and typically requires less treatment than water from lakes, rivers, and streams.



Source: AWWA Drinking Water Week Blue Thumb Kit

Disinfection:

Disinfection of drinking water is considered to be one of the major public health advances of the 20th century. Water is often disinfected before it enters the distribution system to ensure that dangerous microbial contaminants are killed. Chlorine, chlorinates, or chlorine dioxides are most often used because they are very effective **disinfectants**, and residual concentrations can be maintained in the water system.



Water System Filtration Tank

Why Is My Water Bill Rising?

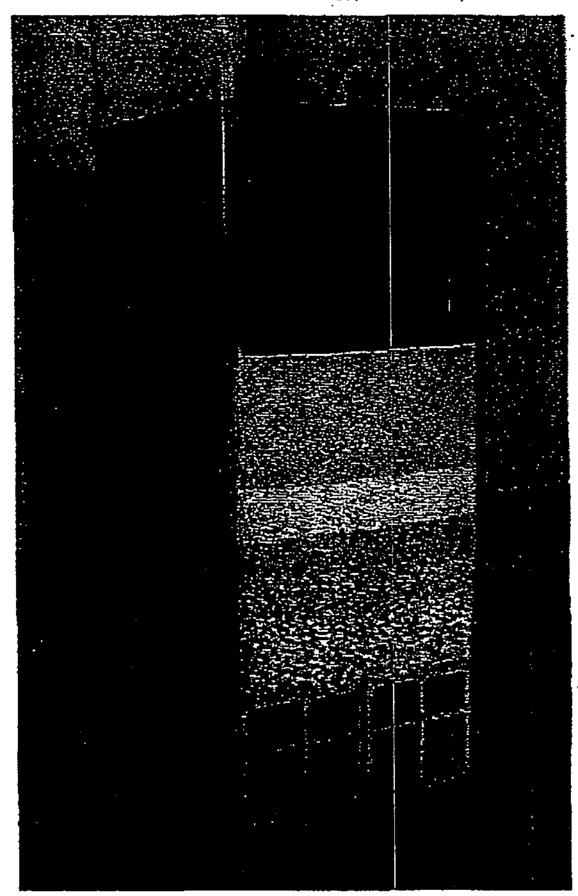
The cost of drinking water is rising as suppliers meet the needs of aging infrastructure, comply with public health standards, and expand service areas. In most cases, these increasing costs have caused water suppliers to raise their rates. However, despite rate increases, water is generally still a bargain compared to other utilities, such as electricity and phone service. In fact, in the United States, combined water and sewer bills average only about 0.5 percent of household income.[2]

1 *Protect Your Drinking Water.* 2002.

2 *Congressional Budget Office Study: Future Investment in Drinking Water & Wastewater Infrastructure, 2002.*

Disinfection Byproducts

Disinfection of drinking water is one of the major public health advances of the 20th century. However, sometimes the disinfectants themselves can react with naturally occurring materials in the water to form unintended byproducts, which may pose health risks. EPA recognizes the importance of removing microbial contaminants while simultaneously protecting the public from disinfection byproducts, and has developed regulations to limit the presence of these byproducts. For more information, see *www.epa.gov/safewater/mdbp.html.*



Water passes through charcoal, sand, and gravel layers in a water system's filtration tank.

4. How Do We Use Drinking Water In Our Homes?

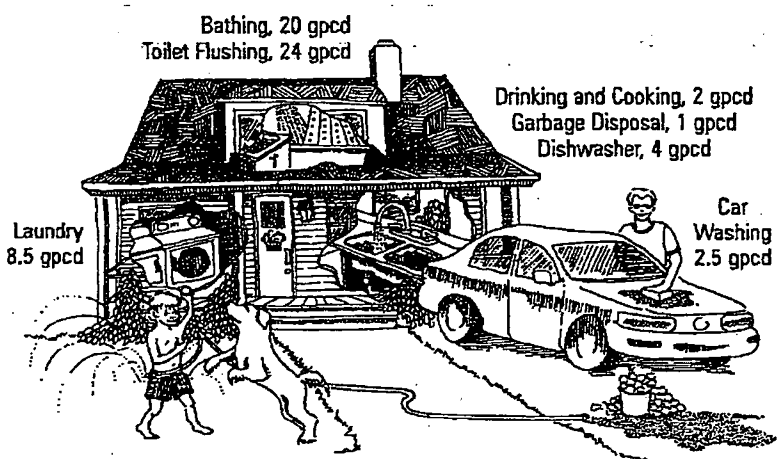
We take our water supplies for granted, yet they are limited. Only one percent of all the world's water can be used for drinking. Nearly 97 percent of the world's water is salty or otherwise undrinkable, and the other two percent is locked away in ice caps and glaciers. There is no "new" water: whether our source water is a stream, river, lake, spring, or well, we are using the same water the dinosaurs used millions of years ago.

How Much Water Do Homes In The U.S. Use Compared To Other Countries?

Americans use much more water each day than individuals in both developed and undeveloped countries: For example, the average European uses 53 gallons; the average Sub-Saharan citizen, 3-5 gallons.[4]

Common Household Uses of Drinking Water*

*(*Gallons per Capita per Day)*



Source: Van Der Leeden, F., F. L. Troise, and D. K. Todd. The Water Encyclopedia. Lewis Publishers, Inc. Second Edition, 1990.

Water efficiency plays an important role in protecting water sources and improving water quality. By using water wisely, we can save money and help the environment. Water efficiency means using less water to provide the same benefit. Using water-saving techniques could save you hundreds of dollars each year, while also reducing the amount of pollutants entering our waterways.

The average American uses about 90 gallons of water each day in the home, and each American household uses approximately 107,000 gallons of water each year.[1] For the most part, we use water treated to meet drinking water standards to flush toilets, water lawns, and wash dishes, clothes, and cars. In fact, 50-70 percent of home water is used for watering lawns and gardens.[2] Nearly 14 percent of the water a typical homeowner pays for is never even used—it leaks down the drain.[3]

How Do Drinking Water Utilities Conserve Water?

Water utilities forecast water source availability, growth in population, and water demand to ensure adequate future water supplies during normal conditions, as well as periods of drought. When water shortages are predicted or experienced, water utilities have many options for conserving water. Temporary cutbacks or permanent operating adjustments can help conserve water.

Temporary cutbacks may include:

- Reduction of system-wide operating pressure, and
- Water use bans, restrictions, and rationing.

Permanent conservation measures may include:

- Subsidizing use of water-efficient faucets, toilets, and showerheads,
- Public education and voluntary use reduction,
- Billing practices that impose higher rates for higher amounts of water use,
- Building codes that require water-efficient fixtures and appliances,
- Leak detection surveys and meter testing, repair, and replacement, and
- Reduction in use and increase in recycling of industrial water.

How Can Businesses Conserve Water?

The industrial and commercial sectors can conserve water through recycling and waste reduction. Industry has implemented conservation measures to comply with state and federal water pollution controls. Evaluation of industrial plant data may show that a particular process or manufacturing step uses the most water or causes the greatest contamination. Such areas can be targeted for water conservation. Also, water that is contaminated by one process may be usable in other plant processes that do not require high-quality water.

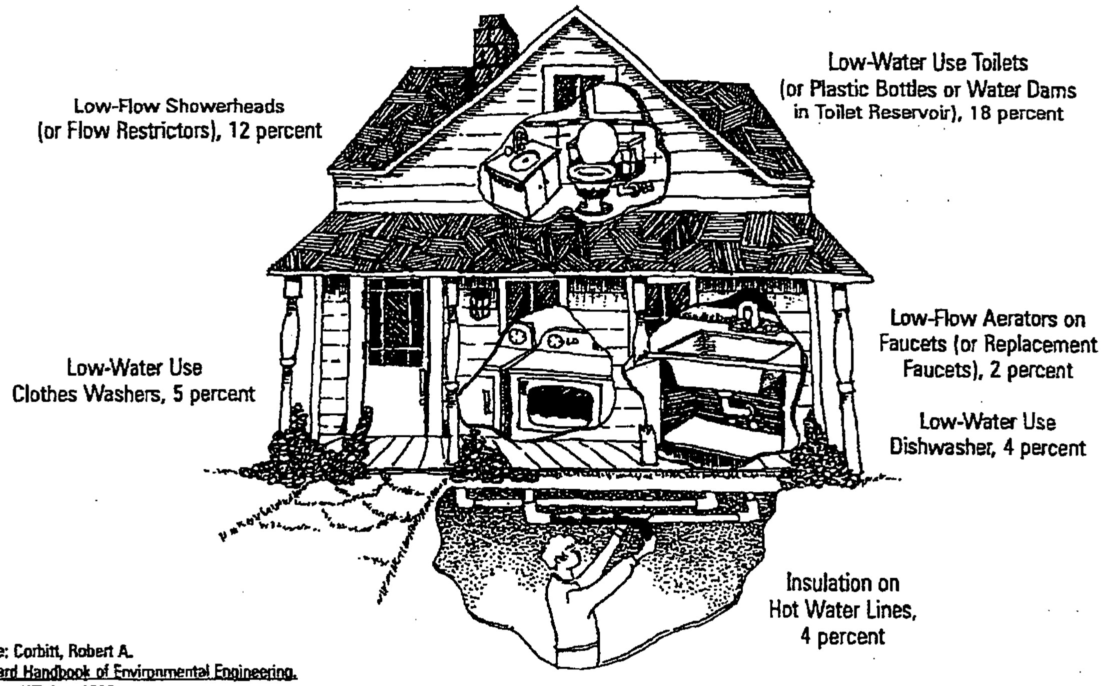
How Can I Conserve Water?

The national average cost of water is $2.00 per 1,000 gallons. The average American family spends about $474 each year on water and sewage charges.[5] American households spend an additional $230 per year on water heating costs.[6] By replacing appliances such as the dishwasher and inefficient fixtures such as toilets and showerheads, you can save a substantial amount each year in water, sewage, and energy costs.

There are many ways to save water in and around your home. Here are the five that might get the best results:

Ways To Save Water At Home*

*(*Water Savings as Percent of Total Interior Water Use)*



Source: Corbitt, Robert A. Standard Handbook of Environmental Engineering. McGraw-Hill, Inc. 1989.

- *Stop Leaks.*
- *Replace Old Toilets* with models that use 1.6 gallons or less per flush.
- *Replace Old Clothes Washers* with EPA Energy Star certified models.
- *Plant the Right Kind of Garden* that requires less water.
- *Provide Only the Water Plants Need.*

For more information on ways to conserve water in the home, see *www.epa.gov/water/waterefficiency.html* or *www.h2ouse.org.*

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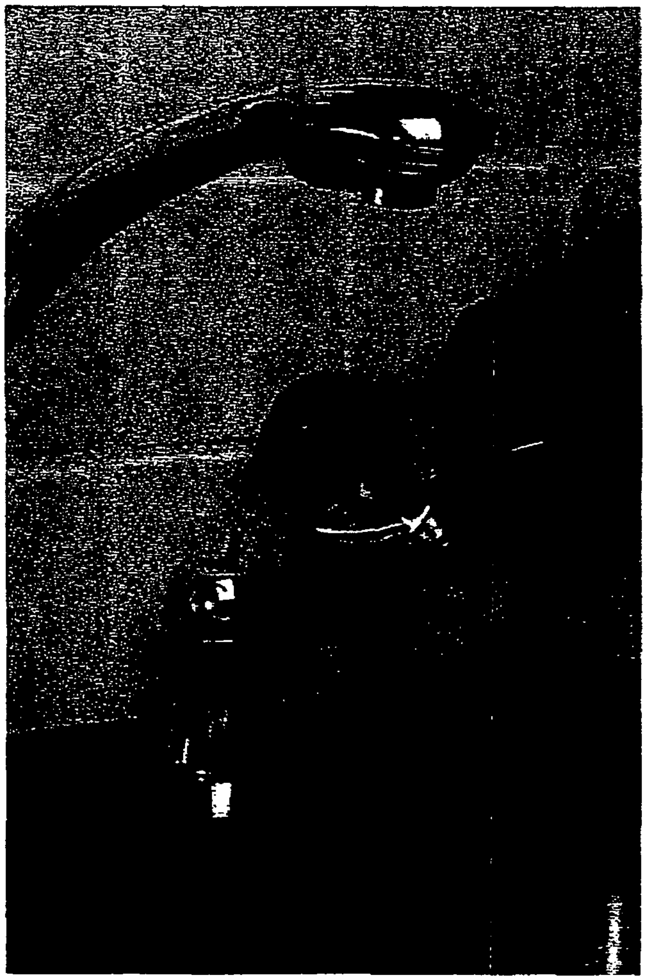
1 *Water Trivia Facts*, EPA 80-F-95-001.
2 AWWA *Stats on Tap.*
3 *Using Water Wisely in the Home*, 2002.
4 *The Use of Water Today*, World Water Council.
5 *Investing in America's Water Infrastructure*, 2002.
6 *Using Water Wisely in the Home*, 2002.



Nearly 14 percent of the water a typical homeowner pays for is never even used— it leaks down the drain.

Using Water Wisely in the Home, 2002

5. What's Being Done To Improve Water Security?

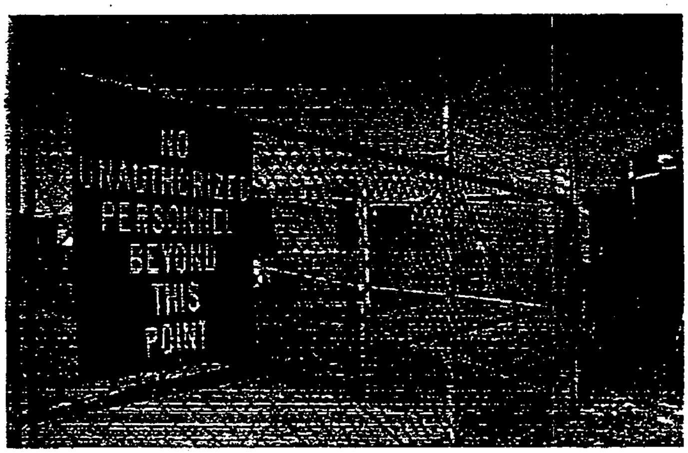
What Security Measures Are In Place To Protect Water Systems?

Drinking water utilities today find themselves facing new responsibilities due to concerns over water system security and counter-terrorism. EPA is committed to the safety of public drinking water supplies and has taken numerous steps to work with utilities, other government agencies, and law enforcement to minimize threats.

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 requires that all community water systems serving more than 3,300 people evaluate their susceptibility to potential threats and identify corrective actions. EPA has provided assistance to help utilities with these **Vulnerability Assessments** by giving direct grants to large systems, supporting self-assessment tools, and providing technical help and training to small and medium utilities. For more information on water system security, see *www.epa.gov/safewater/security.*

How Can I Help Protect My Drinking Water?

Local drinking water and wastewater systems may be targets for terrorists and other would-be criminals wishing to disrupt and cause harm to your community water supplies or wastewater facilities.

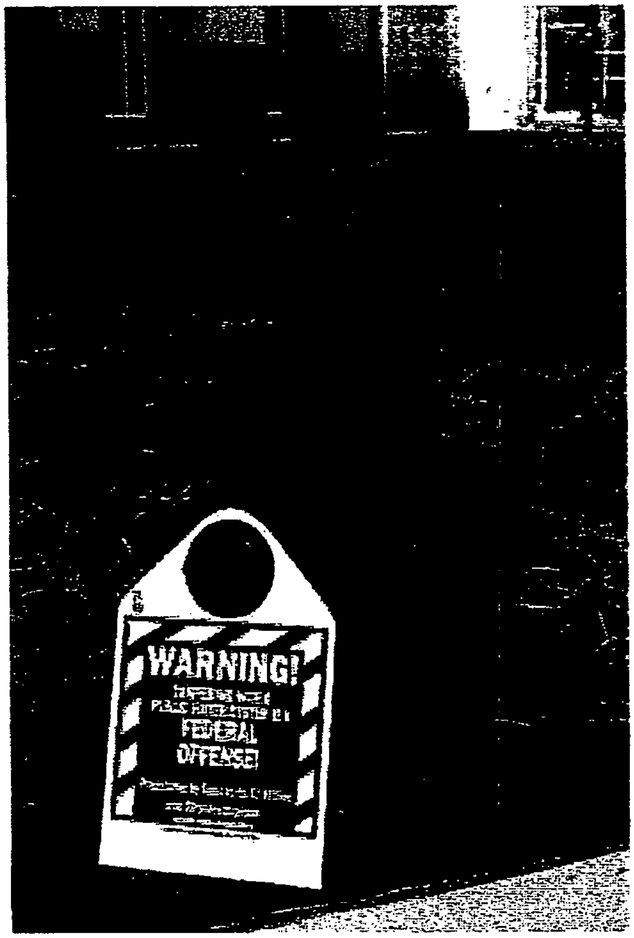


Because utilities are often located in isolated areas, drinking water sources and wastewater collection systems may cover large areas that are difficult to secure and patrol. Residents can be educated to notice and report any suspicious activity in and around local water utilities. Any residents interested in protecting their water resources and community as a whole can join together with law enforcement, neighborhood watch groups, water suppliers, wastewater operators, and other local public health officials. If you witness suspicious activities, report them to your local law enforcement authorities.

Examples of suspicious activity might include:

- People climbing or cutting a utility fence
- People dumping or discharging material to a water reservoir

- Unidentified truck or car parked or loitering near waterway or facilities for no apparent reason
- Suspicious opening or tampering with manhole covers, fire hydrants, buildings, or equipment



- People climbing or on top of water tanks
- People photographing or videotaping utility facilities, structures or equipment
- Strangers hanging around locks or gates

Report suspicious activity to local authorities

Do not confront strangers. Instead report suspicious activities to local authorities.

When reporting an incident:

- State the nature of the incident
- Identify yourself and your location
- Identify location of activity
- Describe any vehicle involved (color, make, model, plate number)
- Describe the participants (how many, sex, race, color of hair, height, weight, clothing)

For emergencies, dial 9-1-1 or other local emergency response numbers.

For more information on water security, visit:
www.epa.gov/safewater/security

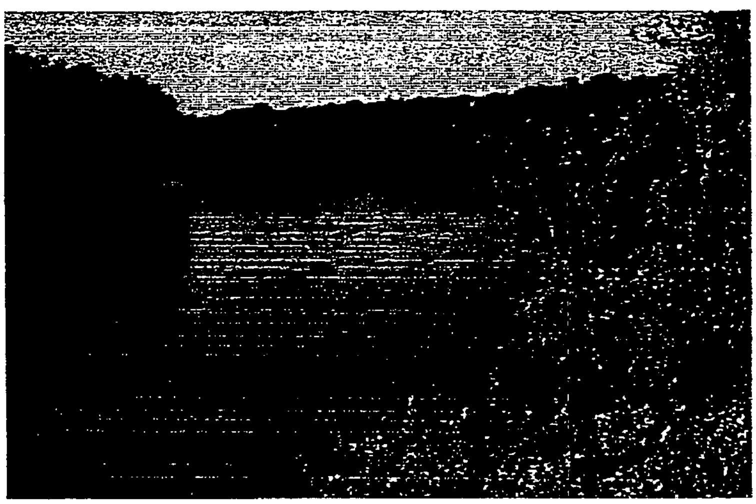
6. What Can I Do If There Is A Problem With My Drinking Water?

Local incidents, such as spills and treatment problems, can lead to short-term needs for alternative water supplies or in-home water treatment. In isolated cases, individuals may need to rely on alternative sources for the long term, due to their individual health needs or problems with obtaining new drinking water supplies.

What Alternative Sources Of Water Are Available?

Bottled water is sold in supermarkets and convenience stores. Some companies lease or sell water dispensers or bubblers and regularly deliver large bottles of water to homes and businesses. It is expensive compared to water from a public water system. The bottled water quality varies among brands, because of the variations in the source water used, costs, and company practices.

The U.S. Food and Drug Administration (FDA) regulates bottled water used for drinking. While most consumers assume that bottled water is at least as safe as tap water, there are still potential risks. Although required to meet the same safety standards as public water supplies, bottled water does not undergo the same testing and reporting as water from a treatment facility. Water that is bottled and sold in the same state may not be subject to any federal standards at all. Those with compromised immune systems may want to read bottled water labels to make sure more stringent treatments have been used, such as reverse osmosis, distillation, UV radiation, or filtration by an absolute 1 micron filter.



Check with NSF International to see if your bottled water adheres to FDA and international drinking water standards. The International Bottled Water Association can also provide information on which brands adhere to even more stringent requirements. Contact information is listed in Appendix C.

Can I Do Anything In My House To Improve The Safety Of My Drinking Water?

Most people do not need to treat drinking water in their home to make it safe. However, a home water treatment unit can improve water's taste, or provide a factor of safety for those people more vulnerable to waterborne disease. There are different options for home treatment systems. Point-of-use (POU) systems treat water at a single tap. Point-of-entry (POE) systems treat water used throughout the house. POU systems can be installed in various places in the home, including the counter top, the faucet itself, or under the sink. POE systems are installed where the water line enters the house.

POU and POE devices are based on various contaminant removal technologies. Filtration, ion exchange, reverse osmosis, and distillation are some of the treatment methods used. All types of units are generally available from retailers, or by mail order. Prices can reach well into the hundreds and sometimes thousands of dollars, and depending on the method and location of installation, plumbing can also add to the cost.

TREATMENT DEVICE	WHAT IT DOES TO WATER	TREATMENT LIMITATIONS
Activated Carbon Filter	√ Adsorbs organic contaminants that cause taste and odor problems.	Is efficient in removing metals such as lead and copper
(includes mixed media that remove heavy metals)	√ Somedesigns remove chlorination byproducts;	Does not remove nitrate, bacteria or dissolved minerals
	√ Some types remove cleaning solvents and pesticides	
Ion Exchange Unit	√ Removes minerals, particularly calcium and magnesium that make water "hard"	If water has oxidized iron or iron bacteria, the ion-exchange resin will become coated or clogged and lose its softening ability
	√ Some designs remove radium and barium	
(with activated alumina)	√ Removes fluoride	
Reverse Osmosis Unit	√ Removes nitrates, sodium, other dissolved inorganics and organic compounds	Does not remove all inorganic and organic contaminants
	√ *Removes foul tastes, smells or colors*	
(with carbon)	√ May also reduce the level of some pesticides, dioxins and chloroform and petrochemicals	
Distillation Unit	√ Removes nitrates, bacteria, sodium, hardness, dissolved solids, most organic compounds, heavy metals, and radionucleides	Does not remove some volatile organic contaminants, certain pesticides and volatile solvents
	√ Kills bacteria	Bacteria may recolonize on the cooling coils during inactive periods

Activated carbon filters adsorb **organic contaminants** that cause taste and odor problems. Depending on their design, some units can remove chlorination byproducts, some cleaning solvents, and pesticides. To maintain the effectiveness of these units, the carbon canisters must be replaced periodically. Activated carbon filters are efficient in removing metals such as lead and copper if they are designed to absorb or remove lead.

Because ion exchange units can be used to remove minerals from your water, particularly calcium and magnesium, they are sold for water softening. Some ion exchange softening units remove radium and barium from water. Ion exchange systems that employ activated alumina are used to remove fluoride and arsenate from water. These units must be regenerated periodically with salt.

Reverse osmosis treatment units generally remove a more diverse list of contaminants than other systems. They can remove nitrates, sodium, other dissolved inorganics, and organic compounds.

Distillation units boil water and condense the resulting steam to create distilled water. Depending on their design, some of these units may allow vaporized organic contaminants to condense back into the product water, thus minimizing the removal of organics.

You may choose to boil your water to remove microbial contaminants. Keep in mind that boiling reduces the volume of water by about 20 percent, thus concentrating those contaminants not affected by the temperature of boiling water, such as nitrates and pesticides. For more information on boiling water, see page 5 of this booklet.

No one unit can remove everything. Have your water tested by a certified laboratory prior to purchasing any device. Do not rely on the tests conducted by salespeople that want to sell you their product.

Maintaining Treatment Devices

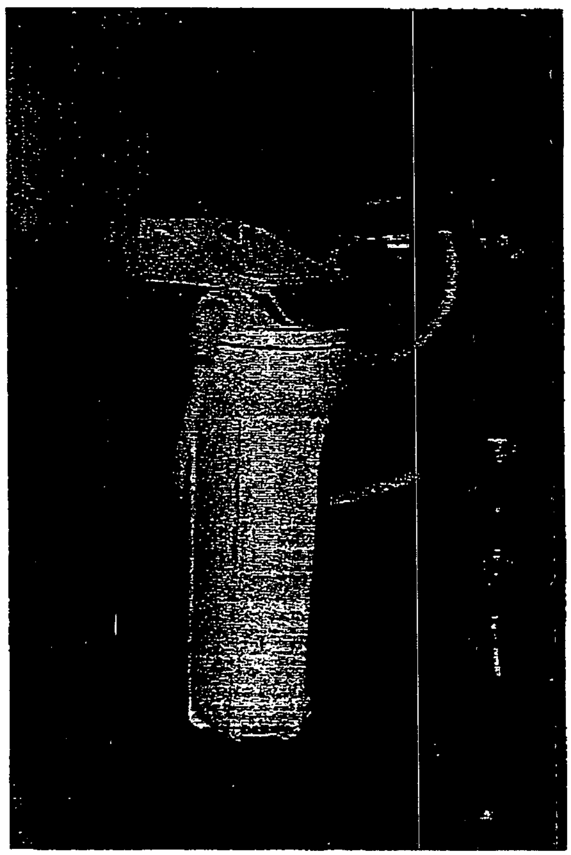
All POU and POE treatment units need maintenance to operate effectively. If they are not maintained properly, contaminants may accumulate in the units and actually make your water worse. In addition, some vendors may make claims about their effectiveness that have no merit. Units are tested for their safety and effectiveness by two organizations, NSF International and Underwriters Laboratory. In addition, the Water Quality Association represents the household, commercial, industrial and small community treatment industry and can help you locate a professional that meets their code of ethics. EPA does not test or certify these treatment units.

Where Can I Learn More About Home Treatment Systems?

Your local library has articles, such as those found in consumer magazines, on the effectiveness of these devices.

The U.S. General Accounting Office published a booklet called *Drinking Water: Inadequate Regulation of Home Treatment Units Leaves Consumers At Risk* (December 1991). To read this booklet, visit *www.gao.gov* and search for **document number RCED-92-34**, or call (202) 512-6000.

This treatment device is for point of use (POU). For more information on different types of devices contact NSF International, Underwriters Laboratory, or the Water Quality Association See Appendix C for contact information.



7. How Safe Is The Drinking Water In My Household Well?

EPA regulates public water systems; it does not have the authority to regulate private wells. Approximately 15 percent of Americans rely on their own private drinking water supplies (*Drinking Water from Household Wells*, 2002), and these supplies are not subject to EPA standards. Unlike public drinking water systems serving many people, they do not have experts regularly checking the water's source and its quality before it is sent to the tap. These households must take special precautions to ensure the protection and maintenance of their drinking water supplies.

Drinking Water from Household Wells is an EPA publication available to specifically address special concerns of a private drinking water supply. To learn more, or to obtain a copy, visit *www.epa.gov/safewater/privatewells*, or call the Safe Drinking Water Hotline.

How Much Risk Can I Expect?

The risk of having problems depends on how good your well is—how well it was built and located, and how well you maintain it. It also depends on your local environment. That includes the quality of the aquifer from which your water is drawn and the human activities going on in your area that can affect your well.

Several sources of pollution are easy to spot by sight, taste, or smell. However, many serious problems can be found only by testing your water. Knowing the possible threats in your area will help you decide the kind of tests you may need.

What Should I Do?

There are six basic steps you can take to help protect your private drinking water supply:

1. Identify potential problem sources.
2. Talk with local experts.
3. Have your water tested periodically.
4. Have the test results interpreted and explained clearly.
5. Set and follow a regular maintenance schedule for your well, and keep up-to-date records.
6. Immediately remedy any problems.

Identify Potential Problem Sources

Understanding and spotting possible pollution sources is the first step to safeguarding your drinking water. If your drinking water comes from a well, you may also have a **septic system**. Septic systems and other on-site wastewater disposal systems are major potential sources of contamination of private water supplies if they are poorly maintained or located improperly, or if they are used for disposal of toxic chemicals. Information on septic systems is available from local health departments, state agencies, and the National Small Flows Clearinghouse (*www.epa.gov/owm/mab/smcomm/nsfc.htm*) at (800) 624-8301. A septic system design manual and guidance on system maintenance are available from EPA (*www.epa.gov/OW-OWM.html/mtb/decent/homeowner.htm*).

Talk With Local Experts

Ground water conditions vary greatly from place to place, and local experts can give you the best information about your drinking water supply. Some examples are your health department's "sanitarian," local water-well contractors, public water system officials, county extension agents of the Natural Resources Conservation Service (NRCS), local or county planning commissions, and your local library.

Have Your Water Tested Periodically

Test your water every year for total **coliform** bacteria, nitrates, total dissolved solids, and pH levels. If you suspect other contaminants, test for these as well. As the tests can be expensive, limit them to possible problems specific to your situation. Local experts can help you identify these contaminants. You should also test your water after replacing or repairing any part of the system, or if you notice any change in your water's look, taste, or smell.

Often, county health departments perform tests for bacteria and nitrates. For other substances, health departments, environmental offices, or county governments should have a list of state-certified laboratories. Your State Laboratory Certification Officer can also provide you with this list. Call the Safe Drinking Water Hotline for the name and number of your state's certification officer. Any laboratory you use should be certified to do drinking water testing.

Have Your Test Results Interpreted And Explained Clearly

Compare your well's test results to federal and state drinking water standards (see Appendix A, or visit *www.epa.gov/safewater/mcl.html* or call the Safe Drinking Water Hotline). You may need to consult experts to aid you in understanding your results, such as the state agency that licenses water well contractors, your local health department, or your state's drinking water program.

Protecting Your Ground Water Supply

- Periodically inspect exposed parts of the well for problems such as:
  - Cracked, corroded, or damaged well casing
  - Broken or missing well cap
  - Settling and cracking of surface seals.
- Slope the area around the well to drain surface runoff away from the well.
- Install a well cap or sanitary seal to prevent unauthorized use of, or entry into, the well.
- Disinfect drinking water wells at least once per year with bleach or hypochlorite granules, according to the manufacturer's directions.
- Have the well tested once a year for coliform bacteria, nitrates, and other constituents of concern.
- Keep accurate records of any well maintenance, such as disinfection or sediment removal, that may require the use of chemicals in the well.
- Hire a certified well driller for any new well construction, modification, or abandonment and closure.
- Avoid mixing or using pesticides, fertilizers, herbicides, degreasers, fuels, and other pollutants near the well.
- Do not dispose of wastes in dry wells or in abandoned wells.
- Do not cut off the well casing below the land surface.
- Pump and inspect septic systems as often as recommended by your local health department.
- Never dispose of hazardous materials in a septic system.

Set A Regular Maintenance Schedule For Your Well And Your Septic System

Proper well and septic system construction and continued maintenance are keys to the safety of your water supply. Your state water well and septic system contractor licensing agency, local health department, or local public water system professional can provide information on well construction. Make certain your contractors are licensed by the state, if required, or certified by the National Ground Water Association.

Maintain your well, fixing problems before they reach crisis levels, and keep up-to-date records of well installation and repairs, as well as plumbing and water costs. Protect your own well area from contamination.

Immediately Remedy Any Problems

If you find that your well water is contaminated, fix the problem as soon as possible. Consider connecting into a nearby community water system, if one is available. You may want to install a water treatment device to remove impurities. Information on these devices is provided on page 16. If you connect to a public water system, remember to close your well properly.

After A Flood-Concerns And Advisories

- Stay away from well pump to avoid electric shock.
- Do not drink or wash from a flooded well.
- Pump the well until water runs clear.
- If water does not run clear, contact the county or state health department or extension service for advice.

Animal waste can contaminate your water supply

8. What You Can Do To Protect Your Drinking Water

Drinking water protection is a shared responsibility. Many actions are underway to protect our nation's drinking water, and there are many opportunities for citizens to become involved.

Be Involved!

EPA activities to protect drinking water include setting drinking water standards and overseeing the work of states that enforce federal standards—or stricter ones set by the individual state. EPA holds many public meetings on issues ranging from proposed drinking water standards to the development of databases. You can also comment on proposed drafts of other upcoming EPA documents. A list of public meetings and regulations open for comment can be found at *www.epa.gov/safewater/pubinput/html.*

Be Informed!

- Read the annual Consumer Confidence Report provided by your water supplier. Some Consumer Confidence Reports are available at *www.epa.gov/safewater/dwinfo.htm.*
- Use information from your state's Source Water Assessment to learn about potential threats to your water source.
- If you are one of the 15 percent of Americans who uses a private source of drinking water—such as a well, cistern, or spring—find out what activities are taking place in your **watershed** that may impact your drinking water; talk to local experts/test your water periodically; and maintain your well properly.
- Find out if the Clean Water Act standards for your drinking water source are intended to protect water for drinking, in addition to fishing and swimming.

Be Observant!

- Look around your watershed and look for announcements in the local media about activities that may pollute your drinking water.
- **Form and operate** a citizens watch network within your community to communicate regularly with law enforcement, your public water supplier and wastewater operator. **Communication** is key to a safer community!
- **Be alert.** Get to know your water/wastewater utilities, their vehicles, routines and their personnel.
- **Become aware of your surroundings**: This will help you to recognize suspicious activity as opposed to normal daily activities.

Other Ways To Get Involved

- Attend public hearings on new construction, storm water permitting, and town planning.
- Keep your public officials accountable by asking to see their environmental impact statements.
- Ask questions about any issue that may affect your water source.
- Participate with your government and your water system as they make funding decisions.
- Volunteer or help recruit volunteers to participate in your community's contaminant monitoring activities.
- Help ensure that local utilities that protect your water have adequate resources to do their job.

- If you see any suspicious activities in or around your water supply, please notify local authorities or call 9-1-1 immediately to report the incident.

Stormwater runoff threatens our sources of drinking water. As this water washes over roofs, pavement, farms and grassy areas, it picks up fertilizers, pesticides and litter, and deposits them in surface water and ground water. Here are some other threats to our drinking water:

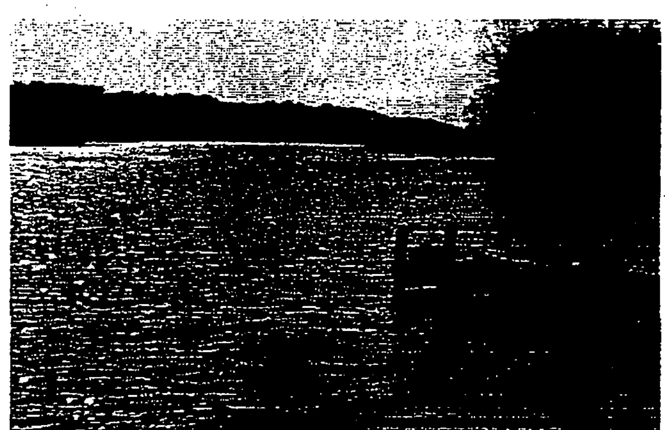
Every year:

- We apply 67 million pounds of pesticides that contain toxic and harmful chemicals to our lawns.
- We produce more than 230 million tons of municipal solid water—approximately five pounds of trash or garbage per person per day—that contain bacteria, nitrates, viruses, synthetic detergents, and household chemicals.
- Our more than 12 million recreational and houseboats and 10,000 boat marinas release solvents, gasoline, detergents, and raw sewage directly into our rivers, lakes and streams.

Don't Contaminate!

- Reduce paved areas: use permeable surfaces that allow rain to soak through, not run off.
- Reduce or eliminate pesticide application: test your soil before applying chemicals, and use plants that require little or no water, pesticides, or fertilizers.
- Reduce the amount of trash you create: reuse and recycle.
- Recycle used oil: 1 quart of oil can contaminate 2 million gallons of drinking water—take your used oil and antifreeze to a service station or recycling center.
- Take the bus instead of your car one day a week: you could prevent 33 pounds of carbon dioxide emissions each day.
- Keep pollutants away from boat marinas and waterways: keep boat motors well-tuned to prevent leaks, select nontoxic cleaning products and use a drop cloth, and clean and maintain boats away from the water.

For more information on how you can help protect your local drinking water source, call the Safe Drinking Water Hotline, or check *www.epa.gov/safewater/publicoutreach.* Additional resources are listed in Appendix C.



Appendix A: National Primary Drinking Water Standards as of 10/03

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Acrylamide	TT[8]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/ wastewater treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha particles	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010 as of 1/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta particles and photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	MRDLG=4[1]

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	MI	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[7]; Action Level = 1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT[7]; Action Level = 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms (including fecal coliform and *E. coli*)	5.0 percent[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste	zero
DBP	Total Trihalomethanes (TTHMs)	0.10 0.080 after 12/31/03	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.20

LEGEND

D Disinfectant	IOC Inorganic Chemical	OC Organic Chemical	DBP Disinfection Byproduct	M Microorganism	R Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero
M	Turbidity	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not *reflect the benefits of the use of disinfectants* to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium* (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99 percent removal.
- *Giardia lamblia*: 99.9 percent removal/inactivation
- Viruses: 99.99 percent removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95 percent of the daily samples in any month. As of January 1, 2002, for systems servicing >10,000, and January 14, 2005, for systems servicing <10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95 percent of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

4 No more than 5.0 percent samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli*. If two consecutive TC-positive samples, and one is also positive for *E. coli* fecal coliforms, system has an acute MCL violation.

5 Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

6 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

7 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

8 Each water system must certify, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

Appendix B: References

US EPA Publications

25 Years of the Safe Drinking Water Act: History & Trends
EPA 816-R-99-007
December 1999

Community Water Systems Survey 2000, Volume I
EPA 815-R-02-0054
December 2002

Drinking Water Costs and Federal Funding
EPA 810-F-99-014
December 1999

Drinking Water from Household Wells
EPA 816-K-02-003
January 2002

Drinking Water Priority Rulemaking: Microbial and Disinfection Byproduct Rules
EPA 816-F-01-012
June 2001

Drinking Water Treatment
EPA 810-F-99-013
December 1999

Factoids: Drinking Water and Ground Water Statistics for 2001
EPA 815-K-02-004
May 2002

Factoids: Drinking Water and Ground Water Statistics for 2002
EPA 816–K-03-001
January 2003

Fact Sheet: 1999 Drinking Water Infrastructure Needs Survey
EPA 816-F-01-001
February 2001

"Investing in America's Water Infrastructure" Keynote Address by G. Tracy Mehan III to the Schwab Capital Markets' Global Water Conference
April 2003

Protect Your Drinking Water
EPA 816-F-02-012
September 2002

Public Access to Information & Public Involvement
EPA 810-F-99-021
December 1999

Report to Congress: EPA Studies on Sensitive Subpopulations and Drinking Water Contaminants
EPA 815-R-00-015
December 2000

Safe Drinking Water Act-Protecting America's Public Health
EPA 816-H-02-003
January 2002

Safe Drinking Water Act: Underground Injection Control Program: Protecting Public Health and Drinking Water Resources
EPA 816-H-01-003
August 2001

The Clean Water and Drinking Water Infrastructure Gap Analysis
EPA 816-F-02-017
September 2002

The Drinking Water State Revolving Fund: Protecting the Public Through Drinking Water Infrastructure Improvements
EPA 819-F-00-028
November 2001

Understanding the Safe Drinking Water Act
EPA 810-F-99-008
December 1999

Using Water Wisely in the Home
EPA 800-F-02-001
June 2001

Publications From Outside Sources

Centers for Disease Control and Prevention. *Morbidity and Mortality Weekly Report: Surveillance for Waterborne-Disease Outbreaks-United States-1999-2000.*
November 22, 2002

Congressional Budget Office. *Future Investment in Drinking Water & Wastewater Infrastructure*
November 2002

Appendix C: Sources of Additional Information

American Water Works Association
Public Affairs Department
6666 West Quincy Avenue
Denver, CO 80235
Phone (303) 794-7711
www.awwa.org

Association of Metropolitan Water Agencies
1620 I Street NW
Suite 500
Washington, DC 20006
Phone (202) 331-2820
Fax (202) 785-1845
www.amwa.net

Association of State Drinking Water Administrators
1025 Connecticut Avenue NW
Suite 903
Washington, DC 20036
Phone (202) 293-7655
www.asdwa.org

Clean Water Action
4455 Connecticut Avenue NW Suite A300
Washington, DC 20008
Phone (202) 895-0420
www.cleanwater.org

Consumer Federation of America
1424 16th Street NW
Suite 604
Washington, DC 20036
Phone (202) 387-6121
www.consumerfed.org

The Groundwater Foundation
P.O. Box 22558
Lincoln, NE 68542
Phone (800) 858-4844
www.groundwater.org

The Ground Water Protection Council
13308 N. Mac Arthur
OKC, OK 73142
Phone (405) 516-4972
www.gwpc.org

International Bottled Water Association
1700 Diagonal Road
Suite 650
Alexandria, VA 22314
Phone (703) 683-5213
Information Hotline 1-800-WATER-11
ibwainfo@bottledwater.org

National Association of Regulatory Utility Commissioners
Phone (202) 898-2200
www.naruc.org

National Association of Water Companies
1725 K Street NW
Suite 1212
Washington, DC 20006
Phone (202) 833-8383
www.nawc.org

National Drinking Water Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506
Phone (800) 624-8301
www.ndwc.wvu.edu

National Ground Water Association
601 Dempsey Rd
Westerville, OH 43081-8978
Phone: (800) 551-7379
www.ngwa.org

National Rural Water Association
2915 South 13th Street
Duncan, OK 73533
Phone (580) 252-0629
www.nrwa.org

Natural Resources Defense Council
40 West 20th Street
New York, NY 10011
Phone (212) 727-2700
www.nrdc.org

NSF International
P.O. Box 130140
789 North Dixboro Road
Ann Arbor, MI 48113
Phone (800) NSF-MARK
www.nsf.org

Rural Community Assistance Program
1522 K Street NW
Suite 400
Washington, DC 20005
Phone (202) 408-1273
www.rcap.org

Underwriters Laboratories
Corporate Headquarters
333 Pfingsten Road
Northbrook, IL 60062-2096
Phone (877) 272-8800
www.ul.com

Water Quality Association
4151 Naperville Road
Lisle, IL 60532
Phone (630) 505-0160
www.wqa.org

U.S. Environmental Protection Agency Water Resource Center
1200 Pennsylvania Avenue NW
RC-4100
Washington, DC 20460
SDWA Hotline (800) 426-4791
www.epa.gov/safewater

Water Systems Council
National Programs Office
101 30th Street NW
Suite 500
Washington, D.C. 20007
Phone: (202) 625-4387
Wellcare Hotline 888-395-1033
www.watersystems council.org

EPA Region 1
(CT, ME, MA, NH, RI, VT)
Phone (617) 918-1111
Phone (617) 918-1614
(UIC issues)

EPA Region 2
(NJ, NY, PR, VI)
Phone (212) 637-5000
Phone (212) 637-4232
(UIC issues)

EPA Region 3
(DE, DC, MD, PA, VA, WV)
Phone (215) 814-5700
Phone (215) 814-5445
(UIC issues)

EPA Region 4
(AL, FL, GA, KY, MS, NC, SC, TN)
Phone (404) 562-9900
Phone (404) 562-9452
(UIC issues)

EPA Region 5
(IL, IN, MI, MN, OH, WI)
Phone (312) 886-2000
Phone (312) 886-1492
(UIC issues)

EPA Region 6
(AR, LA, NM, OK, TX)
Phone (214) 665-6444
Phone (214) 665-7183
(UIC issues)

EPA Region 7
(IA, KS, MO, NE)
Phone (913) 551-7003
Phone (913) 551-7030
(UIC issues)

EPA Region 8
(CO, MT, ND, SD, UT, WY)
Phone (303) 312-6312
Phone (303) 312-6242
(UIC issues)

EPA Region 9
(AZ, CA, HI, NW, AS GU)
Phone (415) 947-8000
Phone (415) 947-1834
(UIC issues)

EPA Region 10
(AK, ID, OR, WA)
Phone (206) 553-1200
Phone (206) 553-1901
(UIC issues)

Appendix D: Glossary

Action Level

The level of lead and copper which, if exceeded, triggers treatment or other requirements that a water system must follow.

Aquifer

A natural underground layer, often of sand or gravel, that contains water

Coliform

A group of related bacteria whose presence in drinking water may indicate contamination by disease-causing microorganisms

Community Water System (CWS)

A water system that supplies drinking water to 25 people or more year-round in their residences

Contaminant

Anything found in water (including microorganisms, radionuclides, chemicals, minerals, etc.) which may be harmful to human health

Cryptosporidium

Microorganism found commonly in lakes and rivers which is highly resistant to disinfection.

Disinfectant

A chemical (commonly chlorine, chloramines, or ozone) or physical process (e.g., ultraviolet light) that kills microorganisms such as viruses, bacteria, and protozoa

Distribution System

A network of pipes leading from a treatment plant to customers' plumbing systems

Ground Water

Water that is pumped and treated from an aquifer

Inorganic Contaminants

Mineral-based compounds such as metals, nitrates, and asbestos; naturally occurring in some water, but can also enter water through human activities

Maximum Contaminant Level

The highest level of a contaminant that EPA allows in drinking water (legally enforceable standard)

Maximum Contaminant Level Goal

The level of a contaminant at which there would be no risk to human health (not a legally enforceable standard)

Microorganisms

Tiny living organisms that can be seen only under a microscope; some can cause acute health problems when consumed in drinking water

Non-Transient Non-Community Water System

A non-community water system that serves the same people more than six months of the year, but not year-round

Organic Contaminants

Carbon-based chemicals, such as solvents and pesticides, which enter water through cropland runoff or discharge from factories

Pathogen

Disease-causing organism

Public Water System (PWS)

A water system which supplies drinking water to at least 25 people, at least 60 days each year

Sensitive Subpopulation

People who may be more vulnerable to drinking water contamination, such as infants, children, some elderly, and people with severely compromised immune systems

Septic System

Used to treat sanitary waste; can be a significant threat to water quality due to leaks or runoff

Source Water

Water in its natural state, prior to any treatment for drinking (i.e., lakes, streams, ground water)

Surface Water

Water that is pumped and treated from sources open to the atmosphere, such as rivers, lakes, and reservoirs.

Transient Non-Community Water System

A non-community water system that serves the public but not the same individuals for more than six months

Violation

Failure to meet any state or federal drinking water regulation

Vulnerability Assessment

An evaluation of drinking water source quality and its vulnerability to contamination by pathogens and toxic chemicals

Watershed

The land area from which water drains into a stream, river, or reservoir

Well

A bored, drilled or driven shaft whose depth is greater than the largest surface dimension, a dug hole whose depth is greater than the largest surface dimension, an improved sinkhole, or a subsurface fluid distribution system

Section 5.9 References

1. U.S. DOE 2004. *Study of Construction Technologies and Schedules, O&M Staffing and Cost, and Decommissioning Costs and Funding Requirements for Advanced Reactor Designs*, prepared by Dominion Energy Inc., Bechtel Power Corporation, TLG, Inc., and MPR Associates for United States Department of Energy Cooperative Agreement DE-FC07-03ID14492, Contract DE-AT01-020NE23476, May. 2004.

2. U.S. NRC 1995. *Revised Analysis of Decommissioning for the Reference Pressurized Water Reactor Power Station*, NUREG/CR-5884, November 1995.

3. U.S. NRC 1999. *Environmental Standard Review Plans for Environmental Reviews for Nuclear Power Plants*, NUREG-1555, Washington D.C,. October 1999.

4. U.S. NRC 2002. *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities,* NUREG-0586, Supplement 1, Office of Nuclear Reactor Regulation, Washington, D.C,. November 2002.

5. U.S. NRC 2003. *Assuring the Availability of Funds for Decommissioning Nuclear Reactors*, Regulatory Guide 1.159, Revision 1. October 2003.

6. U.S. NRC 2007. *Report on Waste Burial Charges, Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities.* NUREG-1307, Revision 12, Office of Nuclear Material Safety and Safeguards, Washington, D.C., November 2007.

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1. ICRP (International Commission on Radiological Protection) 1991. *Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Pergamon Press, Oxford, United Kingdom, 1991.

2. INEEL (Idaho National Engineering and Environmental Laboratory) 2003. *Early Site Permit Environmental Report Sections and Supporting Documentation*, Engineering Design File Number 3747, Idaho Falls, Idaho, 2003.

3. Johnson, P. E. and R. D. Michelhaugh, 2000. *Transportation Routing Analysis Geographic Information System (WebTRAGIS) User's Manual*, ORNL/TM-2000/86, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Available at http://www.ornl.gov/~webworks/cpr/v823/rpt/106749.pdf.

4. NAS (National Academy of Sciences) 2005. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII – Phase 2,* Committee to Assess Health Risks From Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, Division of Earth and Life Studies, National Research Council, National Academy Press, Washington D.C., 2005. Available at http://www.nap.edu/books/030909156X/html.

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8. U.S. AEC (U.S. Atomic Energy Commission) 1972. *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants*, WASH-1238, Washington D.C., December 1972.

9. U.S. DOE 2002a. *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250, Office of Civilian Radioactive Waste Management, U.S. DOE, Washington D.C., February 2002.

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14. U.S. NRC 2006a. *Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna ESP Site*, NUREG-1811, Office of New Reactors, Washington D.C., December 2006.

15. U.S. NRC 2006b. *Environmental Impact Statement for an Early Site Permit (ESP) at the Exelon ESP Site*, NUREG-1815, Office of Nuclear Reactor Regulation, U.S. NRC, Washington D.C., July 2006.

16. U.S. NRC 2006c. *Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site*, NUREG-1817, Office of Nuclear Reactor Regulation, Washington D.C., April 2006.

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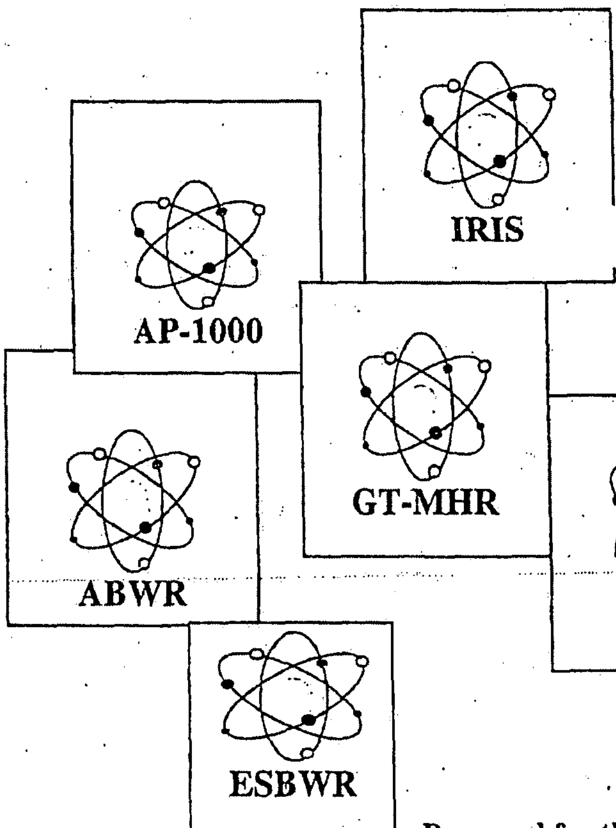
Section 5.11 Ref 2

(INEEL 2003)

V-104

Early Site Permit Environmental Report Sections and Supporting Documentation



Prepared for the

United States Department of Energy
Office of Nuclear Energy, Science and Technology

May 15,2003

Proprietary information has been been removed from this document.

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01/30/2003
Rev. 11

ENGINEERING DESIGN FILE

EDF No.: 3747 EDF Rev. No.: 0 Project File No.: N/A

1. Title: Early Site Permit ER Sections and Supporting Documentation

2. Index Codes:
Building/Type NIA SSC ID NIA Site Area NIA

3. NPH Performance Category: ______ or ☒ N/A

4. EDF Safety Category: ______ or ☐ N/A SCC Safety Category: ______ or ☐ N/A

5. Summary:
This EDF provides three sections of the Early Site Permit Environmental Report and Supporting Documentation.

6. Review (R) and Approval (A) and Acceptance (Ac) Signatures:
(See instructions for definitions of terms and significance of signatures.)

	R/A	Typed Name/Organization	Signature	Date
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Early Site Permit ER Sections and Supporting Documentation

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ORNL/TM-2000/86

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ORNL-27 (4-00)

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Chemical Technology Division

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April 2000

Prepared for the
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ACRONYMS AND ABBREVIATIONS

*BRG	Barge, inland waterway
*M-M	Merchant Marine, deep draft waterway
<TR>	Terminal Railroad
AAR	Association of American Railroads
AMTK	Amtrak (National Railroad Passenger Corporation)
CFR	Code of Federal Regulations
CN	Canada
CSXT	CSX Transportation
DOE	Department of Energy
DOT	Department of Transportation
EM	Office of Environmental Restoration and Waste Management
ESRI	Environmental Systems Research Institute, Inc.
FIPS	Federal Information Processing Standards
FRA	Federal Railroad Administration
GIS	Geographic Information System
GUI	Graphical user interface
HM-164	Hazardous Materials Docket Number 164
HRCQ	Highway Route Controlled Quantity
IAIS	Iowa Interstate
IC	Illinois Central
ID	Identification
LAT/LON	Latitude/longitude
L/D	Lock and Dam
NS	Norfolk Southern
ORNL	Oak Ridge National Laboratory
PC	Personal computer
PPU	Peoria and Pekin Union
SMIP	Safety Metrics Indicator Program
TIGER	Topologically Integrated Geographic Encoding and Referencing system
TRAGIS	Transportation Routing Analysis Geographic Information System
UP	Union Pacific
USGS	United States Geological Survey
WebTRAGIS	Transportation Routing Analysis Geographic Information System
WIPP	Waste Isolation Pilot Plant
WWW	World wide web

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TRANSPORTATION ROUTING ANALYSIS GEOGRAPHIC INFORMATION SYSTEM (TRAGIS) USER'S MANUAL

1. INTRODUCTION

In the early 1980s, Oak Ridge National Laboratory (ORNL) developed two transportation routing models: HIGHWAY, which predicts truck transportation routes, and INTERLINE, which predicts rail transportation routes. Both of these models have been used by the U.S. Department of Energy (DOE) community for a variety of routing needs over the years. One of the primary uses of the models has been to determine population-density information, which is used as input for risk assessment with the RADTRAN model, which is available on the TRANSNET computer system. During the recent years, advances in the development of geographic information systems (GISs) have resulted in increased demands from the user community for a GIS version of the ORNL routing models. In April 1994, the DOE Transportation Management Division (EM-261) held a Baseline Requirements Assessment Session with transportation routing experts and users of the HIGHWAY and INTERLINE models. As a result of the session, the development of a new GIS routing model, Transportation Routing Analysis GIS (TRAGIS), was initiated.

TRAGIS is a user-friendly, GIS-based transportation and analysis computer model. The older HIGHWAY and INTERLINE models are useful to calculate routes, but they cannot display a graphic of the calculated route. Consequently, many users have experienced difficulty determining the proper node for facilities and have been confused by or have misinterpreted the text-based listing from the older routing models. Some of the primary reasons for the development of TRAGIS are (a) to improve the ease of selecting locations for routing, (b) to graphically display the calculated route, and (c) to provide for additional geographic analysis of the route.

TRAGIS was originally written with the ArcView™ software, which is marketed by Environmental Systems Research Institute, Inc. (ESRI). ArcView is a versatile multifunctional GIS package. TRAGIS was written primarily in ArcView Avenue language, but several functions in TRAGIS (including the routing routines) were written in the C++ programming language. TRAGIS operates on a UNIX® platform, primarily because of the size of the routing databases in the model. Additionally, several platform incompatibilities exist between the UNIX and Windows™ versions of ArcView. These incompatibilities make it difficult to run TRAGIS under the Windows platform. Also, each user must have a licensed copy of the ArcView™ software. This requirement would get very expensive as the number of users increases.

Accessibility to DOE users has been a problem because TRAGIS was written for a SUN™ UNIX workstation. At that time the UNIX workstation was fast enough for the mapping features, but Windows personal computers (PCs) were not. Now that the speed and capability of Windows personal computers have increased dramatically, they are fully capable of performing the mapping function satisfactorily. The need to make TRAGIS more available to the DOE community indicated that development of the next version of TRAGIS as a world wide web (WWW) application might be the best option. Since the main routing software was written in C++, it could be compiled for either a PC or a UNIX machine. Also, the user interface of TRAGIS was separate from the routing engine, it would be easier to build a new user interface and use essentially the same routing engine. During the development of WebTRAGIS (web-based TRAGIS), however, it was discovered that extensive modification of the routing engine in C++ was required to give it a simple universal interface. This modification was completed, and now the routing engine can easily be used in other programs, such as Batch-TRAGIS for pass through analysis and for generating Safety Metrics Indicator Program (SMIP) normalization data, and the engine is expected to be used for TRANSCOST.

WebTRAGIS was developed to be accessible over the WWW using the capabilities of the Internet Explorer 5.0™ web browser. WebTRAGIS consists of an access-controlled web page with a custom-built ActiveX™ control, which serves as the user interface to the routing engine, which resides on the server and is sent the route description-information. The routing engine uses the information to calculate the route and then generates output listings as text files. The user interface can then pick up and display the output files. Since the mapping feature is still slow, especially when map data are sent over the internet, two different user interfaces were built—one with the mapping feature and one without the mapping feature. The user interface without the mapping feature is obviously much faster and will operate quickly and efficiently over the WWW. It is basically a direct replacement for HIGHWAY and INTERLINE with an easy-to-use Windows interface. The user's interface with the mapping feature is slower, and in order to keep the speed to an acceptable level, the large data files must reside on the user's PC. Therefore, it was decided to deploy the mapping version as a client-server application, where the map data files and user interface software reside on the user's PC and the routing engine and its large data files reside on the server. The client communicates over the internet with the server. The software was written to minimize the data transmission, so the speed of operation is virtually the same whether one is connected via a modem or a high-speed internet connection.

WebTRAGIS is designed to use the rail, highway, and waterway transportation modes for routing. The rail network used in the initial version of the model is the same database as that used in the INTERLINE model. This database, which was developed for the Federal Rail Administration (FRA) in the mid-1970s, is not a fixed-scale database and has been extensively modified since its inception by ORNL. Currently, a 1:100,000-scale database is being developed, and when this network is completed, it will be incorporated into WebTRAGIS. The road database is a 1:100,000-scale database, which was developed from the U.S. Geological Survey (USGS) Digital Line Graphs and the U.S. Bureau of Census Topologically Integrated Geographic Encoding and Referencing (TIGER) system. This waterway network information, for the inland waterway systems, is based on the USGS 1:2,000,000-U.S. Geodata. Deep-water routes are depicted in WebTRAGIS as straight-line segments. It is planned to incorporate a 1:100,000-scale waterway database for the model so that all modes are at a consistent scale.

One of the features of WebTRAGIS is a consistent user interface between and among the transportation modes. Functions are similar for running rail, highway, or waterway routes. Some variations occur, such as prompts requesting the name of the railroad company to be used. However, when a user learns one portion of the WebTRAGIS system, it is not difficult for that person to run other portions of the model.

WebTRAGIS allows the selection of the origin and destination of a route from a list of node names. When selecting nodes, the program displays a list of state abbreviations from which the user selects a state. Next, a list of node names within that state is displayed. The user can scroll through this list and select a node. After a node is selected, WebTRAGIS displays the selected node's identification (ID) number. In addition to nodes at city locations and within the network, the WebTRAGIS databases contain hundreds of specific nodes for locations of commercial nuclear reactors, DOE sites, military installations, and other important nuclear-related sites.

After an origin and a destination are selected, the model is ready to calculate a route based on criteria established by option selections. A default set of criteria is active for each transportation mode in the model. After completing the route calculation, WebTRAGIS displays the standard route listing. The user can also view a detailed listing of the route and population-density information, which can be used with the RADTRAN risk model.

Option settings provide a mechanism to change various parameters used by the model for route calculations. Examples of some of the options include adjusting the penalty factors for the mainline classifications for rail routing, using preferred highway routes for radioactive materials, and running alternative routes for the different transportation modes in WebTRAGIS.

WebTRAGIS also provides functions to temporarily modify the routing networks. The user can select individual nodes and links or an entire state in which all nodes and links are blocked from the network.

This user's manual has six sections following this introductory section. Section 2 is a general overview of the WebTRAGIS. This section is very useful if the user has not worked with graphical user interface (GUI) programs. Rail, highway, and waterway features are discussed in Sects. 3–5, respectively. Section 6 describes the operation of the mapping functions.

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2. GENERAL OVERVIEW OF WebTRAGIS

WebTRAGIS is written to operate as a Windows application for Microsoft Windows 32-bit operating systems. A 32-bit Windows PC with a copy of Internet Explorer (Version 5.0 or later) is necessary in order to use the WebTRAGIS software. The software is distributed as an ActiveX control or a downloadable client-server application. Instructions for installing the software are provided on the WWW page.

To start WebTRAGIS with mapping, click on START - Programs - TRAGIS - Tragis. Accessing the WWW page and logging on to the system will start WebTRAGIS without mapping. It will take a few seconds for WebTRAGIS to connect across the internet to the databases needed for the model. After the loading, the model will display a username window, which is used to control user access to the WebTRAGIS routing engine (Fig. 2.1).

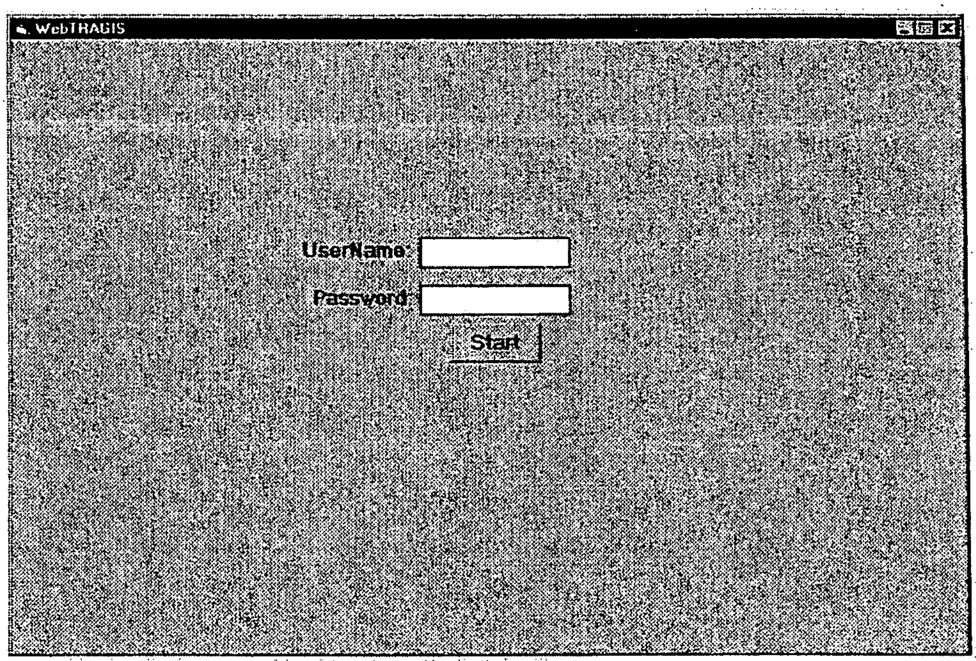

Fig. 2.1. Logon screen.

2.1 WebTRAGIS LAYOUT

WebTRAGIS has several tabs of options. It opens to the 'Select Origin and Destination' tab. Figure 2.2 shows how WebTRAGIS appears when the program has finished loading and the user has entered their username and password. There are five tabs on the WebTRAGIS WWW home page. There are six tabs on the WebTRAGIS with maps program—the same 5 that are on the WWW page plus a tab for maps.

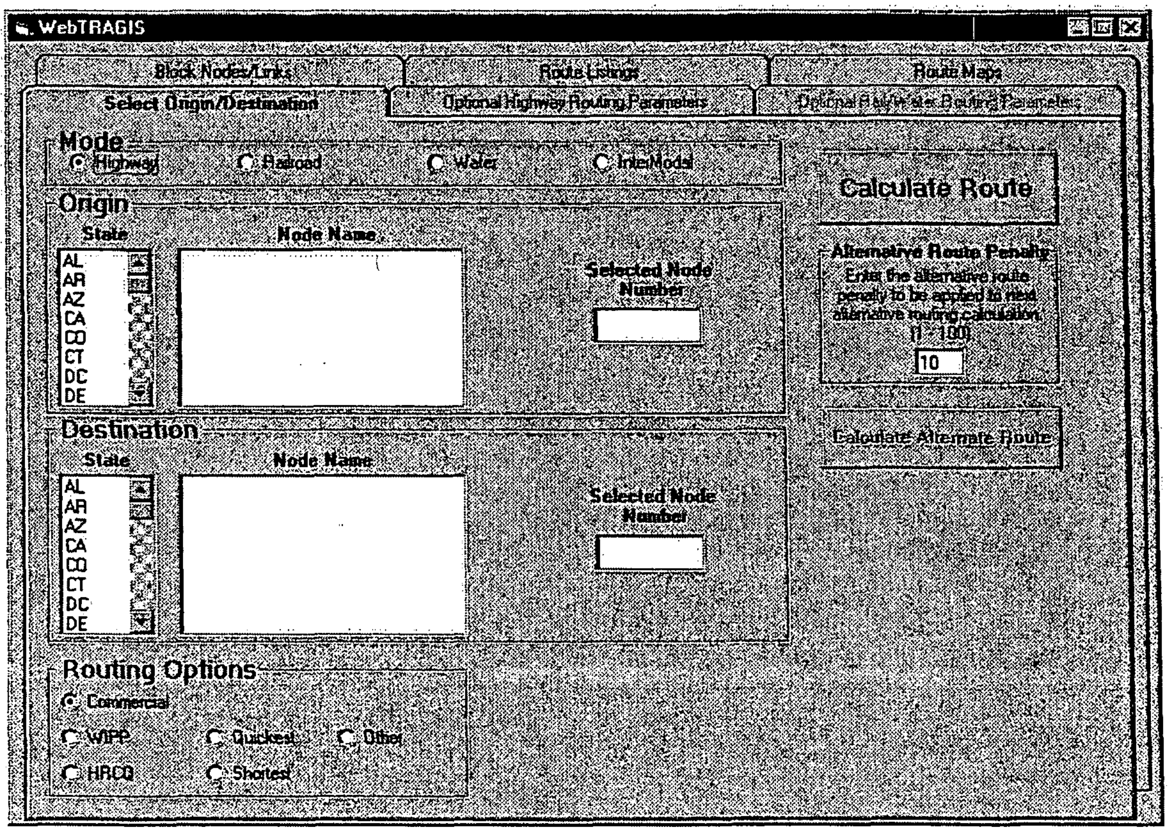

Fig. 2.2. WebTRAGIS.

2.1.1 Tab 1—Select Origin/Destination

This tab contain several options for selection mode; origin and destination, and route options; input of alternative route penalty; and, depending on the routing option selected, input of preferred route-weighting factor; and input of time and mile bias.

2.1.2 Tab 2—Optional Highway Routing Parameters

This tab contains six optional routing parameters. They are selection of one or two drivers, highway inspection, date and time options, toll-bias factor, other constraints, and road-lane-type penalty.

2.1.3 Tab 3—Optional Rail/Water Routing Parameters

This tab contains three optional routing parameters for railroads and two for water routing. The three railroad options are (1) Change Originating Railroad Preference, (2) Change Rail Line Type Weighting Factors, and (3) Modify Rail Transfer Penalties. The two water options are (1) Select Water Route Type and (2) Modify Mode Transfer Penalty.

2.1.4 Tab 4—Block Nodes/Links

This tab contains four ways for blocking available routing features: block nodes, block links, block states, and block railroad companies.

2.1.5 Tab 5—Route Listings

This tab allows the user to view and print the input file and the four route output files. These are the detailed input file and the standard route listing, detailed route listing, population density, and the route latitude/longitude (LAT/LON) listing. After completing the route calculation, the standard listing is automatically displayed.

2.1.6 Tab 6—Route Maps

This tab is available only on the WebTRAGIS with the Maps version. On this tab are several buttons; these buttons are described in detail in Sect. 6 of this manual.

2.2 RUNNING WebTRAGIS

The remainder of this manual will be based on the individual transportation mode chosen within WebTRAGIS. Rail routing will be discussed first and next by highway and water routing. The long-range plans for WebTRAGIS include full intermodal capabilities so that users can route via two or three modes. In the initial version of WebTRAGIS, intermodal capabilities, as envisioned, do not exist as yet because of funding constraints. As an interim measure, an additional mode is available in WebTRAGIS. The rail-water mode is available for rail-waterway intermodal routing. This feature is not discussed in this manual; the functions of this combination mode are described in both the rail (Sect. 3) and waterway (Sect. 5) portions of this manual.

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3. RAIL ROUTING

The WebTRAGIS model calculates rail routes that simulate the routing practices of the railroad companies in the United States. The basic concept of determining rail routes is to calculate the shortest path based on travel distance and traffic density on rail segments. Each segment of the rail-network database has a distance, in miles, and a variable signifying the volume of traffic density. The traffic-density information is divided into four classes as follows:

A–mainline—more than 20-million gross ton miles per year,
B–mainline—between 5- and 20-million gross ton miles per year,
A–branchline—between 1- and 5-million gross ton miles per year, and
B–branchline—less than 1-million gross ton miles per year.

In addition to biasing the distance based on traffic density, the model also penalizes changing from one rail carrier to another. Finally, the model also reduces the impedance values on the originating rail carrier. These features replicate the practice of actual rail routing—which is that the originating carrier will attempt to keep the shipment on its system for as much of the total route as possible.

To set WebTRAGIS to calculate rail routes, the user needs to move the pointer over the Mode on the **Select Origin/Destination** tab and click the **Rail** option. This selects the mode Rail as the currently active mode in WebTRAGIS. After the rail mode is selected, the entire rail node listing is loaded, and the appropriate optional parameters are made visible. Figure 3.1 shows the display of WebTRAGIS after the rail network is activated.

3.1 SELECT ORIGIN/DESTINATION TAB

3.1.1 Selecting Origin

After the rail network is initialized, select the origin and destination for calculating a route. The first step is to select an origin for a route by first selecting the state, next selecting the node name, and then selecting the railroad company if more than one railroad services the selected node. The selected rail node number and railroad abbreviation are displayed. Repeat for selection of the destination. (The abbreviation CN represents Canada. Several rail lines in the current rail database extend into Canada.)

Figure 3.1 shows an example of node names for the state of Tennessee. In this example, the list has been scrolled about midway through the list of nodes (as is indicated by the position of the marker on the scroll bar), and the Knoxville node has been highlighted. After the desired node has been selected, a listing of all available railroads providing service at this location is identified. Then select one of the railroads by highlighting it. If there is only one servicing railroad company, it is automatically selected. WebTRAGIS now displays the selected node number and railroad company.

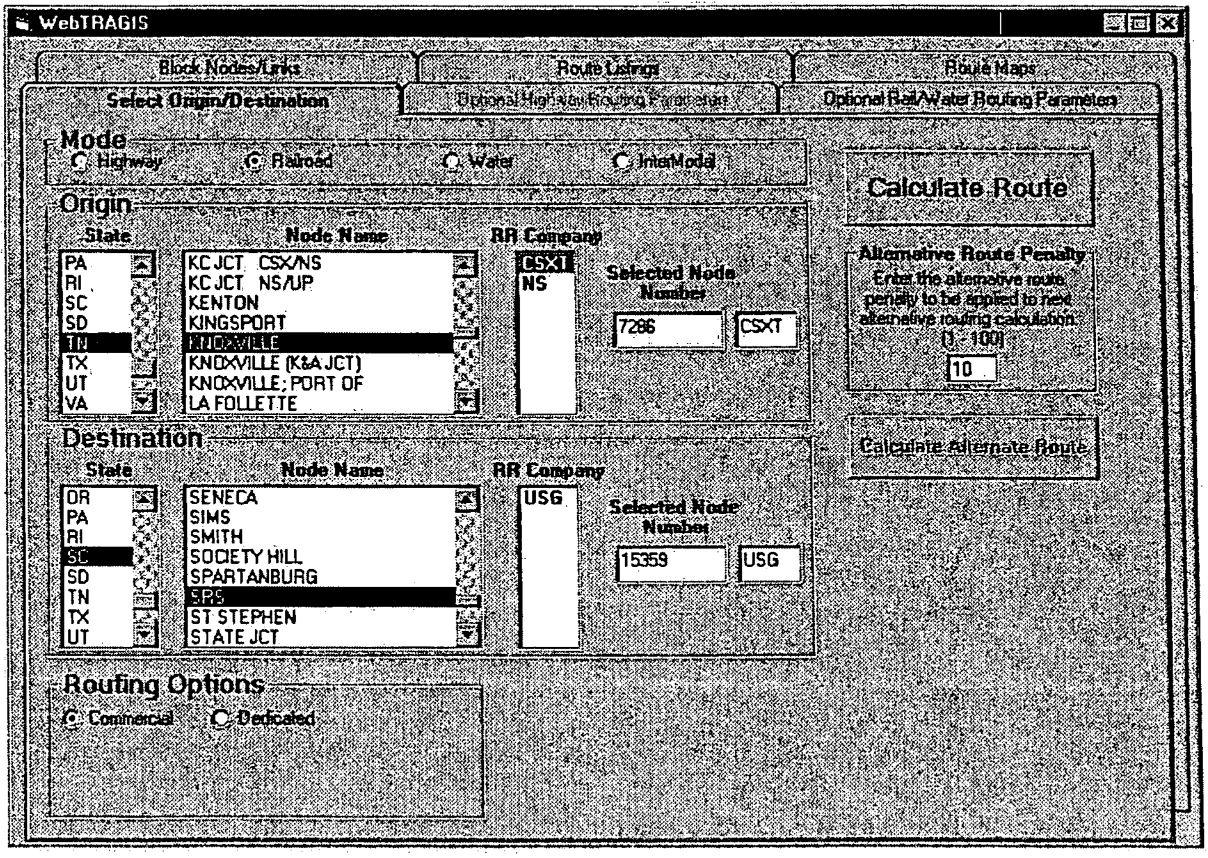

Fig. 3.1. Rail mode activated.

3.1.2 Selecting Destination

This same process is repeated for a destination location for a route. Selection of the route destination is the last required step before a route can be calculated. Press the **Calculate Route** button on the right side of the screen. The different origin or destination can be selected after a route has already been calculated. When this is done, the information from the previously calculated route is discarded, and all current information is used for the new route. The earlier destination or other selections will not be considered in the new route.

3.1.3 Routing Options

The routing type option is shown in Fig. 3.1. This option allows a choice between the default general commercial freight routing option or the dedicated-train routing option. With the dedicated-train routing option, the transfer penalty between railroad systems and the originating railroad advantage are eliminated. To switch between these two, click the appropriate choice.

3.14 Calculate Route and Calculate Alternative Route

After a destination has been determined, click the **Calculate Route** button on the right side of the screen. If an origin or a destination is not selected, a message reminding you to select these will be displayed. WebTRAGIS will calculate the rail route and then display a window that shows the standard listing for the route.

After a route has been calculated, the **Calculate Alternative Route** button becomes active, allowing the user to generate alternative routes. To calculate an alternative route, go back to the Select Origin/Destination tab and then click the **Calculate Alternative Route** button. When an alternative route (or another route) is calculated, it overwrites all of the output files from the previous route. Therefore, you must save or print all route files before running an alternative (or another) route. An alternative route is generated by penalizing the links comprising the current route by the Alternative Route Penalty Factor in preparation for running the alternative route when the **Calculate Alternative Route** is clicked.

3.2 ROUTE LISTINGS TAB

The **Route Listings** tab provides access to input and output listings of routes and population-density information of the most recently calculated route. The displayed listing can be saved or printed. Figure 3.2 shows the route listings.

The standard listing identifies only the origin and destination, any transfer locations, and larger cities along the route. This listing also identifies the railroad used for each portion of the route, a cumulative mileage figure for each location listed, a breakdown of mileage by railroad and line classification, and a summary of mileage by state.

The detailed listing provides much more information on the route. Every node on the route is listed along with information on link characteristics. Not every node in the database has a name, so node numbers are listed. Link information includes the link number; the distance of the link; the line classification code; a traffic volume code; a speed limit for freight trains; and if the operating railroad is using trackage rights over this line, the abbreviation of the railroad owning the tracks. As with the standard listing, summary information by railroad and state follows the route listing.

The population-density information is viewed by clicking the **Population Data** button. A listing of the population density information for the route is displayed. The basic table includes 12 population-density categories ranging from 0 to over 9996 people per square mile. The entries in the table show the distance that the route travels in each category. At the end of the table, summary information is provided for the route. This information combines the data from the 12 categories into rural, suburban, and urban groups and also provides a weighted population-density value for each of these groups. This information is used as input for routing risk analysis using the RADTRAN or RISKIND computer codes.

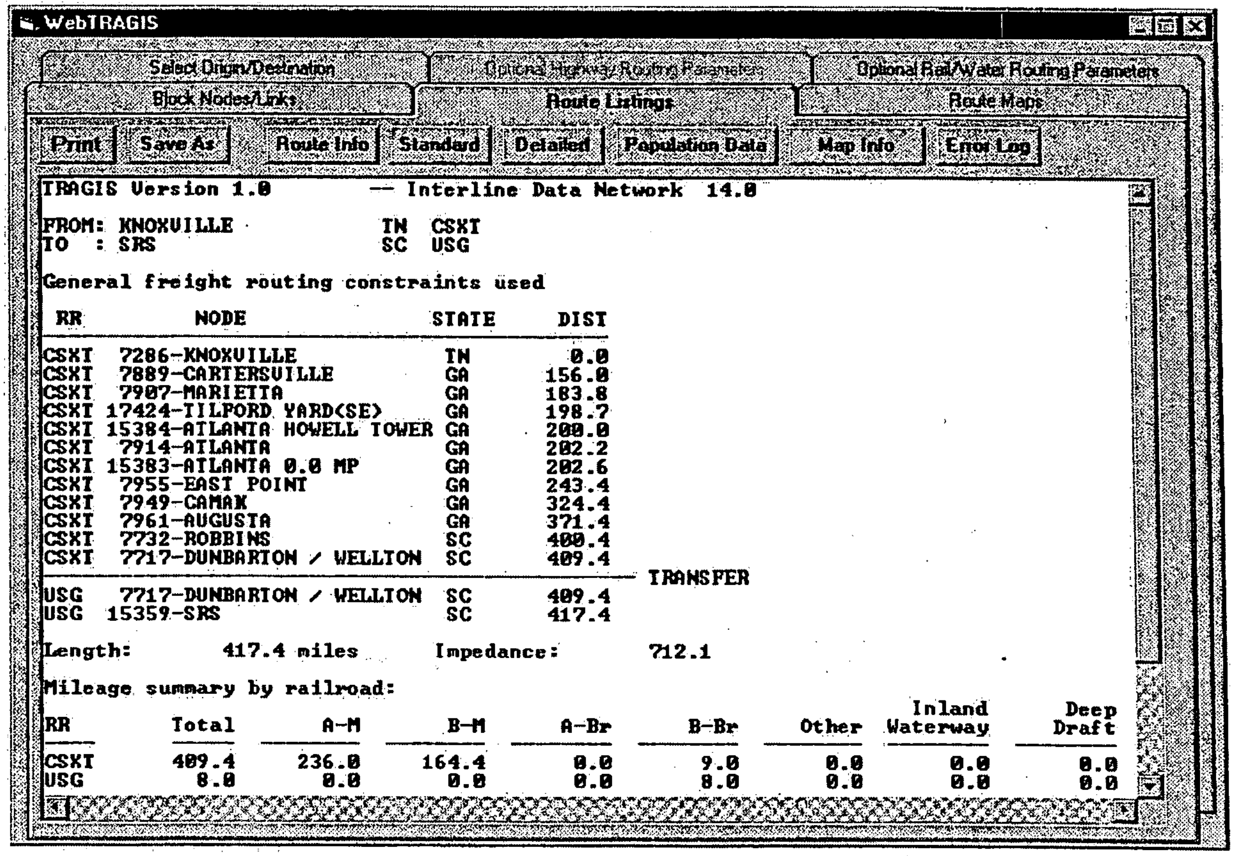

Fig. 3.2. Rail-route listings.

The final items on the **Route Listings** tab are the **Print** and **Save As** buttons. When the **Print** button is clicked, the listing currently being viewed is sent to the printer. (Note: Be sure to display the desired information to the screen before printing). When the **Save As** button is clicked, a file selection dialog box is displayed. The file name and location can then be selected, and the listing currently being displayed can be saved to that selected file.

3.3 OPTIONAL RAIL/WATER ROUTING PARAMETERS TAB

The **Optional Rail/Water Routing Parameters** tab provides access to a number of parameters that control the routing functions. When rail is the active mode, **Optional Rail/Water Routing Parameters** tab is available, and the **Optional Highway Routing Parameters** tab is not.

When the **Optional Rail/Water Routing Parameters** tab is selected, a window of the rail options is displayed. Figure 3.3 shows the rail options window. Within this window, available options can be selected. Click on the item of interest to select it. The following sections discuss the various rail options.

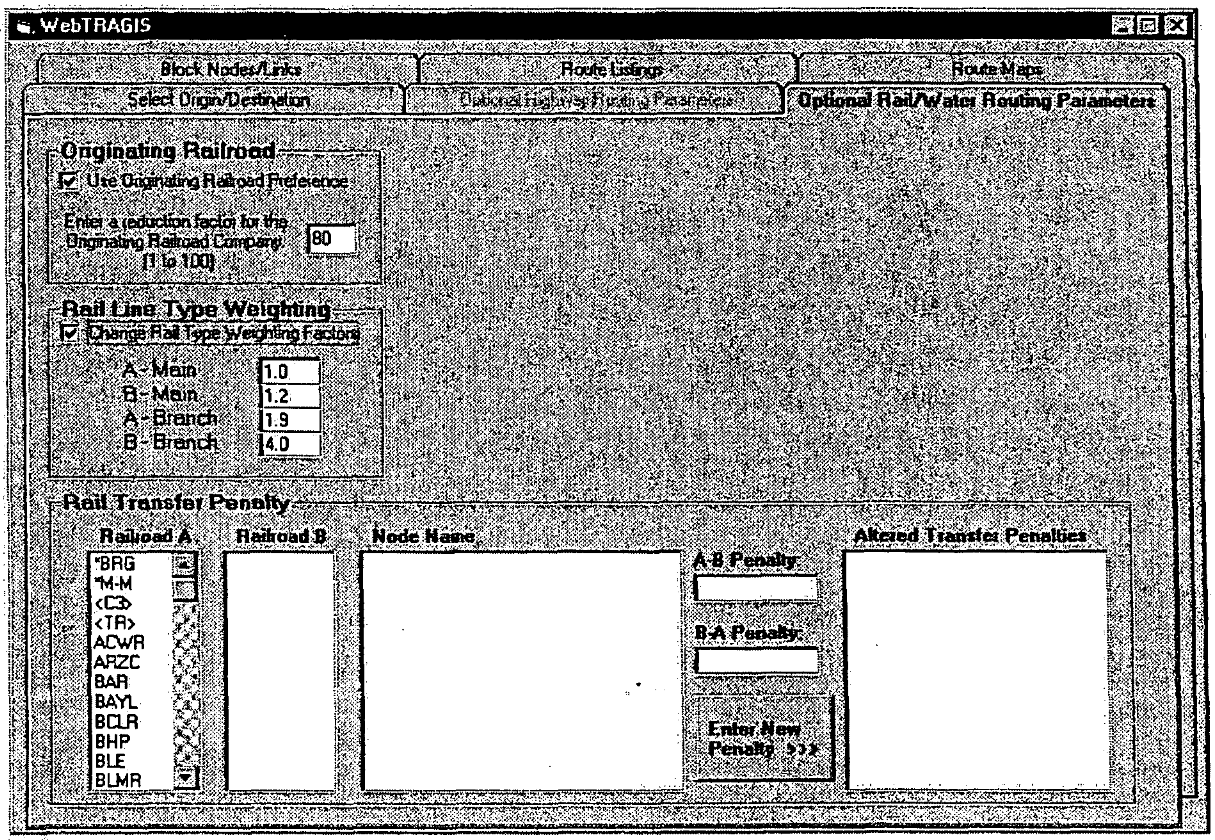

Fig. 3.3. Optional rail-routing parameters.

3.3.1 Rail Line Type Weighting

The weighting factor option allows adjustments to the factors that are used to calculate routes. This window is shown in Fig. 3.3. The default values are displayed for each penalty factor. Any of the variables can have a new value assigned by entering a new value in the appropriate box. The appropriate factors are multiplied by the distance of each link or railroad. Using the default values, an A-Mainline link has an impedance that is the same as its distance, whereas the impedance of a B-Branchline link is four times its distance.

3.3.2 Originating Railroad Preference

The impedance of the originating railroad is multiplied by a factor of 80%. This percentage reduces the impedance of the originating railroad, thereby encouraging the shipment to remain with the originating railroad as long as practicable.

3.4 BLOCK NODES/LINKS TAB

The **Block Nodes/Links** tab allows the user to block portions of the rail database or different rail companies. These features can be useful when there is a need to analyze various scenarios (e.g., determining a route that avoids a damaged bridge or section of rail line and analyzing rail mergers). The **Block Nodes/Links** tab has three functional groupings. The first group involves blocking nodes. The second group involves blocking links. Finally, the last group allows for the blocking of individual railroad companies. The window is shown in Fig. 3.4 below.

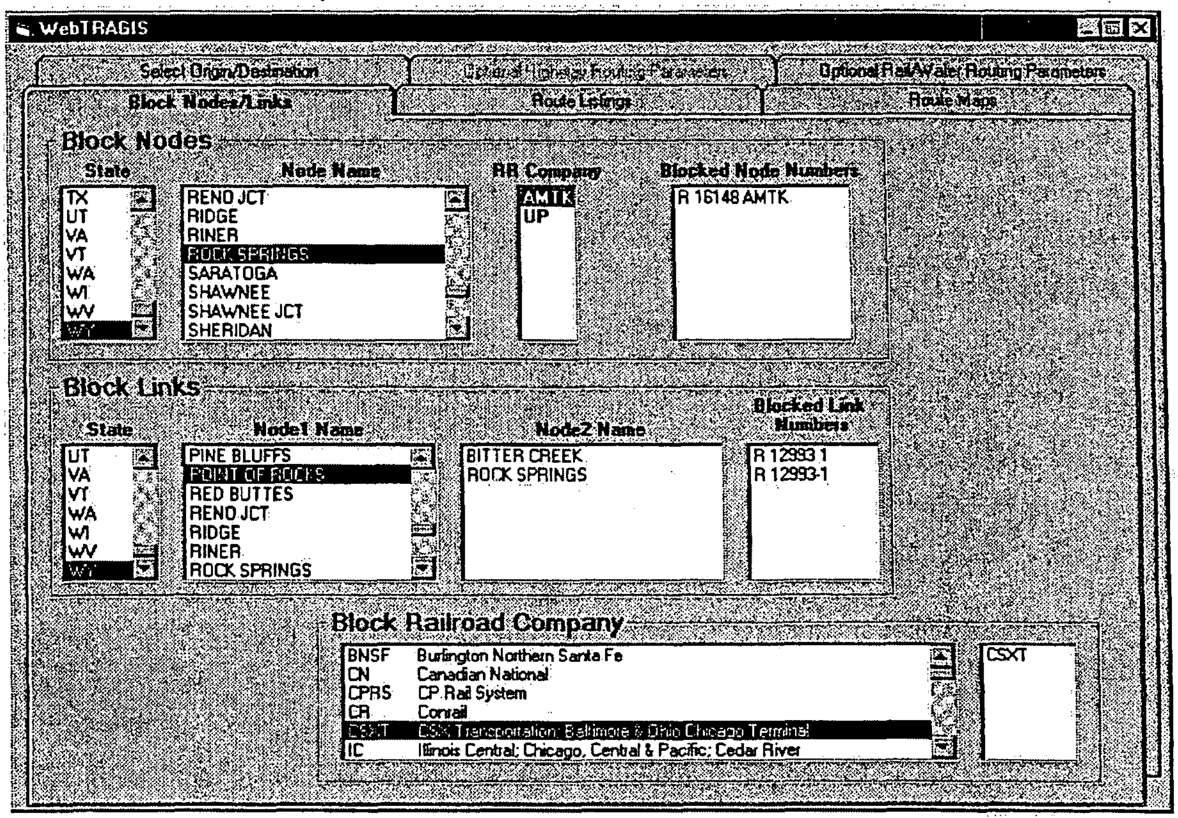

Fig. 3.4. Rail node/link blocking.

3.4.1 Node Blocking

To block a rail node, click the state of interest and find the node name to be blocked. As an example, Rock Springs, Wyoming, is served by the Union Pacific (UP) and by Amtrak (AMTK), the national rail passenger service. For other nodes, several rail companies could be listed. Thus, a node could be blocked for one railroad, but remain available for another. To remove an entry from the **Blocked Nodes** list, double-click on it.

3.4.2 Link Blocking

To block a link, click the state of interest and find the node of one end of the link to be blocked. Then select the other end node of the link. The blocked link is then displayed. (Note: There are two entries shown, one ending in '1' and the other ending in '-1'). These block the link in both directions.

3.4.3 Block Railroad Company

The rail network in WebTRAGIS is subdivided into 94 subnetworks. The **Block Railroad Company** tab provides a method to remove a railroad subnetwork from consideration. Figure 3.4 shows the rail system window as it would be displayed. The window provides a list of the railroad names for the rail systems in the rail database. A number of rail systems are comprised of several separate railroads that are owned by a single company. An example, shown on Fig. 3.4, is the Illinois Central (IC), which also owns the Chicago, Central & Pacific and the Cedar River. To remove a rail system from consideration, scroll through the list to locate the desired railroad and double-click on the name to block it. The abbreviation will appear in the box to the right.

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4. HIGHWAY ROUTING

The WebTRAGIS model can calculate a number of different types of highway routes. By default, the model calculates commercial highway routes; but with the change of an option, the model can determine routes that meet the U.S. Department of Transportation (DOT) regulations for shipments of highway route-controlled quantities (HRCQ) of radioactive material, specified routes for shipments to WIPP, the shortest, or the quickest route.

To set WebTRAGIS to calculate highway routes, the user needs to move the pointer over the Mode on the **Select Origin/Destination** tab and click the **Highway** option. This selects the mode Highway as the currently active mode in WebTRAGIS. After the **Highway** mode is selected, the entire highway node listing is loaded, and the appropriate optional parameters are activated. Figure 4.1 shows the display of WebTRAGIS after the highway network is activated.

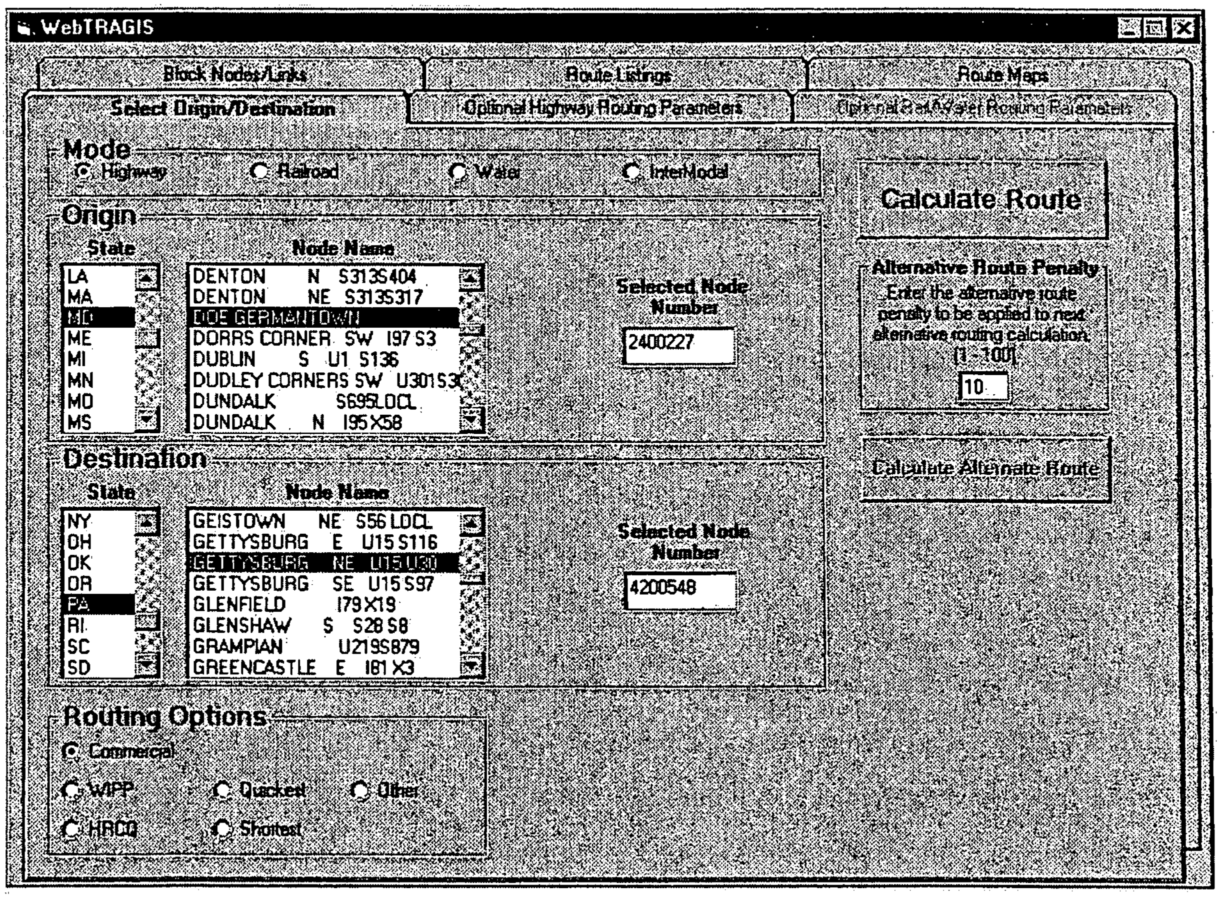

Fig. 4.1. Highway routing.

4.1 SELECT ORIGIN/DESTINATION TAB

4.1.1 Selecting Origin

After the highway network is initialized, select the origin and destination for calculating a route. The first step is to select an origin for a route by first selecting the state, and then selecting the node name. The selected highway node number is displayed. Repeat for selection of the destination. Figure 4.1 shows an example of node names for the state of Maryland. In this example, the list has been scrolled partway through the list of nodes (as is indicated by the position of the marker on the scroll bar), and the DOE-Germantown node has been highlighted. WebTRAGIS now displays the selected node number.

4.1.2 Selecting Destination

This same process is repeated for a destination location for a route. Selection of the route destination is the last required step before a route can be calculated. For this example, Gettysburg, Pennsylvania has been selected. Press the **Calculate Route** button on the right side of the screen. A different origin or destination may be selected after a route has been calculated. When this is done, the information from the previously calculated route is discarded, and all current information is used for the new route. An earlier destination or other selections will not be considered in the new route.

4.1.3 Routing Options

The **Routing Options** are shown in Fig. 4.1. These options allow a choice between the Commercial (default), HRCQ, WIPP, Quickest, Shortest, and Other routing options. Click the appropriate choice.

4.1.4 Calculate Route and Calculate Alternative Route

After a destination has been determined, click the **Calculate Route** button on the right side of the screen. If an origin or destination is not selected, a message reminding you to select these will be displayed. WebTRAGIS will calculate the highway route, and then display a window which shows the standard listing for the route.

After a route has been calculated, the **Calculate Alternative Route** button becomes active allowing the user to generate alternative routes. To calculate an alternative route, go back to the **Select Origin/Destination** tab, and then click the **Calculate Alternative Route** button. When an alternative route (or another route) is calculated, it overwrites all of the output files from the previous route. Therefore, you must save or print all route files before running an alternative (or another) route. An alternative route is generated by penalizing the links comprising the current route by the Alternative Route Penalty Factor in preparation for running the alternative route when the **Calculate Alternative Route** is clicked.

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The **Route Listings** tab provides access to the input and output listings of routes and population-density information of the most recently calculated route. The displayed listing can be saved or printed (Fig. 4.2).

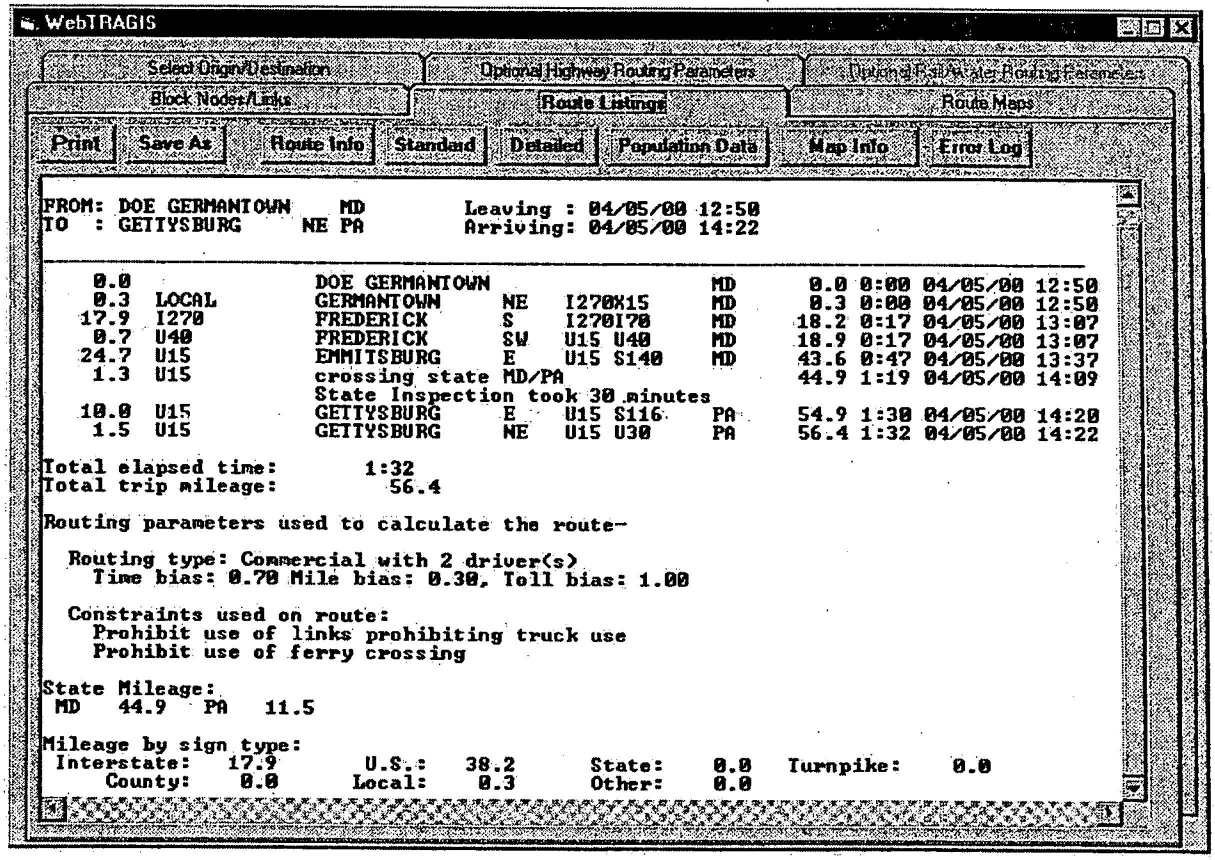

Fig. 4.2 Highway-route listings.

For highway routes, standard and detailed route listings are available. The standard listing is the shorter route listing, which is the one used most often (Fig. 4.2). This listing is for a route between DOE offices in Germantown, Maryland, and Gettysburg, Pennsylvania. The origin and destination, along with the departure and arrival date and time, are identified at the top of the listing. Next, a description of the route is provided. The first column is the distance, in miles, between each location in the listing. Following this is an identification of the road. Up to two road identifications are listed (e.g., a dual-designation road such as I-40/I-75). The first letter of the road number is a designation of the road type. Interstate highways start with an I, U.S. highways start with an U, state highways start with an S, turnpikes and tollways start with a T, county roads start with a C, and local roads start with an L. Other types of roads, such as farm-to-market roads in Texas, may start with other letters. The route number or an alphabetic abbreviation of the road follows the designation letter. Next the name of the node is listed. In some cases, actual facilities are identified, such as DOE-Germantown. Most often, nodes are identified by the nearest town or city, followed by the direction that this location is from the named location. Junction information is provided to assist in the node description. This information may include the two roads that form an intersection or the interstate route number and the exit number. The state is identified, and this identification is followed by a cumulative mileage and time columns. Finally, the date and time when the shipment is expected to pass the node are given. By default, the model assumes the departure time to be the current time from the computer. The user can set the departure time through the **Optional Highway Routing Parameters** tab, which is discussed in Sect. 4.3.

In the example shown in Fig. 4.2, the route originates at DOE-Germantown at 12:50 p.m. The route travels 0.3 miles on a local road and turns onto I-270 at Exit 15. This location is northeast of Germantown, Maryland. After traveling 17.9 miles on I-270, the shipment exits the Interstate at the junction of I-270 and I-70, south of Frederick, and then travels 0.7 miles on U.S. 40 to the junction of U.S. 15 and U.S. 40, southwest of Frederick, Maryland. At this location, the length of the route is 18.9 miles, and the trip has taken about 18 minutes. The route follows U.S. 15 for 24.7 miles to Emmitsburg, Maryland. This location is the last node encountered on the route in Maryland. (At least one line will appear in the route listing for every state that is on a route.) After another 12.8 miles on U.S. 15, the shipment arrives at the destination, which is Gettysburg, Pennsylvania. The location of this node is northeast of town at the junction of U.S. 15 and 30.

Following the route description, a summary of the total elapsed time and trip mileage is given. The routing parameters used to calculate the route is also provided along with a summary of mileage by state and a breakdown of mileage by highway sign type.

The detailed route listing is basically the same as the standard route listing other than that every node on the route is listed on the description. The length of a route listing for a cross-country route can be very long.

Population-density information can be obtained for the most recent calculated route by choosing the **Population** button in **the Route Listings** tab. A window is generated that lists the population-density information for the route. The basic table includes 12 population-density categories ranging from 0 to over 9996 people per square mile. The entries in the table show the distance that the route covers in each category. At the end of the table, summary information is provided for the route. This information combines the data from the 12 categories into rural, suburban, and urban groups and also provides a weighted population-density value for each of these groups. This information is useful as input for routing risk analysis using the RADTRAN computer code at Sandia National Laboratories or the RISKIND computer code at Argonne National Laboratory.

4.3 OPTIONAL HIGHWAY ROUTING PARAMETERS TAB

The **Optional Highway Routing Parameters** tab provides access to a number of parameters that control the routing functions. Selecting the **Optional Highway Routing Parameters** tab, a window like that shown in Fig. 4.3 is displayed. This window identifies all the options that are available for road routing. To select an option, click on the appropriate option.

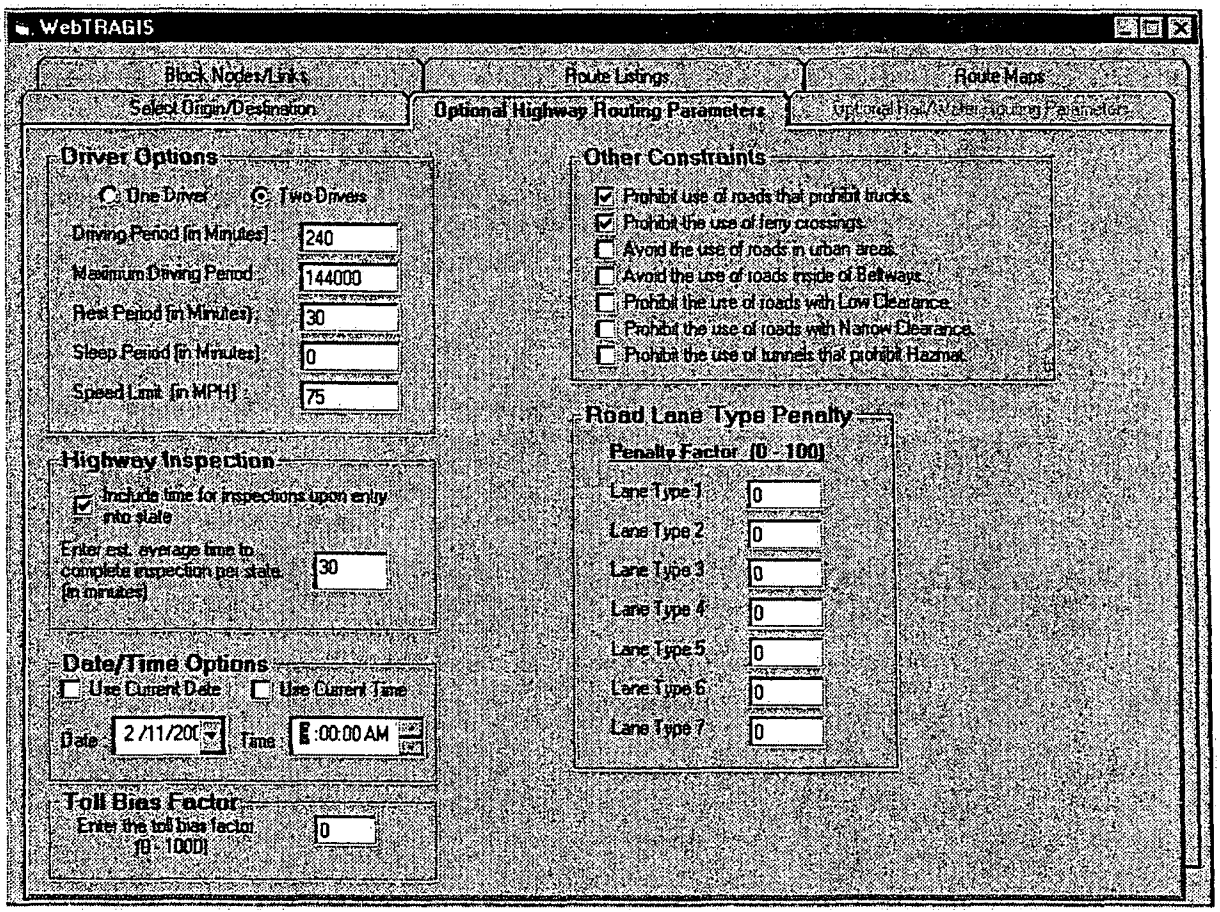

Fig. 4.3. Optional highway routing parameters.

4.3.1 Driver Options

When changing the **Driver Options** is desired, the user must select between the one or two drivers options. Figure 4.3 shows this option. The default is **Two Drivers**. Each of these options has several parameters that may be changed for a particular route. Double-click on either of the options to view the additional parameters. You may change these parameters by editing the displayed values.

4.3.1.1 One Driver

The next four items in this option window involve the periods of time for driving and resting. With a **One Driver** shipment, the default follows a pattern that the driver works for 5 hours and then takes a 0.5-hour break. After this break, another 5 hours of driving can occur, for a total of 10 hours, before an 8-hour rest period is required. You can change the amount of driving time before the short break and between major rest periods by entering new values in the driving time fields. The latter two lines request the length of the short and long break periods, respectively.

The final item of this option permits you to specify the maximum speed that a shipment will travel. Congressional action in 1995 lifted national speed limits and allowed states to specify their own limits. In certain cases, an upper limit may need to be specified for the speed of the shipment. The default value for this variable in WebTRAGIS is 75 mph. To specify a maximum travel speed of 55 mph, the model will use the speed specified in the truck database—except that those links with speeds higher will be assumed to be the value the user specified. Adjusting this value may affect the route calculation; it is also used to determine arrival times that are identified on the route listing.

4.3.1.2 Two Drivers

These items in this option window involve the periods of time for driving and resting. With two drivers, the default follows a pattern of 4 hours of driving followed by a 0.5-hour break. This pattern is followed throughout the duration of the shipment because one driver can rest while the other is driving.

The final item of this option allows the maximum speed of a shipment to be specified. Congressional action in 1995 lifted national speed limits and allowed states to specify their own limits. In certain cases, an upper limit may need to be specified for the speed for the shipment. The default value for this variable in WebTRAGIS is 75 mph. To specify a maximum speed of 55 mph, the model will use the speed specified in the truck database—except that those links with higher speeds will be assumed to be the value the user specified. Adjusting this value will not affect the route calculation; it is also used to determine arrival times that are identified on the route listing.

4.3.2 State Inspection

WebTRAGIS has an option to perform state inspections of a shipment when that shipment is transported into a new state. Figure 4.3 is the option that is displayed when the **Highway Inspection** option is checked. If the user clicks the checkbox below **Highway Inspection**, the inspection time box is displayed. The default value is 30-minutes; this value can be changed by entering a new value.

This option will create a delay every time the calculated route crosses a state boundary to simulate the delay a shipment may experience if a state inspection is required. Use of this option will not change a route (e.g., such as minimizing the number of states traversed). It will increase only the travel time for the shipment.

4.3.3 Date/Time Options

This option allows the user to specify the departure date and time for the shipment. By default, WebTRAGIS uses the current date and time from the computer. If the departure date needs to be specified, select the date with the drop-down calendar, as shown in Fig. 4.3. The departure time can be entered using the drop-down selector. If the route origin is not located in the same time zone as the computer running WebTRAGIS, the input time will be adjusted by the model (e.g., if the origin is in the central time zone, the departure time is specified as 16:30, and the computer is in the eastern time zone, WebTRAGIS will adjust the departure time to 3:30 p.m.).

4.3.4 Other Routing Constraints

Figure 4.3 shows the **Other Constraints** option. Checking the box before the item can activate any of these constraints. Two of the constraints are automatically activated by WebTRAGIS: the commercial truck and ferry crossing constraints.

The commercial truck constraint prohibits the program from using any route that restricts commercial truck traffic. An example of this is the Baltimore-Washington Parkway; no commercial truck traffic is allowed on this road. Thus, for any routing of commercial traffic, this constraint needs to be active.

Several ferry crossings are in the WebTRAGIS road database, such as those between Long Island, New York, and Connecticut. The ferry-crossing constraint prohibits the use of a ferry on a route. To use the ferries that are in the database, the user would uncheck the box (**Prohibit the use of ferry crossings**).

Roads that pass through urbanized areas with populations exceeding 100,000 are identified in the road database. By checking this option, **Avoid the use of roads in urban areas**, the model will not use any roads within any urbanized areas.

Another available constraint restricts the use of all roads within interstate beltways of larger metropolitan areas. This constraint is not related to the HRCQ-preferred routing (HM-164) option. Use of this constraint will cause the route to avoid going within the major beltways in large cities. To activate this constraint, check the box, **Avoid the use of roads inside of Beltways.**

The next two constraints involve low clearance and narrow road clearance. Road segments with height clearances of less than 13 ft 6 in and width restrictions of 8 ft or less are identified and will prohibit the use of these road segments. Each of these constraints can be activated when checking the box for the appropriate restriction.

The final constraint is identified as a tunnel. All tunnels that have hazardous materials restrictions are identified in the road database, and when this item is activated, the program will prohibit calculating routes that include these restricted tunnels.

4.4 BLOCK NODES/LINKS TAB

The **Block Nodes/Links** tab allows the blocking of a portion of the road database. This feature can be useful for analysis of various scenarios such as road closures, construction zones, or damaged bridges. You can block portions of the road database by selecting nodes, links, or entire states. Figure 4.4 shows the Block Nodes/Links window.

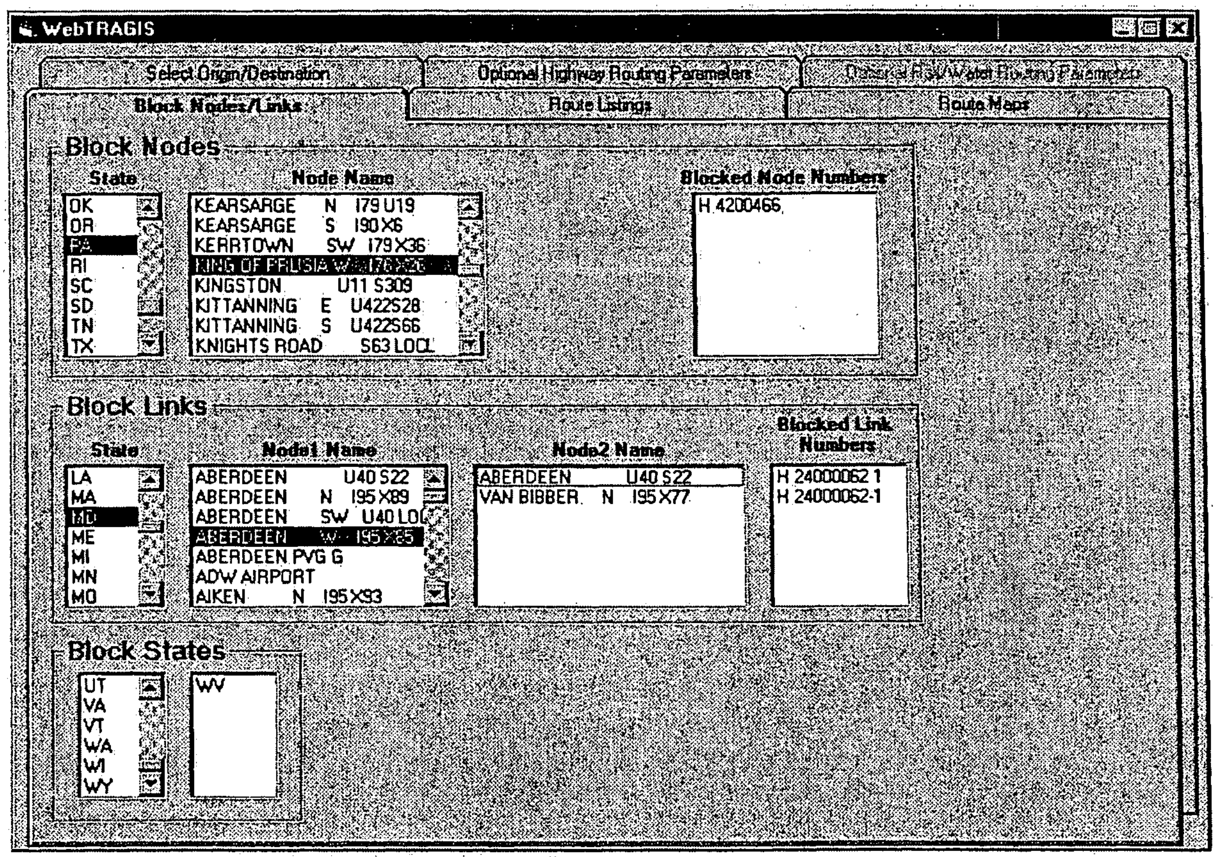

Fig. 4.4. Highway node/link blocking.

4.4.1 Node Blocking

Nodes can be blocked in the road database by making all the links that emanate from the node ineligible for routing. To block a node, select the state in which the node exists. The **Node Name** list will be populated with node names for that state. Now select the node to be blocked by scrolling to the name and clicking on it. The node number will then appear in the **Blocked Node Numbers** list.

The node numbers are six or seven digits. The right-most five digits are unique to the node within a state, and the digits to the left of the five digits are the state Federal Information Processing Standard (FIPS) code for the state. For example, code 47 is Tennessee. A node number may be removed from the **Blocked Node Numbers** list by double-clicking on it.

4.4.2 Link Blocking

Since a link is defined by its nodes, you will be choosing the link by selecting its endpoints. Block links in the road database by first choosing the **State**. After a state is chosen, the **Node1 Name** list will be populated. The **Node2 Name** list will be populated with all of the nodes connected to **Node1**. Select **Node2** from the list in **Node2 Name** list. The **Blocked Link Numbers** list will now contain two entries, the first ending with a '1' and the second ending with a '-1'. These block the link in both directions. If you want to block a link in only one direction, double click on the undesired entry, and it will be removed from the list.

4.4.3 State Blocking

An entire state can be temporarily removed from the road routing database by selecting the state (or states) from the **Blocked States** list. The blocked states will appear in the list to the right. A state may be removed from this list by double-clicking on the state abbreviation. Figure 4.4 shows that an alphabetical list of state abbreviations is displayed in a list. Scroll through the list and click the state to be removed.

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5. WATERWAY ROUTING

Waterway routing is available to users of WebTRAGIS. The waterway database consists of both inland waterways and deep-water routes. Inland waterways include all channels with a minimum depth of 9 feet. The deep-water network consists of connections between ports on the Pacific Ocean, Gulf of Mexico, Atlantic Ocean, and Great Lakes regions. Transfers between the inland and deep-water routes are treated as break-of-bulk points.

To set WebTRAGIS to calculate water routes, the user needs to move the pointer over the **Mode** on the **Select Origin/Destination** tab and click the **Water** option. This selects the mode **Water** as the currently active mode in WebTRAGIS. After the **Water** mode is selected, the entire water node listing is loaded, and the appropriate optional parameters are made active. Figure 5.1 shows the display of WebTRAGIS after the water network is activated.

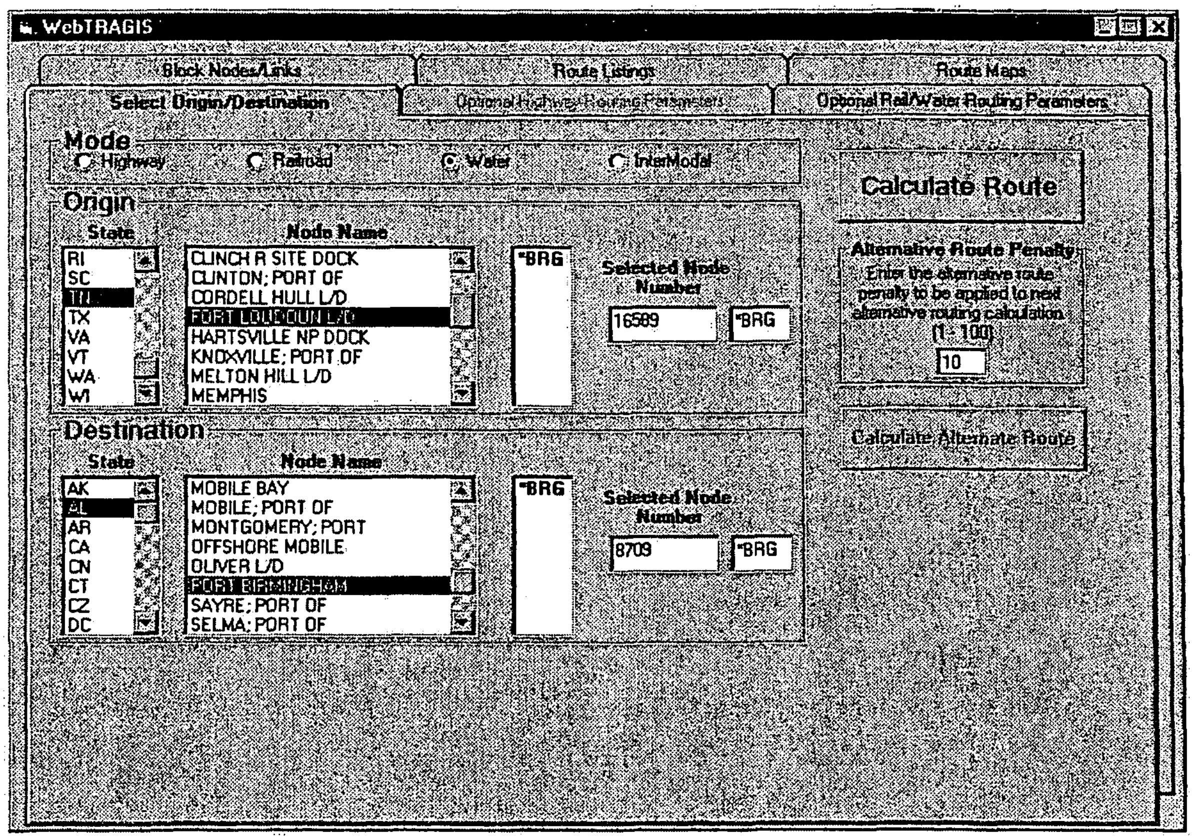

Fig. 5.1. Water routing.

5.1 SELECT ORIGIN/DESTINATION TAB

5.1.1 Selecting Origin

After the water network is initialized, select the **Origin** and **Destination** for calculating a route. The first step is to select an origin for a route by first selecting the state, then selecting the node name, and then selecting the subnetwork if more than one services the selected node. The **Selected Node Number** and subnetwork abbreviation are displayed.

Figure 5.1 shows an example of node names for the state of Tennessee. In this example, the list has been scrolled about midway through the list of nodes (as is indicated by the position of the marker on the scroll bar), and the Knoxville node has been highlighted. After the desired node has been selected, a listing of all available subnetworks providing service at this location is identified. Then select one of the railroads by highlighting it. If there is only one servicing subnetwork, it is automatically selected. WebTRAGIS now displays the selected node and subnetwork.

5.1.2 Selecting Destination

This same process is repeated for a destination location for a route. Selection of the route destination is the last required step before a route can be calculated. Press the **Calculate Route** button on the right side of the screen. A different **Origin** or **Destination** can be selected after a route has already been calculated. When this is done, the information from the previously calculated route is discarded, and all current information is used for the new route. The earlier destination or other selections will not be considered in the new route.

5.1.3 Calculate Route and Calculate Alternative Route

After a destination has been determined, click the **Calculate Route** button on the right side of the screen. If an origin or destination is not selected, a message reminding you to select these will be displayed. WebTRAGIS will calculate the water route and then display a window that shows the standard listing for the route.

After a route has been calculated, the **Calculate Alternative Route** button becomes active, allowing the user to generate alternative routes. To calculate an alternative route, go back to the **Select Origin/Destination** tab, and then click the **Calculate Alternative Route** button. When an alternative route (or another route) is calculated, it overwrites all of the output files from the previous route. Therefore, you must save or print all route files before running an alternative (or another) route.

5.2 ROUTE LISTINGS TAB

The **Route Listings** tab provides access to input and output listings of routes and population-density information of the most recently calculated route. The displayed listing can be saved or printed. Figure 5.2 shows the route listings.

The standard listing identifies only the origin and destination, any transfer locations, and larger cities along the route. This listing also identifies the subnetwork used for each portion of the route, a cumulative mileage figure for each location listed, a breakdown of mileage by subnetwork and line classification, and a summary of mileage by state.

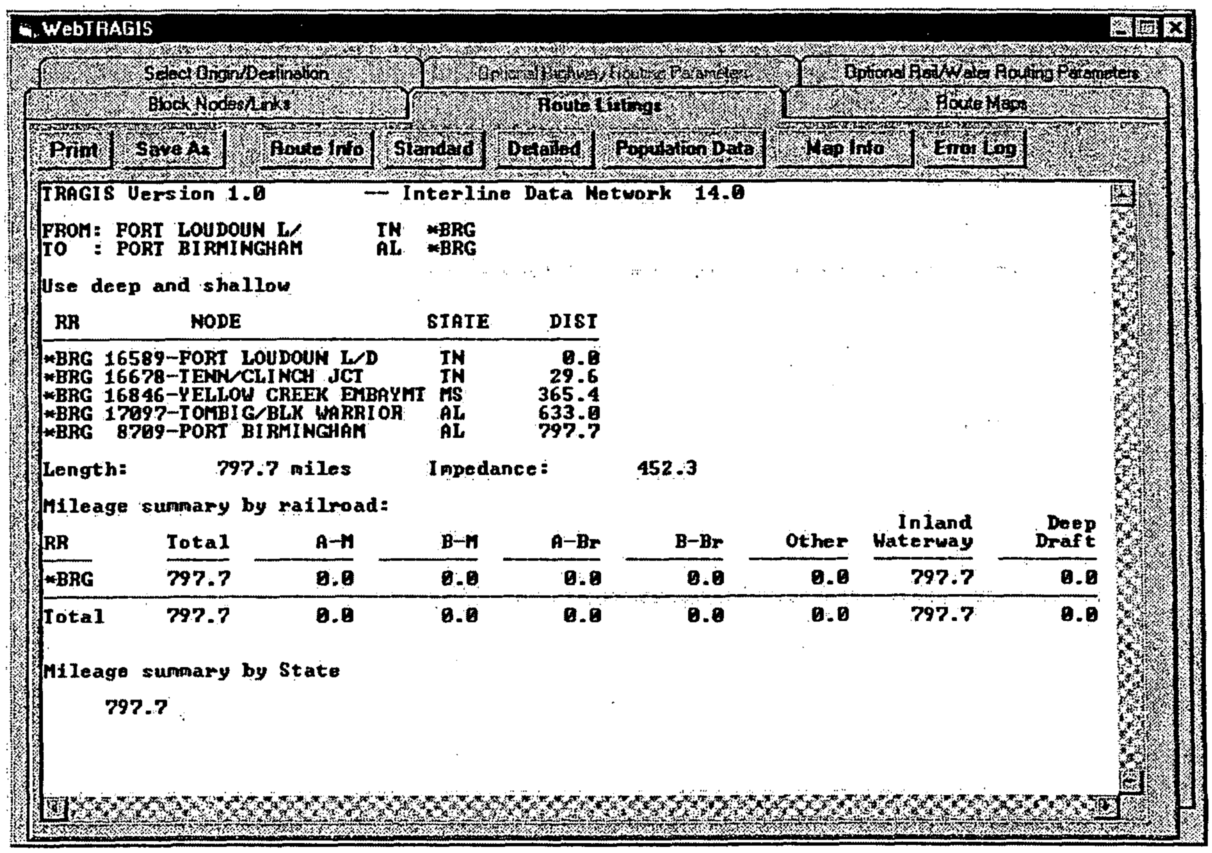

Fig. 5.2. Water-route listings.

The detailed listing provides much more information on the route. Every node on the route is listed along with information on link characteristics. Not every node in the database has a name, so node numbers are listed. Link information includes the link number; the distance of the link; the line classification code; a traffic volume code; a speed limit for freight trains; and, if the operating railroad is using trackage rights over this line, the abbreviation of the railroad owning the tracks. These items specific to railroad will be blank for water routes. As with the standard listing, summary information by subnetwork and state follows the route listing.

The population-density information is viewed by clicking the **Population Data** button. A listing of the population density information for the route is displayed. The basic table includes 12 population-density categories ranging from 0 to over 9996 people per square mile. The entries in the table show the distance the route travels in each category. At the end of the table, summary information is provided for the route. This information combines the data from the 12 categories into rural, suburban, and urban groups and also provides a weighted population-density value for each of these groups. This information is used as input for routing risk analysis using the RADTRAN or RISKIND computer codes.

The final items on the **Route Listings Tab** are the **Print** and **Save As** button. When the **Print** button is clicked, the listing currently being viewed is sent to the printer. (Note: Be sure to display the desired information to the screen before printing). When the **Save As** button is clicked, a file selection dialog box is displayed. The file name and location can then be selected, and the listing currently being displayed is saved to that selected file.

5.3 OPTIONAL RAIL/WATER ROUTING PARAMETERS TAB

The **Optional Rail/Water Routing Parameters** tab provides access to a number of parameters that control the routing functions. When water is the active mode, **Optional Rail/Water Routing Parameters** tab is available, and the **Optional Highway Routing Parameters** tab is not.

When the **Optional Rail/Water Routing Parameters** tab is selected, a window of the water options is displayed. Figure 5.3 shows the water options window. Within this window, available options can be selected. Click on the item of interest to select them. The following sections discuss the various water options.

5.3.1 Select Water Route Type

The user can select the type of water route to be used, such as **Deep Water** route, **Shallow Water** route, or **Both** (deep and shallow).

5.3.2 Modify Mode Transfer Penalty

This allows the user to modify the transfer penalty from deep water to shallow water or the reverse. This is intended to cause the model to minimize the transfers similar to industry practice. The user selects the modes and enters the desired transfer penalty. **(Note: This procedure is for experienced users only.)**

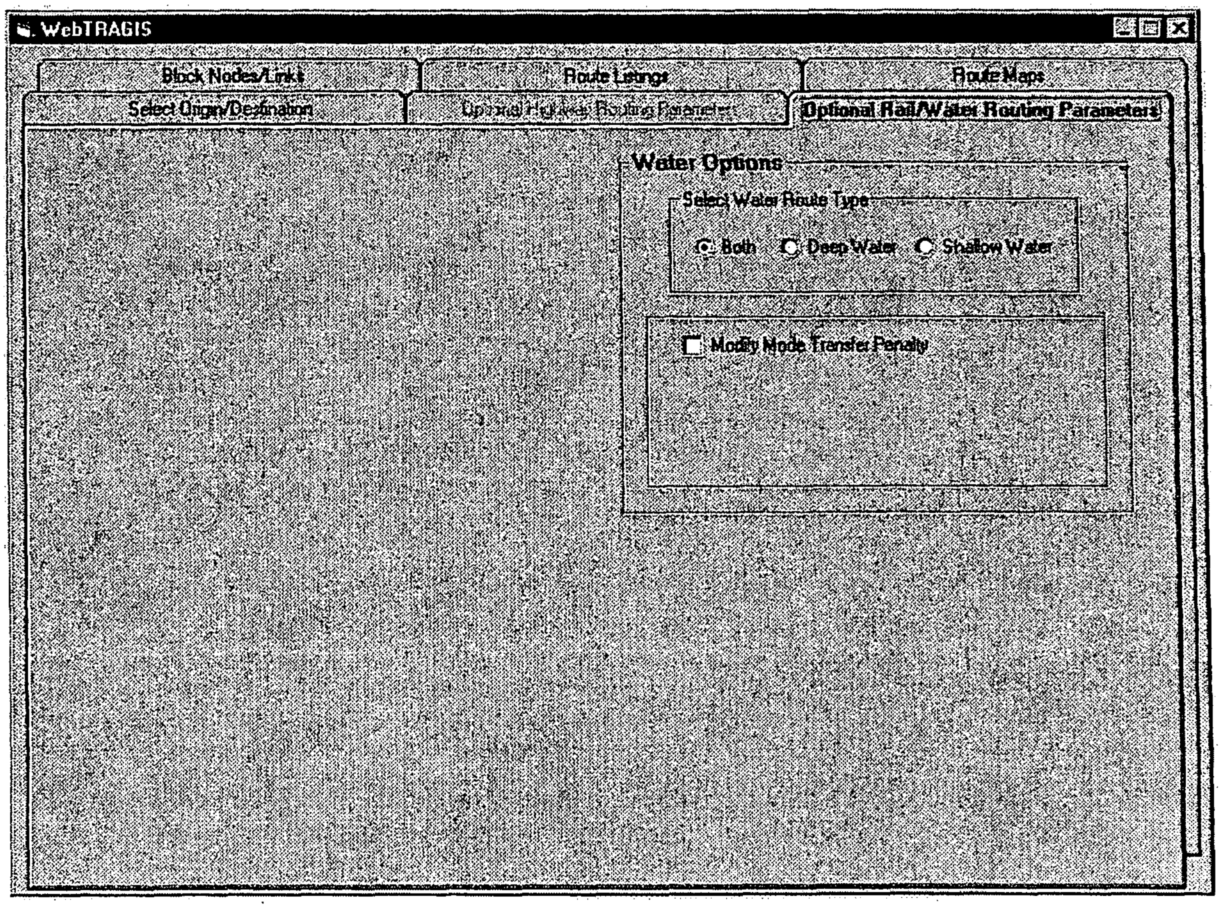

Fig. 5.3. Water options window.

5.4 BLOCK NODES/LINKS TAB

The **Block Nodes/Links** tab allows the user to block portions of the route database. These features can be useful when there is a need to analyze various scenarios. The **Block Nodes/Links** tab has two grouping of commands. The first group involves blocking nodes. The second group involves blocking links. This window is shown in Fig. 5.4.

5.4.1 Node Blocking

Nodes can be blocked in the database by making all the links that emanate from the node ineligible for routing. To block a node, select the state in which the node exists. The Node Name list will be populated with node names for that state. Now select the node to be blocked by scrolling to the name and clicking on it. The node number will then appear in the **Blocked Node Numbers** list.

5.4.2 Link Blocking

Since a link is defined by its nodes, you will be choosing the link by selecting its end points. **Block Links** in the road database by first choosing the **State**. After a state is chosen, the **Node1 Name** list will be populated. The **Node2 Name** list will be populated will all of the nodes connected to **Node1**. Select **Node2** from the list in **Node2 Name** list. The **Blocked Link Numbers** list will now contain two entries, the first ending with a '1' and the second ending with a '-1'. These block the link in both directions. If you want to block a link in only one direction, double click on the undesired entry and it will be removed from the list.

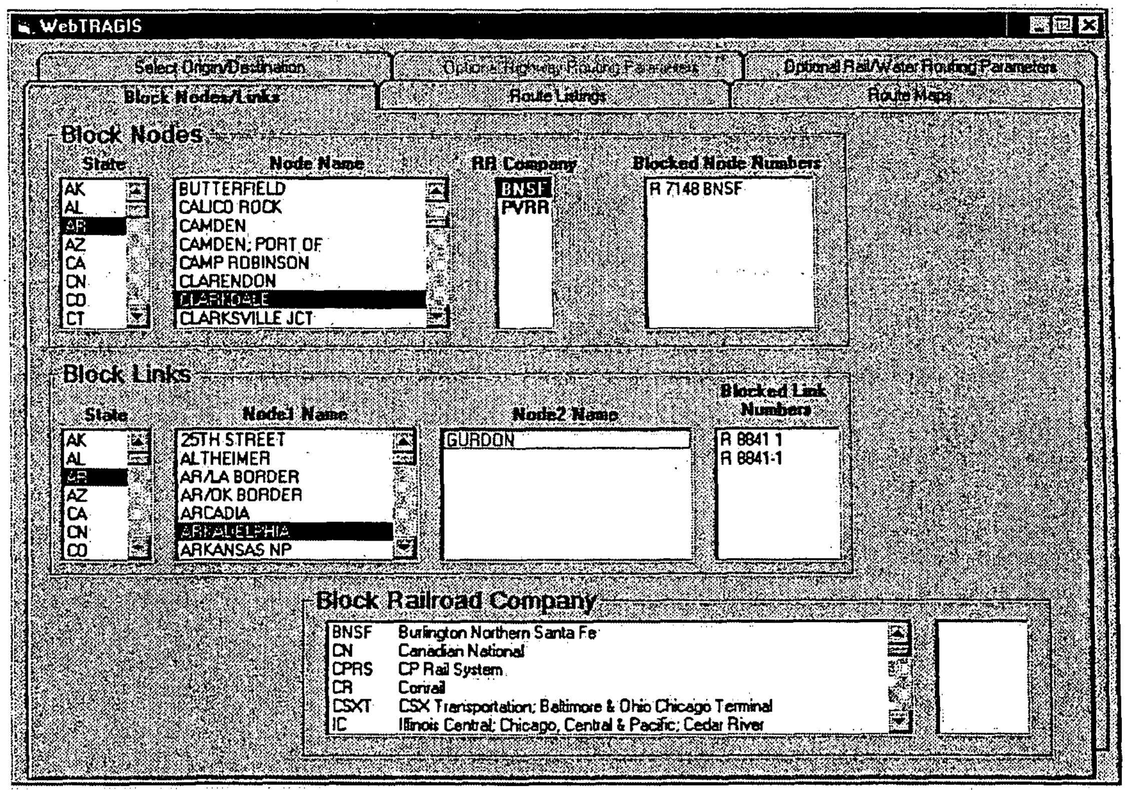

Fig. 5.4. Water node/link blocking.

6. ROUTE MAPS

6.1 BUTTON BAR ITEMS ON ROUTE MAPS TAB

There are several buttons on the **Route Maps** tab. These buttons are useful for the mapping feature (Fig. 6.1). Each button has a popup box with a short description of its function and is described with more detail in the following sections.

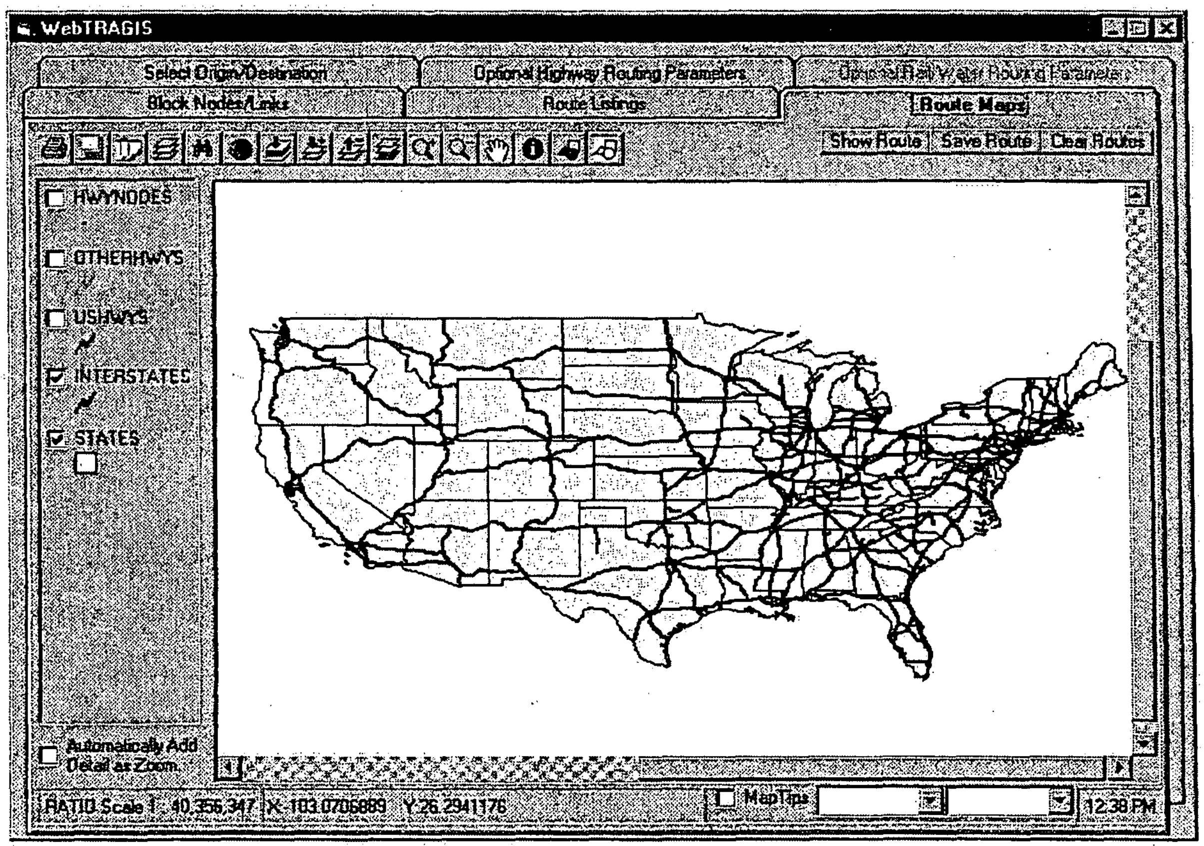

Fig. 6.1 Route maps.

6.1.1 Print

The **Print** button is symbolized by a icon of a printer. This button allows the printing of the current map display.

6.1.2 Save As

A floppy disk icon symbolizes the **Save As** button. This button allows saving the current map display as an enhanced windows metafile or as a bitmap file. The default is as an enhanced metafile because a metafile can be resized without appreciable loss of detail. This makes insertion of maps into a document easy.

6.1.3 Copy

The **Copy** button is symbolized by a paper clip on a piece of paper. This button copies the currently displayed map onto the Windows clipboard, so it can be pasted into Windows applications.

6.1.4 Map Properties

Three-colored layers symbolize the **Map Properties** button. This button opens a window that allows the user to change properties of the map.

6.1.5 Search

The **Search Map Information Files** button is symbolized by a binocular. The maps have data elements associated with them, such as highway sign, speed limit, node names, etc. This button opens a window that allows the user to search these data elements.

6.1.6 Display Full Extent of Map

The **Display Full Extent of Map** button is symbolized by a globe. This button zooms out to fill the map display with the entire map.

6.1.7 Display Map to Extent of Active Layer

The **Display Map to Extent of Active Layer** button is symbolized by an arrow pointing into three gray layers. This button zooms out to fill the map display with the current layer data.

6.1.8 Add Map Layer

The **Add Map Layer** button is symbolized by an arrow pointing into colored layers with a plus sign. This is usually used to display a route that was saved earlier. Click this button, and a file selection dialog box will allow the selection of a map layer to display.

6.1.9 Remove Active Map Layer

The **Remove Active Map Layer** button is symbolized by an arrow pointing out of colored layers with a minus sign. Choose a map layer by clicking on the title of the map layer in the legend, and then click this button to delete layer from the map.

6.1.10 Modify Map Layer Properties

The **Modify Map Layer Properties** button is symbolized by colored layers with green, yellow, and red layers. This button opens a window to allow the user to modify the properties of the current map layer. The current layer is denoted by an outline on the legend.

6.1.11 Zoom In

The **Zoom In** button is symbolized by a magnifying glass containing a plus sign. This tool is used to zoom in or to enlarge an area within the display. To perform a zoom in, choose the zoom in tool so that the button icon appears depressed. When moving the pointing device over the display window, the pointer icon appears as the magnifying glass with a plus sign in it. Position the pointing device at a corner of the area desired to be enlarged while holding down the left mouse button. Move the pointer to the opposite corner of the desired area and release. The display window is redrawn.

6.1.12 Zoom Out

The **Zoom Out** tool is symbolized by a magnifying glass containing a minus sign. This tool is used to show a larger geographic area in the display. To zoom out, use the left mouse button to choose the **Zoom Out** button. The **Zoom Out** tool functions in a way opposite that of the zoom in tool. If the click-and-drag method is used, the smaller the area that is defined, the more area will be displayed after the zoom out.

6.1.13 Pan

A hand symbolizes the **Pan** tool item. This tool will pan or drag the display in the direction the cursor is moved in order to reposition the map within the window. As with other tools, first choose the **Pan** tool and then move the pointer over the display window. The pointer will be displayed as a hand. Hold the left mouse button down and drag the display within the window.

6.1.14 Identify

The **Identify** tool button has a lowercase I inside a black circle. This tool is used to display information about features in the map display. To use this tool, first choose the identity tool in the tool bar. Next, examine the legend box to determine which theme is currently highlighted (the item that appears to have a highlight box around it). To change the highlighted theme, move the pointer over the theme name and click either the left or right mouse button. Now click on a feature in the display, and an identity-results window will appear which lists all the attribute variables and their values for that feature. To remove the identity-results window, move the pointer over the title bar of this window and press the **X** button.

6.1.15 Add Graphics to Map

Colored geometric shapes symbolize the **Add Graphics to Map** button. This tool allows the user to draw dots, straight lines, multiple-point lines, rectangles, circles, and polygons. To select the appropriate item, press the **Add Graphics to Map** button. A new tool bar will appear showing icons for the different features available. After selecting a type of feature to draw, the symbol can be drawn. The technique used for each type of draw tool varies; either click at one spot (to locate a dot); multiple spots with a double-click to end (to draw lines, rectangles, and polygons); or click, hold, move, and release (to draw circles).

6.1.16 Remove Graphics

Gray geometric shapes symbolize the **Remove Graphics** button. The **Remove Graphics** tool is the right-most item on the tool bar. Clicking this button will remove all graphics added to the map with the **Insert Graphics** button.

6.2 SHOW ROUTE

Depressing the **Show Route** button converts the data from the last route calculated and displays the route on the map.

6.3 SAVE ROUTE

The **Save Route** button saves the last route calculated in the map layer format so that the route can be displayed later using the **Add Map Layer**. This is useful when it is desired to display several routes on a single map.

6.4 CLEAR ROUTES

Depressing the **Clear Routes** button clears all routes from the displayed map.

6.5 OTHER ITEMS

At the bottom of the map is a status bar. The first item displays the scale at which the map is currently displayed. The second item displayed the X, Y coordinates of the map cursor. The display is in decimal degrees.

The third item contains a check box titled "MapTips" and two drop down lists. Checking this box will display information associated with the map available for display. The first drop-down list shows the map layers. The second drop-down list shows the data elements available for the map layer selected by the first drop-down list. Select the desired map layer in the first drop-down list. Next select the desired data item from the second drop-down list; then hold the cursor still over the map feature. After a second or so, a box will appear showing the data item related to that map feature.

The fourth item displays the computer's clock.

7. CONCLUSION

WebTRAGIS provides a major change in technology from the earlier routing models developed at ORNL. The HIGHWAY and INTERLINE models were developed at a time when text based programs were the standard form. Additional improvements will be made to WebTRAGIS to improve and enhance the performance of the model.

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RADTRAN 5 User Guide

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Abstract

This User Guide for the RADTRAN 5 computer code for transportation risk analysis describes basic risk concepts and provides the user with step-by-step directions for creating input files by means of either the RADDOG input file generator software or a text editor. It also contains information on how to interpret RADTRAN 5 output, how to obtain and use several types of important input data, and how to select appropriate analysis methods. Appendices include a glossary of terms, a listing of error messages, data-plotting information, images of RADDOG screens, and a table of all data in the internal radionuclide library.

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1. Introduction and Overview

The RADTRAN computer code is used for risk and consequence analysis of radioactive material transportation. A variety of radioactive materials (RAM) is transported annually within this country and internationally. The shipments are carried out by overland modes (mainly truck and rail), marine vessels, and aircraft. Transportation workers and persons residing near or sharing transportation links with these shipments may be exposed to radiation from RAM packages during routine transport operations; exposures may also occur as a result of accidents. Risks and consequences associated with such exposures are the focus of the RADTRAN 5 code.

The User Guide specifies and describes the required data, control inputs, input sequences, analyst options, and other information and activities necessary for execution of RADTRAN 5.

1.1 History of RADTRAN

Sandia National Laboratories (SNL) in Albuquerque, New Mexico, developed the RADTRAN code. It was first released in 1977 (Taylor and Daniel, 1977) in conjunction with the preparation of NUREG-0170 (NRC, 1977). The analytical capabilities of the code have been expanded and refined in subsequent releases. RADTRAN II was released in 1983 (Madsen et al., 1983), and RADTRAN III was released in 1986 (Madsen et al., 1986). RADTRAN 4 (Neuhauser and Kanipe, 1992) represented a major new direction for RADTRAN development. The analyst now could carry out route-specific analyses by assigning route-segment-specific values for a number of parameters (population density, vehicle speed, traffic count, etc.) to up to 60 route segments per run. These route-specific capabilities were improved and expanded in RADTRAN 5, and a number of features have been added.

1.2 Features of RADTRAN 5

RADTRAN 5 may be used to evaluate radiological[1] consequences of routine, accident-free transportation of radioactive materials, as well as radiological and nonradiological consequences and risks from accidents that might occur during transportation of such materials. RADTRAN 5 produces estimates of incident-free population dose, accident dose-risk, nonradiological traffic mortality, and a suite of individual dose estimates. Doses and dose risks[2] may be converted to health risks. Calculation of incident-free population dose considers persons adjacent to the route (off-link), persons in vehicles sharing the route (on-link), crew members, and persons at stops. Potential dose risks are calculated for populations downwind from hypothetical releases associated with accidents of varying severities.

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1 A unit risk factor for latent cancer fatalities putatively caused by vehicle emissions is available in RADTRAN, but the postulated health effect of such emissions is speculative at best.

2 Dose-risk is the product of a given consequence dose and its probability of occurrence.

1.3 Route-Specific Analysis

RADTRAN 5 permits route-specific analyses to be performed. A route may be subdivided into segments with independent, analyst-assigned values for population density and other route-specific parameters. Features include (1) an expansion of the number of parameters that can be made segment-specific; (2) the capability to treat individual stops separately, and (3) the capability to treat each handling separately.

The internal library of radionuclide-related parameter values contains data on 60 of the most commonly transported radionuclides. The analyst can also independently define additional radionuclides.

1.4 User-Definable and Standard Parameters

Nearly all RADTRAN 5 parameters are user-definable. An array of "standard" or recommended values for many parameters is available. The analyst may employ all, some, or none of these values, as the needs of the analysis dictate. Parameters are defined and discussed in detail in Chapter 3. Analysis strategies are addressed in Chapter 4.

1.5 Maximum Individual Accident Dose

RADTRAN 5 permits direct estimation of individual accident doses by a method that parallels the population-dose consequence calculation. The calculations differ in two essential features. (1) The minimum centerline downwind distance associated with a given time-integrated concentration may be included in the appropriate input-data array. The analyst may calculate distance values with dispersion codes such as INPUFF (Petersen et al., 1984). (2) The calculated population dose in an isopleth is divided by the total population in that isopleth. This simple arithmetic operation yields a mean individual dose to persons within a given isopleth, which may then be associated with the minimum centerline distance value for that isopleth. This capability was tested as an independent code, called TICLD (Transportation Individual Centerline Dose), prior to being incorporated into RADTRAN 5 (Weiner, Neuhauser, and Kanipe, 1993).

1.6 Ingestion Dose Model

A development goal has been to keep RADTRAN calculational methodologies reasonably parallel to the MACCS code (Melcor Accident Consequence Calculational System), now in its second major release, MACCS2 (Chanin and Young, 1997). COMIDA2, which is based on a dynamic food chain model (Abbot and Rood, 1994a,b), is the ingestion model used in MACCS2. Values of ingestion-dose per activity unit of ground deposition have been pre-calculated for most radionuclides in the internal library.[3] The COMIDA2 module of MACCS2 may be used

[3] Ingestion factors are not calculated for radionuclides with half-lives of less than 1 hour.

directly to obtain values for unusual radionuclides or unusual situations. The dose values for prompt health effects also have been updated to be consistent with MACCS2.

1.7 Nonradiological Fatalities

The expected numbers of fatalities from mechanical effects of traffic accidents are calculated in RADTRAN 5 under keyword NONRAD.[4]

1.8 Sensitivity and Uncertainty Analysis

In previous releases of RADTRAN, the sensitivity of the incident-free dose result to variation of the input parameters could be analyzed. The analysis method depends on obtaining partial derivatives of linear equations in RADTRAN. With the advent of the capability to consider the neutron component of dose rate (if any) explicitly, the calculation of incident-free dose could involve nonlinear relationships for which the partial-derivative method might prove inadequate. The partial-derivative method is still available, but other methods also may be employed. Sensitivity and uncertainty measures for RADTRAN analyses now may be obtained with the assistance of a separate computer code, the Latin Hypercube Sampling (LHS) code (Iman & Shortencarier, 1984). The LHS code can be used as a "shell" with RADTRAN (Mills et al., 1995) and is available on TRANSNET, the RADTRAN Internet site (see Chapter 3, Section 3.2.1). Classical Monte Carlo methods have been applied in the past (e.g., Neuhauser & Reardon, 1986) and still may be used.

1.9 Mathematical Models in RADTRAN 5

RADTRAN 5 models yield conservative estimates of integrated population dose and other metrics in a way that can be supported by readily available data. Data gathering is usually the most expensive and time-consuming part of performing a risk analysis. An example of unobtainable data is detailed meteorological information for each point or segment of a route. The limitations imposed by data availability are explicitly acknowledged in the development of RADTRAN 5.

All route segments are modeled as straight lines without grade or curves, providing ease of calculation and yielding slightly conservative dose estimates (because the dose calculation involves integration to infinite distance from the package although actual route segments have finite lengths). All highway and rail links are treated as being one lane (or track) wide for the purpose of estimating distances to population beside the road or railroad. However, they are treated as being two lanes wide (one lane or track in each direction) for the purpose of estimating doses to persons in vehicles sharing the road or railroad. The first treatment achieves symmetry

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4 Only fatalities from accidents are calculated; hypothetical fatalities from inhalation of vehicle exhaust particulates are no longer calculated because toxicity thresholds for exhaust constituents are now well known and the unit-risk-factor approach can no longer be justified (see Chapter 5).

(and, hence, mathematical simplicity) around the lane in which the shipment is traveling. The second treatment (one lane each direction) yields the smallest perpendicular distance and, hence, the highest incident-free dose to persons in vehicles traveling in the opposite direction. Thus, for this latter purpose, all rail routes are modeled as having double tracks, when in fact double tracks are not common. Such departures from absolute parallelism with physical reality have been used to simplify a calculation without either underestimating or greatly overestimating dose or risk, and to reduce expensive data-gathering requirements. Details of the RADTRAN 5 mathematical modeling may be found in the RADTRAN 5 Technical Manual (Neuhauser, Kanipe and Weiner, 1999).

1.10 Technical Information Summary

RADTRAN 5 is written in ANSI Standard FORTRAN 77 (ANSI, 1978) and is operational on a HP-UNIX computer at SNL in Albuquerque, New Mexico. Execution time for a single problem is usually between a few seconds and about a minute, depending on the length of input and output files. The input file is named R5IN.DAT. There are a total of 73 subroutines and functions in RADTRAN 5. The main routine is named RADTRN. Instructions for creating input files and for saving and renaming output files are given in Chapter 3. The results of intermediate accident-risk calculations are written to R5INTERM.DAT. Probability-consequence pairs are written to R5PLOT0.DAT, R5PLOT1.DAT, and R5PLOT2.DAT for later graphical or quality-assurance applications (see Appendix B). RADTRAN 5 has been recompiled with a FORTRAN 95 compiler; the compiled product is RADTRAN5 PC, runs locally on a PC (currently in beta-test version).

1.11 Outline of User Guide

Chapter 2 defines essential terms and concepts that are used throughout this guide. Chapter 3 provides instructions for data entry and Chapter 4 is a guide to the output. Chapter 5 discusses options and strategies for performing analyses with RADTRAN 5 and describes the basic output. Appendix A is a Glossary of Terms. Appendix B describes the data from intermediate calculations written to output file R5INTERM.DAT and contains instructions on how to generate probability-consequence plots of the data with output files R5PLOT0.DAT, R5PLOT1.DAT and R5PLOT2.DAT. Appendix C contains a list of RADTRAN 5 error messages and suggested error-correction strategies. Appendix D contains the Radionuclide Data Library.

2. Transportation Risk - Concepts and Overview

A number of terms used throughout this User Guide have specific meanings in the fields of radiological risk analysis and radioactive materials (RAM) transportation. The most important of these, along with terms for underlying concepts of radioactivity and risk, are defined and explained in this chapter. A full Glossary of Terms may be found in Appendix A.

2.1 Risk and Risk Assessment

Risk is commonly defined as the product of a consequence and its probability of occurrence. What this means in the context of RADTRAN 5 is that transportation risks, like the risks associated with any complex process, may be decomposed into "what can happen...how likely things are to happen, and the consequences for each set [of things that can happen]" (Helton, 1991). As the terminology in this definition implies, set theory provides an ideal framework for formal expressions of risk.

For accident risk assessment, the answer to the first question ("What can happen?") is that the set of all accidents can be expressed as disjoint sets of accidents (S_i, i=1,...nS). In other words, sets of accidents such that

(1) no two sets contain any accidents in common (i.e., are disjoint),

(2) each set consists of accidents with similar outcomes, and

(3) the sets are jointly exhaustive (that is, all the sets taken together include the entire range of accidents from low consequence to high consequence).

"How likely things are to happen" can be defined as the probability that an accident in set S_i will take place. The "consequences for each set" consist of one or more specified consequence results (population dose, early morbidity, etc.) (Helton, 1991).

In accident risk analysis with RADTRAN 5, the set of all accidents for the mode(s) being analyzed must be divided by the analyst into subsets (i.e., into the subsets S_i, i=1,...,nS), as described above. The subsets also must satisfy the other conditions described in the previous paragraph. The term "similar outcomes" refers to similar package damage and not to any other features such as driver mortality or time of day. The subsets and their probabilities are most commonly developed by means of event-tree analysis, but are not required to be. In RADTRAN, these subsets are referred to as *accident-severity categories.*

Corresponding probabilities are obtained from the products of accident rate and *severity fraction* values.

Severity fraction is defined as the conditional probability, given that an accident occurs, that it will be of a specified severity (i.e., belong to a given accident subset). Examples of accident-severity category development include the work of Wilmot (1981), Fischer et al. (1987), and Sprung et al. (1998; 2000).

RADTRAN calculates distinct probability-consequence products for up to six exposure pathways for each accident-severity category for all route segments. These products are summed and printed in the main output file. The individual probabilities, consequences, and products are also saved and written to supplementary output files (R5INTERM.DAT, R5PLOT0.DAT, R5PLOT1.DAT, and R5PLOT2.DAT), as discussed in Appendix B.

2.2 Terms used in Radioactive-Material Transportation

2.2.1 Package and Packaging

The terms "package" and "packaging" are defined in Volume 10 of the Code of Federal Regulations (CFR), Title 71.4 (10 CFR 71.4). Briefly, in radioactive-material transportation, a *package* consists of a *packaging* and its *radioactive contents*. A packaging consists of one or more receptacles and wrappers and their contents, excluding radioactive materials but including absorbent material, spacing structures, thermal insulation, radiation shielding, devices for cooling and absorbing mechanical shock, external fittings, neutron moderators, nonfissile neutron absorbers, and other supplementary equipment. The radioactive contents may consist of one or more radioactive materials, which are defined in the next section.

2.2.2 Radioactive Materials, Physical-Chemical Forms, Isotopes, and Radionuclides

The *radioactive contents* of a package are defined by regulation as *radioactive material* (10 CFR 71.4), which is often abbreviated as RAM. A radioactive material must contain at least one *radionuclide*. The term radionuclide refers only to unstable nuclides that emit ionizing radiation.

The description of a radioactive material (package contents) in a RADTRAN 5 analysis must include a user-assigned name, also referred to as a *package identifier*. Each material has one or more *physical-chemical forms*, which are assigned via the constituent radionuclides. Physical-chemical form is a function of physical properties [i.e., whether the material is a monolithic solid, divided solid (powders of various types), liquid, or gas] and chemical properties (such as melting point or oxidation state) that might affect dispersion or toxicity in potential accidents.

RADTRAN 5 permits the analyst to identify one or more physical-chemical forms for each material. Each such form is known as a *physical-chemical group*, and each must be assigned a *physical-chemical-group identifier*, as shown in Box 2-1. Each radionuclide in a material must be assigned to at least one group. Properties such as deposition velocity, which depend on physical state (particle size in the case of deposition velocity), are assigned to the physical-

BOX 2-1
PACKAGE IDENTIFIERS, PHYSICAL-CHEMICAL GROUPS, AND NUCLIDES

Examples of Package Identifiers (Material Names) (analyst assigned):
UO2 POWDR for Uranium Dioxide Powder
VHLW for Vitrified High-Level Waste
MOLYGEN for Molybdenum-99 Generator

Examples of Physical-Chemical Group Identifiers (analyst assigned):
VOLSOL for volatile solids (e.g., radioruthenium)
GAS for gaseous materials such as tritium gas
POWDR1 for a metal oxide such as uranium dioxide with a 1-mm average particle diameter

Examples of Radionuclides and their RADTRAN 5 Identifiers (fixed; analyst cannot vary)
Uranium-235; identifier is U235
Cesium-137; identifier is CS137
Molybdenum-99; identifier is MO99

chemical group. Photon energy, on the other hand, is a property of atoms and so is assigned to individual nuclides. Physical-chemical properties of materials cannot be supplied in advance by RADTRAN. Most radionuclide properties, however, are supplied in the internal library of radionuclide data (see Chapter 3). The notable exception to this is, of course, the radionuclide inventory, i.e., the amount of each radionuclide that is present in the package. Nuclide identifiers, when entered in the format recognized by the RADTRAN 5 internal library (see box for examples), will cause all recorded nuclide properties to be automatically entered in the input file.

2.2.3 Shipment and Related Terms

Shipment, Conveyance, Vehicle, Vessel

A *shipment* is defined as the set of all packages in one or more conveyances, traveling together as a unit. A *conveyance* is any *vehicle*, *vessel*, railcar, or aircraft used to transport packages. Although the term vehicle generally refers to trucks, vans, etc. for highway-mode transportation, the terms vehicle and conveyance are often used interchangeably. The term vessel refers only to ships and barges for waterway-mode transportation. More than one package of radioactive material may be transported together in a single conveyance. In the rail mode, more than one conveyance may be transported at the same time in a single shipment (i.e., several railcars in a single train).

Transportation Modes and Vehicles

Commercial transportation involves one or more of the five basic modes: highway, railway, waterway, passenger air, and cargo air. Five variants of highway and two variants of waterway mode have been included in RADTRAN 5 for analyst convenience. The modes and variants available in RADTRAN 5 are listed in Table 2-1, which also indicates the conveyance types most likely to be used with each mode or variant. The old designators used in previous releases of RADTRAN are included for the convenience of long-time RADTRAN users. Each of the transportation modes and variants available in RADTRAN 5 is assigned a numerical mode-identifier (Table 2-1). Potential operational differences within the rail mode (e.g., the differences between general rail freight and dedicated rail) are addressed with user-assigned variable values discussed elsewhere in this User Guide.

The analyst also identifies the transportation conveyance (the vehicle) and creates an alphanumeric identifier for each vehicle in a RADTRAN analysis (e.g., SEMI-TRUCK for a tractor-trailer and DELIVERY for a van). Each conveyance type is assigned to a transportation mode (see Table 2-1). The analyst also must enter information associated with the conveyance, such as number of crew members. Up to 12 distinct conveyance types may be described in a single RADTRAN 5 run. Each conveyance must be assigned to at least one mode, but assignment variations are permitted since more than one conveyance or mode may be used to get a single package or a shipment to its final destination. When more than one mode is used, the one in which the majority of the transportation occurs may be referred to as the *primary mode*, while others are referred to as *secondary modes*. A secondary mode is required when material must be moved to its primary-mode conveyance (e.g., an airplane) from its origin point or from the primary mode to its final destination by another vehicle, usually a truck or van.

Table 2-1. RADTRAN 5 Modes and Common Conveyance Types

Mode	Mode Number	Conveyance Types Associated with Mode	Old Name (RADTRAN 4)
HIGHWAY	1	Any truck; usually a tractor-trailer (also called a "semi" or a combination truck)	TRUCK
RAILWAY	2	One or more railcars in a single train	RAIL
WATERWAY_A	3	Any vessel; usually barge	BARGE
WATERWAY_B	4	Any vessel; usually ocean-going ship (>3000 gross tons)	SHIP
CARGO_AIR	5	Any plane carrying only cargo	CARGO_AIR
PASNGR_AIR	6	Any plane carrying passengers & cargo	PASS_AIR
HIGHWAY_A	7	Any truck; usually small truck or passenger van	P_VAN
HIGHWAY_B	8	Any truck; usually cargo van/delivery truck as secondary vehicle with tractor-trailer as primary mode	CVAN_T
HIGHWAY_C	9	Any truck, usually cargo van/delivery truck as secondary vehicle with rail as primary mode	CVAN_R
HIGHWAY_D	10	Any truck; usually cargo van/delivery truck as secondary vehicle with cargo air as primary mode	CVAN-CA

Terms Associated with Stops and Handlings

The term *stop* refers to any of the various events that may occur in the course of transportation during which a conveyance remains stationary. A *handling* is a special type of stop that is treated separately in RADTRAN 5. In all stops, the shipment is modeled as a stationary point- or line-source; the duration of the stop and the number and average distance (or population density) of persons in the vicinity of a stop are problem-specific input parameters. The RADTRAN 5 stop model is flexible and can be used to describe most transportation-related stops with little difficulty. Common types of stops modeled are listed in Box 2-2 and described briefly below:

Box 2-2 - Common Types of Stops

-Rest/Refueling (Highway mode)

-Classification (Rail mode)

-Port Call (Water modes)

Intermodal Transfer (any 2 modes)

Storage (any mode)

- Rest/Refueling Stops (HIGHWAY Mode). For commercial truck shipments, most stop time is incurred at commercial truck stops. Data for this type of stop have been published (Griego et al., 1996; Madsen and Wilmot, 1983). In the case of delivery vans, especially when used as a secondary mode, the stop time is incurred primarily at traffic stops and at intermediate destinations (when packages are delivered to two or more destinations by the same conveyance).

- Classification Stops (RAILWAY Mode). The majority of stop time for trains is incurred at classification yards, which may be thought of as "nodes" along the rail network where trains are broken down and reassembled into new trains according to their ultimate destination on the network. Railcars are inspected at classification stops, and rail inspectors may be exposed as a result. Other personnel in the rail yard also would come within various distances of cars carrying radioactive material while performing their duties. Ostmeyer (1986) models this type of stop, and rail worker doses are automatically calculated in RADTRAN 5 according to the Ostmeyer model. However, the stop model is used to assess the area surrounding the classification yard.

- Port Calls (WATERWAY Modes). Most stop time in maritime modes is incurred in ports either at the dock or in an anchorage. Inspectors from the U.S. Coast Guard, the port authority, and possibly the carrier or shipper, may incur exposure during inspection of packages in the cargo areas. Transportation by ship or barge is nearly always a primary mode used in conjunction with a secondary surface mode. Therefore, exposures incurred during or after loading and offloading a ship or barge fall under the heading of intermodal transfers, which are discussed below.

- Intermodal Transfers. Packages may be carried part of the way by one mode, removed from the first conveyance, placed in another, and transported all or part of the remaining distance by a second mode. Each change from one mode to another is defined as an intermodal transfer. One or more intermodal transfers may be required to get a package from its origin point to its final destination. For example, carriage of a package by vessel (ship or barge) is usually preceded by carriage by truck or rail from the package's origin point to a marine port, where the package is loaded onto a vessel (1st intermodal transfer). At the final port of call, the package is usually offloaded to a truck or railcar that carries the package to its final destination (2nd intermodal transfer). Doses to port workers (except handlers) incurred during an intermodal transfer can be calculated with the RADTRAN STOP model (Neuhauser and Weiner, 1992a:b)

- Storage. Temporary storage may be associated with intermodal transfer. Warehouse employees and other workers may be exposed during storage. Storage is modeled in the same manner as an ordinary stop with appropriate input values, as described by Neuhauser and Weiner (1992a).

2.3 Two Options in Stop Model

A stop can be modeled in two ways, as described in Box 2-3. Either radius values and population densities or distances and numbers of persons are assigned by the analyst. RADTRAN 5 allows the analyst to separately label each stop, although stops also can be treated in an aggregate manner. In the latter case, for example, all fuel stops might be treated as a single stop equal in duration to the sum of the durations of individual stops, with average or bounding values for other parameters.

Box 2-3. Two Ways to Estimate Potentially Exposed Population at a Stop

1. Population Density within annular area(s) – User specifies population density and two or more different radial distances
2. Number of Persons at an average radial distance – User specifies number of persons and one radial distance

2.4 Separate Model for Handling and Inspection

Handlings and inspections are special types of stop-related activities that are treated separately under keyword HANDLING. Handlers and inspectors are routinely located closer to a package or shipment for longer periods of time than most other persons at stops. Thus, they constitute special subgroups of potentially exposed persons for whom dose estimates may be separately calculated (Weiner and Neuhauser, 1992a,b). A line-source method of calculating handling dose is used for all but the smallest packages. Doses for handling the latter are calculated with an empirical factor. As noted in the section on stops, intermodal transfers have characteristics of both a stop and a handling.

Commercial maritime carriers usually plan a sequence of port calls to take on and discharge cargo in the course of a single voyage. Radioactive materials packages that may be onboard would experience stop time at each such intermediate port, but measurable exposure would normally be limited to hold inspectors, and the latter are modeled under keyword HANDLING.

Inspection/Weigh Station stops are often associated with state and national boundary crossings. Trucks and railcars carrying radioactive materials may be required to stop at a state boundary for inspection. Exposure of inspectors located at short distances from the shipment should be modeled with the HANDLING subroutine, while exposure of weigh-station operators and other personnel located at greater distances from the shipment should be considered under the keyword STOP.

3. Creating an Input File for RADTRAN

3.1 Access to RADTRAN 5

Analysts may access RADTRAN 5 by two means. The recommended method is to access the code by Internet via Sandia National Laboratories' TRANSNET system. The other method is to install an executable version on a UNIX workstation or mainframe computer. An executable version that operates under DOS or Windows is being developed.

3.1.1 The TRANSNET System

TRANSNET is a collection of risk, systems analysis, routing, and economic codes and related databases pertaining to RAM transportation. TRANSNET resides on a dedicated computer at Sandia National Laboratories. After obtaining a user name and password, analysts may access TRANSNET at no charge with a personal computer and an Internet connection. At present, TRANSNET is accessible only through a secure shell program.

3.1.2 Executable RADTRAN 5

Executable copies of RADTRAN 5 that run on a workstation or mainframe computer may be obtained by contacting the address shown in Box 3-1. RADTRAN 5 is resident at SNL on a Hewlett-Packard 700 Series computer running with a UNIX operating system. Other systems will also support RADTRAN 5. Details on installing RADTRAN 5 are machine-dependent; directions are provided at the time of request and are not discussed further in this User Guide. As previously noted, RADTRAN5 PC is now in beta-test form and may be generally available by 2004.

Box 3-1
FOR TRANSNET ACCESS consult http://ttd.sandia.gov/risk/transnet.htm.

3.2 Accessing RADTRAN 5 on TRANSNET

Instructions for obtaining a secure shell program as well as access to TRANSNET may be found at http://ttd.sandia.gov/risk/transnet.htm. Basic hardware and software requirements for accessing TRANSNET are a personal computer, workstation, or other computer, and

- an Internet Service Provider (ISP), a web browser, and Secure Shell software;
- or a network or Ethernet board, a direct cable link to the Internet, and Secure Shell software

These topics are discussed in the revised "Guide to TRANSNET Communications and Operations," which is sent to users on request. TRANSNET cannot be accessed without an SNL-issued user name and password.

The RADTRAN Web Site may be accessed at http://ttd.sandia.gov/risk/radtran.htm. This URL is case-sensitive. Electronic versions of this User Guide, other code documentation, and up-to-date information regarding persons to contact, etc., are posted at this site.

3.3 RADTRAN 5 Input File Generator Software (RADDOG)

RADTRAN 5 input files may be created on the TRANSNET system by means of menus produced by the RADTRAN 5 Input File Generator (RADDOG).

The TRANSNET Guide provides general information on navigating the TRANSNET menus, and these menus lead to the TRANSNET RADTRAN 5.2.5 Control Menu (Figure 3-1) as follows:

- On the TRANSNET Main Menu, select Risk Assessment
- On the Risk Assessment menu, select RADTRAN 5..

3.3.1 RADTRAN 5 Control Menu[5]

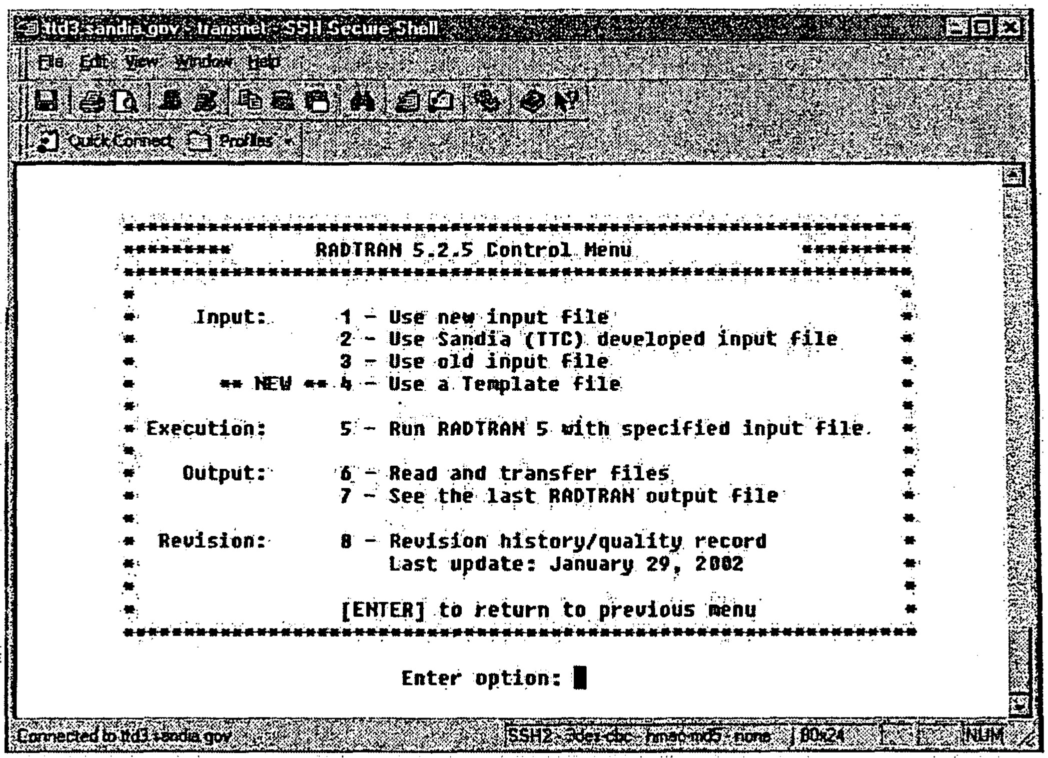

Figure 3-1 TRANSNET Control Menu

5 Figures 3-1 through 3-20 are screen prints using two different secure shell screens, SSH and F-Secure. The two shells have identical functionality.

3.3.2 Main Menu for the Menu System (RADDOG)

If the analyst enters the number 1 as an option, the RADDOG Main Menu, shown in Figure 3-2, appears.

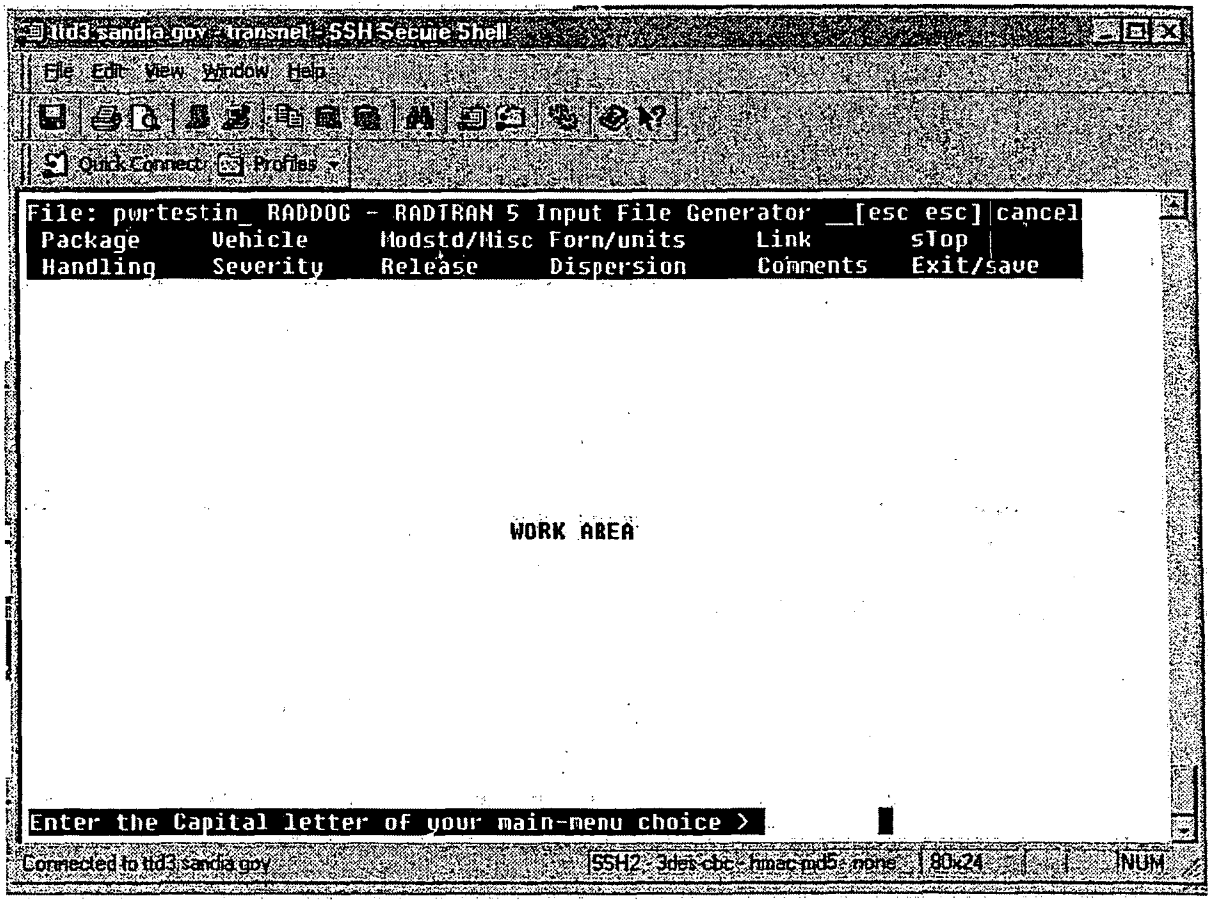

Figure 3-2. RADDOG Main Menu

The work area of the Main Menu is blank. Twelve headings appear at the top of the Main Menu screen. Each heading except the last (Exit/save) represents one or more subordinate menus in which various types of input data are entered.

A command line appears at the bottom of every menu screen. The text on the command line tells the analyst what commands may be used for each screen; the blinking cursor following the informational text indicates where typed commands entered by the analyst will appear. The command line of the Main Menu informs the analyst that he or she must enter the capitalized letter of a heading in order to bring up the menu screen(s) for that class of data. For example, enter "T" for the stop menu screen.

If the analyst selects a TTC file or an old input file, a message asking "Do you want to open or modify this file?" appears. Answering "yes" brings up the screen shown in Figure 3-2, to which the name of the selected file has been added at the top.

3.4 RADTRAN 5 Data-Entry Menus

Data-entry menus are subordinate to the RADDOG Main Menu and are reached by typing the appropriate heading letter. For example, typing "P" on the Main Menu command line (with no carriage return) brings up the Package screen (Figure 3-3). Data must be entered by typing in the appropriate alphanumeric; the program does not respond to mouse signals. Text on the screen can only be edited from left to right and top to bottom. Movement between columns is accomplished by using the tab or arrow key. There is no copy-and-paste utility. Typing "Q" in a column while editing exits the analyst from that column. Data can be saved only by typing "E" for Exit after returning to the Main Menu and naming the file by following on-screen instructions.

Data are entered and modified in the same manner on every screen brought up under each heading at the top of the Main Menu. The preferred order is to work sequentially from left to right, starting with "Package," because some values that appear in later screens depend on those entered in earlier screens.

The data entries for each menu are discussed in somewhat greater detail in Section 3.7.

3.4.1 Package Menu

Selecting "P" for "Package" brings up the screen shown in Figure 3-3

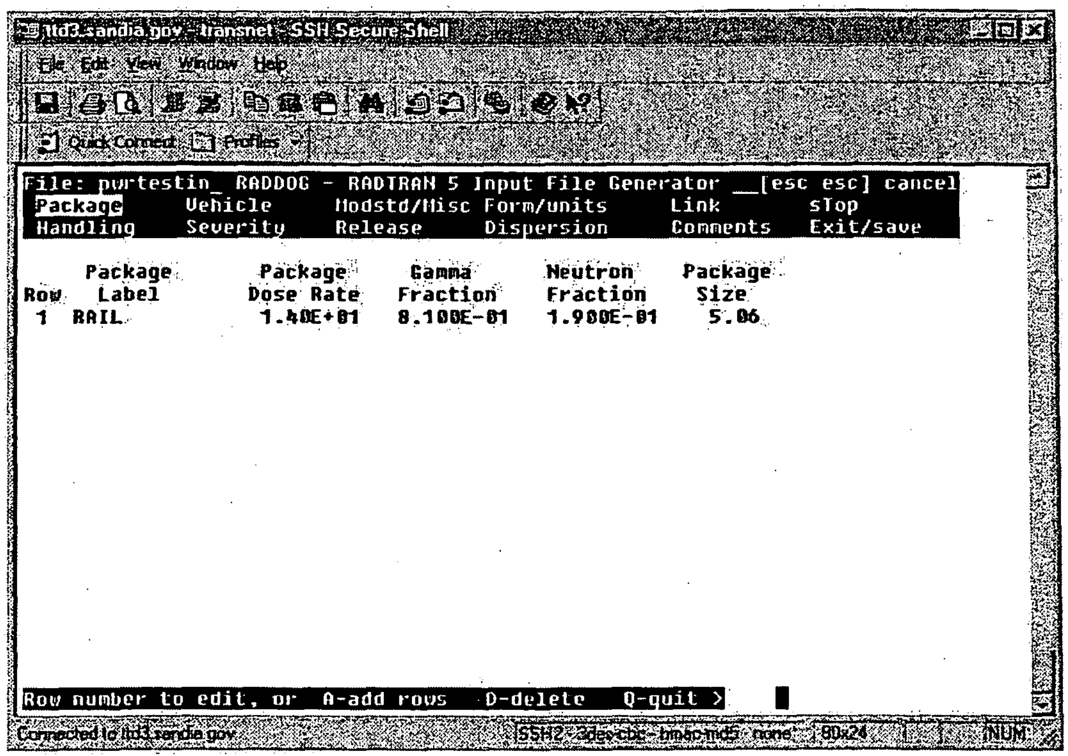

Figure 3-3. Package Menu

The word "Package" is now highlighted on the screen, and column headings for package-related parameters appear in the Work Area. The analyst is prompted to enter an alphanumeric package label and appropriate numerical values in the remaining columns in the row. If the analyst were modifying an existing file, he or she would first enter the number of the row to be modified. A duplicate number appears under the "Row" heading. When data entry is complete, typing "Q" (for quit) brings up the screen shown in Figure 3-4. Note that if no data are entered, the analyst is prompted for a name for the package.

Radionuclide Sub-menu

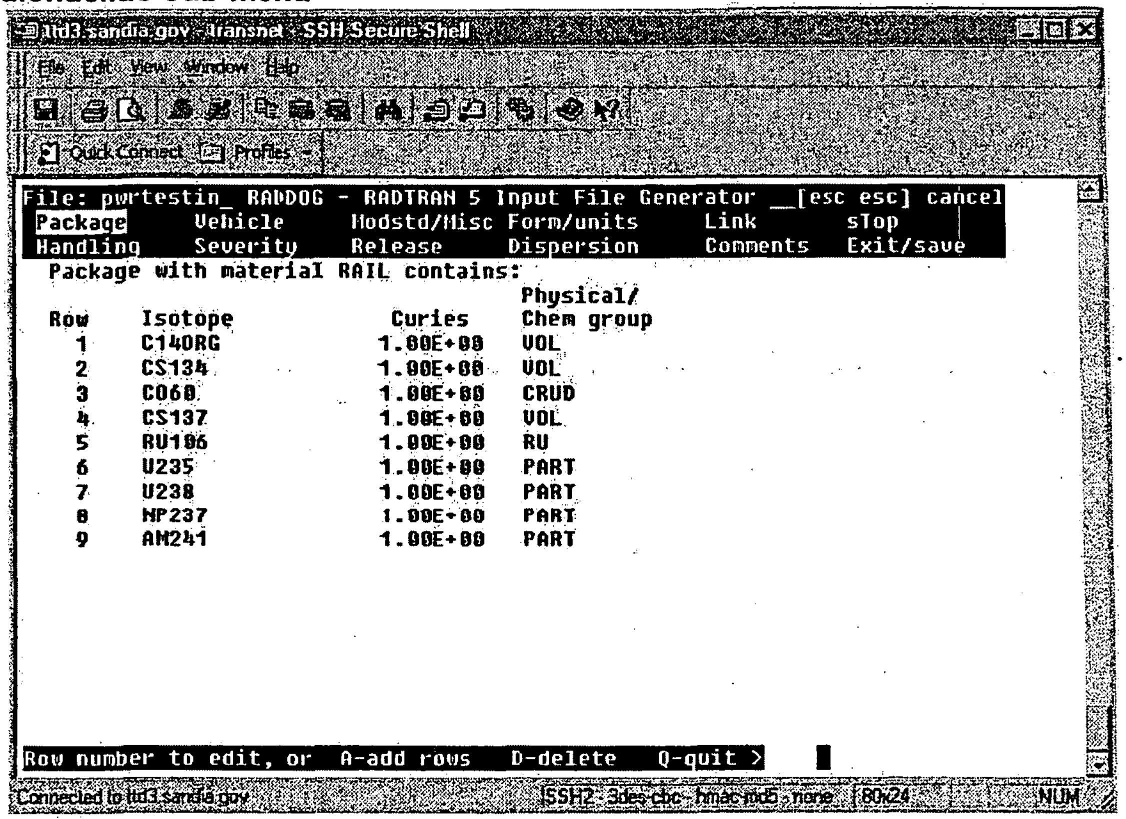

Figure 3-4.Radionuclide Sub-menu to the Package Menu

If the analyst enters a radionuclide name or symbol that is not is the RADTRAN internal library, a prompt will appear asking if the name is correct. Responding "yes" (i.e., that a radionuclide name that is not in the internal library is entered deliberately) brings up a screen on which the half-life, photon energy and dose conversion factors for the radionuclide can be entered by the analyst.[6] The radionuclide screen (Figure 3-4) can accommodate up to 200 radionuclides. Up to 15 different physical/chemical groups can be designated, and their names are user-defined. Editing any row requires first entering the number of the row to be modified. Typing "Q" in a row causes exit from that row.

[6] Federal Guidance Reports 11 and 12, and the Health Physics Handbook (Shleien et al, 1996) are appropriate sources for this information.

3.4.2 Vehicle Menu

Quitting the screen of Figure 3-4 returns the analyst to the RADDOG Main Menu (Figure 3-2). Selecting "V" brings up the vehicle screen shown in Figure 3-5.

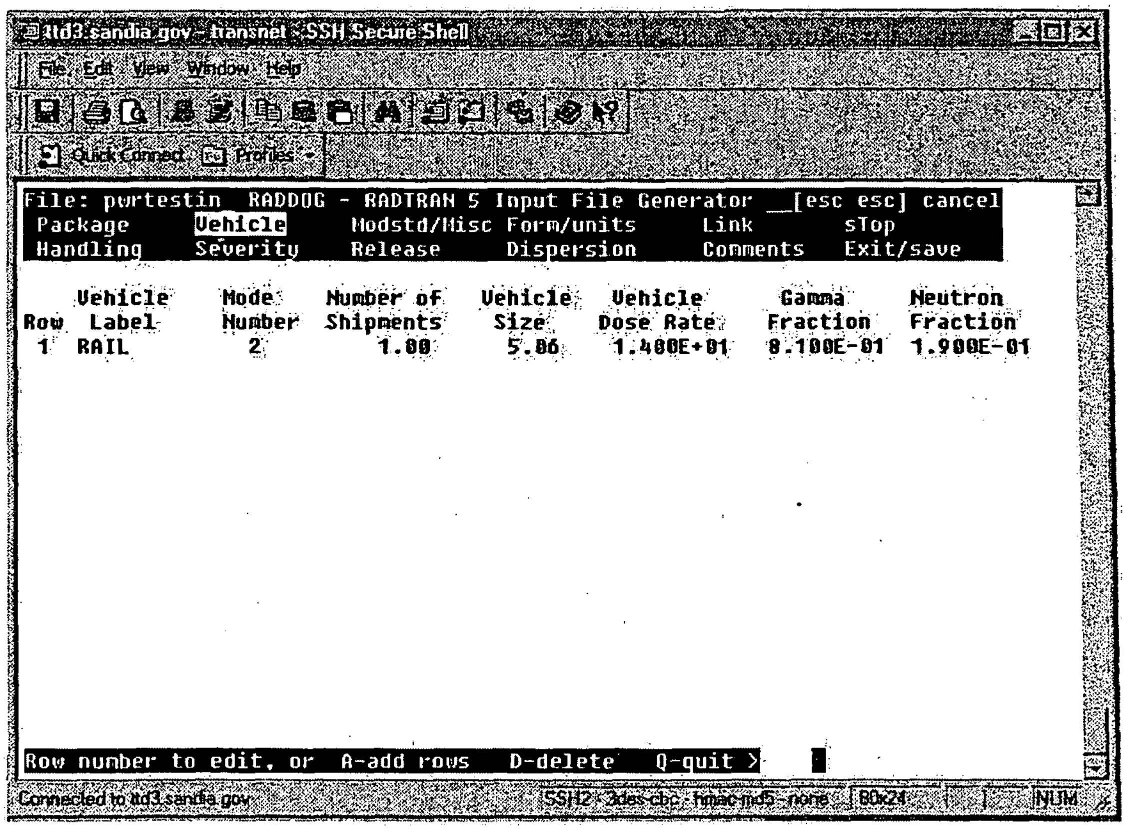

Figure 3-5. Vehicle Menu

The remaining vehicle parameters: crew size, distance of the crew from the source ("crew distance"), crew shielding ('crew modfac"), end dimension of the package ("crew view"), and number of packages per vehicle, are entered by quitting the screen in Figure 3-5. Editing any row requires first entering the number of the row to be modified. Typing "Q" in a row causes exit from that row.

3.4.3 STANDARD Parameter Value Menu

Quitting the last "vehicle" screen returns the analyst to the RADDOG Main Menu (Figure 3-2). Selecting "M" brings up a screen on which the analyst will be prompted to choose the STANDARD input file or the ZERO input file. The STANDARD input file continues a number of commonly used parameter values which the analyst can change if he or she desires to do so. In the ZERO file, all of these parameter values are zero, and the analyst must supply values. Use of the STANDARD file is recommended. Entering "S" to read in the STANDARD file brings up the screen shown in Figure 3-6. Opening an old file or a TTC file brings up the screen of

Figure 3-6 when "M" is selected. The analyst is free to substitute values for any of the STANDARD parameter values.

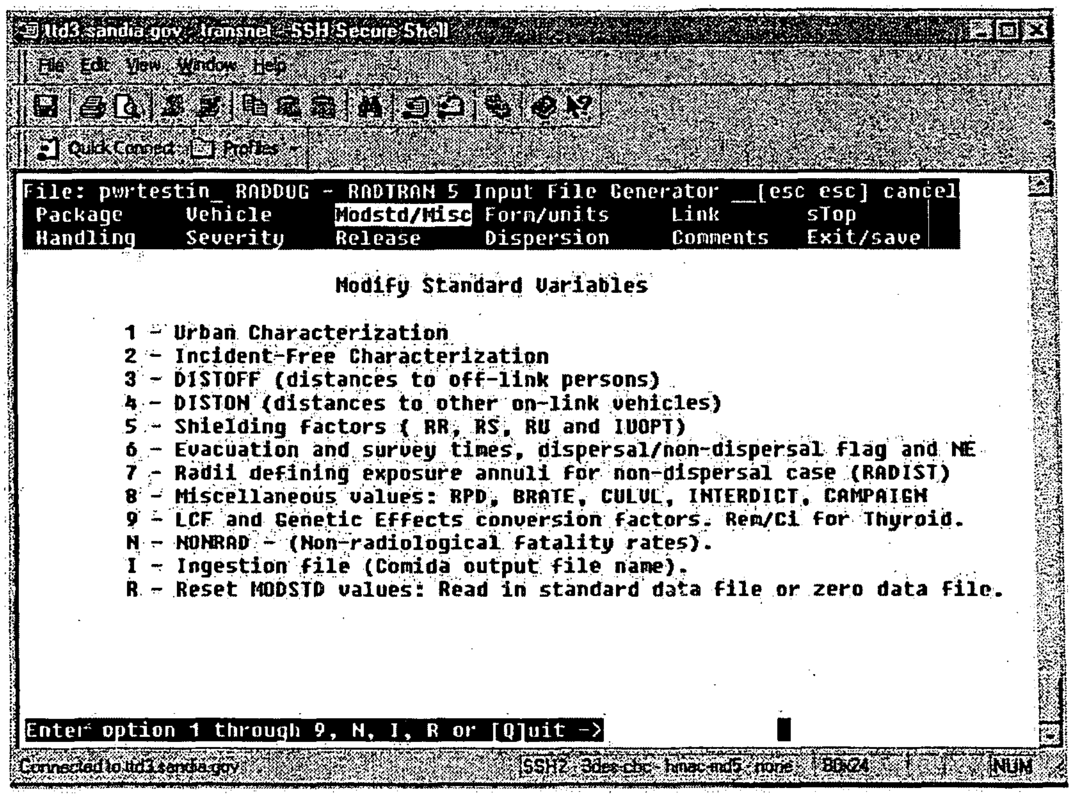

Figure 3-6. STANDARD Values Top-level Menu

3.4.4 Form and Units Menu

Selecting "F" from the Main Menu brings up the screen shown in Figure 3-7, which allows the analyst to select output as person-rem (and rem) or as latent cancer fatalities (LCF), and to choose to express doses output in Standard International units.

3.4.5 Links Menu

Selecting "L" from the Main Menu brings up the screen shown in Figure 3-8: the "Links" screen. A *link*, in RADTRAN parlance, is a route segment. Each link is characterized by its length in km, the off-link population density in persons/km^2, the total vehicle density in vehicles/hour, persons per vehicle and the vehicle accident rate in accidents/km. Each link should also be characterized in the column "Pop Zone" as rural (R), suburban (S), or urban (U), based on the population density in the 800-meter-wide strip along each side of the link. [7] The road type (column "RD") must also be designated:

[7] The usual divisions are R<59 persons/km^2, 59<S<1830 persons/km^2, U>1830 persons/km^2.

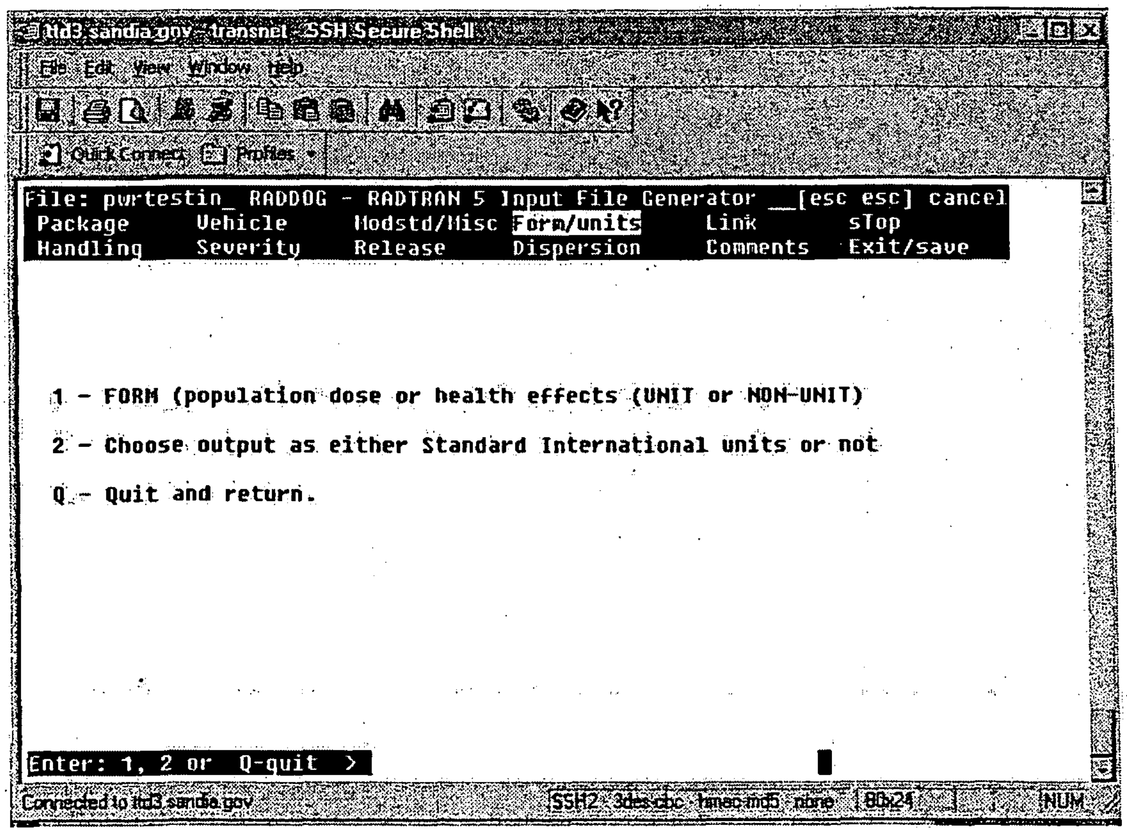

Figure 3-7. Form/units Menu

- RD=1: Interstate or primary US highway
- RD=2: Secondary road
- RD=3: Rail
- RD=4: Waterway

The fraction of land devoted to farming may be designated only for rural links. Note also that a new vehicle name cannot be added at this screen; the menu system will only accept vehicle identifiers that have been added at the "Vehicle" screen (Figure 3-5).

Accident frequency is usually state-by-state, and may be obtained from the U. S. Bureau of Transportation Statistics (http://www.bts.gov) or from a compilation of statistics like Saricks and Tompkins (1999). National average vehicle densities are approximately 470, 760, and 2800 vehicles per hour for rural, suburban, and urban links, respectively, but more accurate estimates may also be found on the Bureau of Transportation Statistics website.

As with similar screens, editing any row requires first entering the number of the row to be modified. Typing "Q" in a row causes exit from that row.

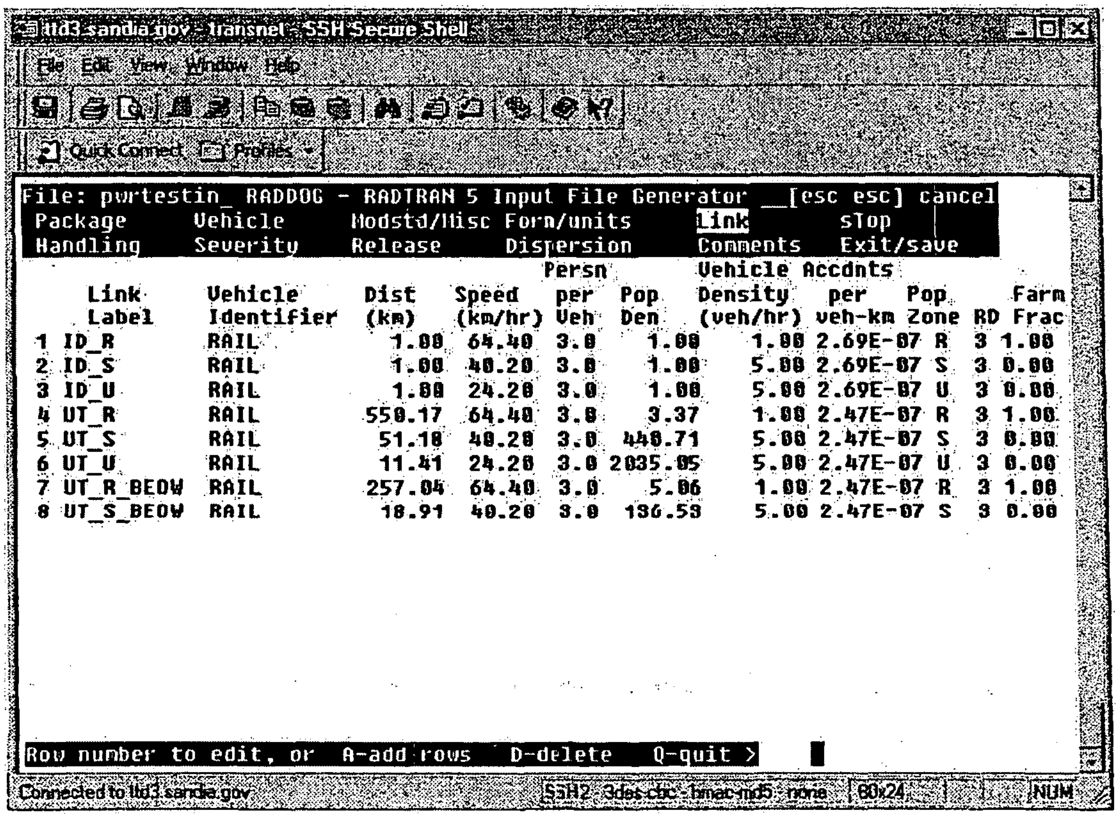

Figure 3-8. Links Menu

3.4.6 Stops Menu

Selecting "T" from the Main menu brings up the "stops" screen, shown in Figure 3-9. Parameters of the stop dose calculation are the distance that the receptor population is from the source (the vehicle) and the exposure time. The analyst names the stop (e.g., refueling, overnight, inspection, etc.). The vehicle name must be the same as a name entered in the "Vehicle" screen.

The value entered in the column "Population Density" depends on whether a population in an annular area around the source is being modeled, or whether people all at the same distance from the source are being modeled. If the minimum distance from the source (see Figure 3-9) is different from the maximum distance, RADTRAN 5 will read the value in the "Population Density or No. Persons" column as a population density, and this will be indicated in the column headed "This Stop Using." If the minimum distance from the source is the same as the maximum distance, RADTRAN 5 will read the value in the "Population Density or No. Persons" column as the number of people. The shield factor is the fraction of ionizing radiation that reaches the receptor; i.e., Shield Factor = 1 means no shielding. Further discussion of stop modeling is presented in Chapter 5.

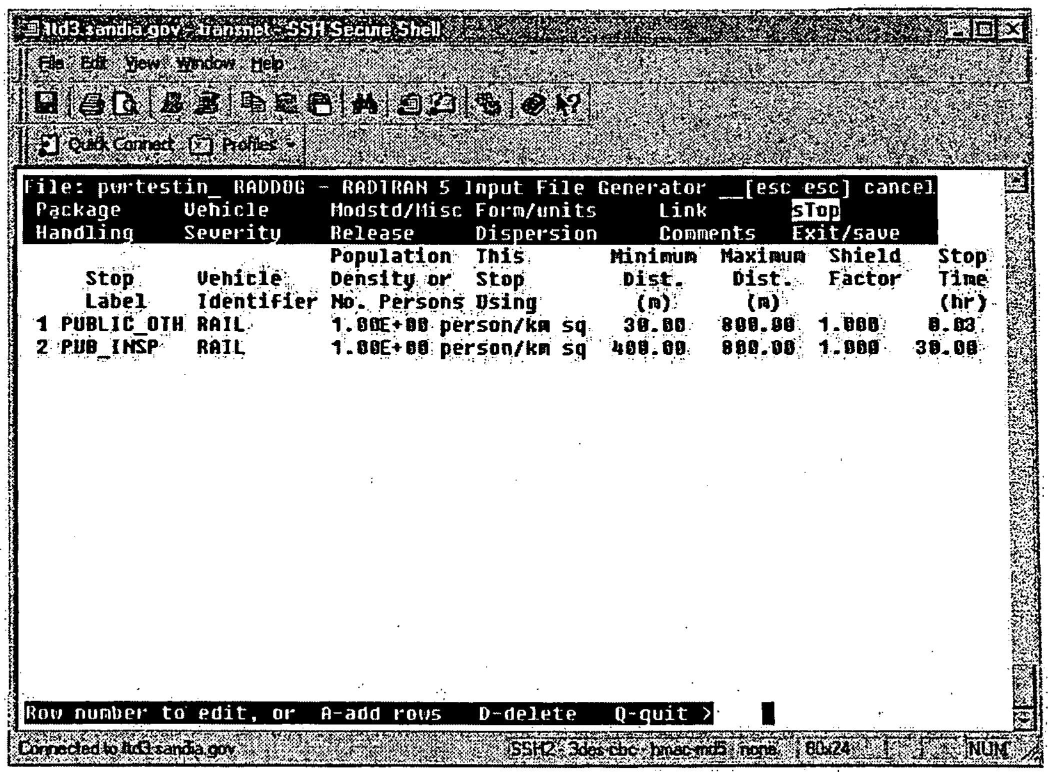

Figure 3-9. Stop Menu

3.4.7 Handling Menu

Selecting "H" on the Main Menu opens the handling screen shown in Figure 3-10. The data needs are self explanatory.

3.4.8 Severity Fraction Menus

Selecting "S" on the Main Menu opens the Severity screen shown in Figure 3-11. On this screen the analyst selects the number of *severity categories*; that is, the number of groups of accidents to be considered. For example, if the analyst selects three severity categories (NSEV = 3), one category would be minor accidents that have no impact on the cargo, one category would be accidents in which half the contents of the package were released, and one would be accidents in which all the contents were released.

The number of categories is an index only, and does not indicate how frequent or likely such accidents would be. Frequency is discussed in the screen shown in Figure 3-12.

Selecting "Severity" from the menu shown in Figure 3-11 prompts the analyst to select the transportation mode of the shipment (highway, rail, etc.) and then opens the screen shown in Figure 3-12.

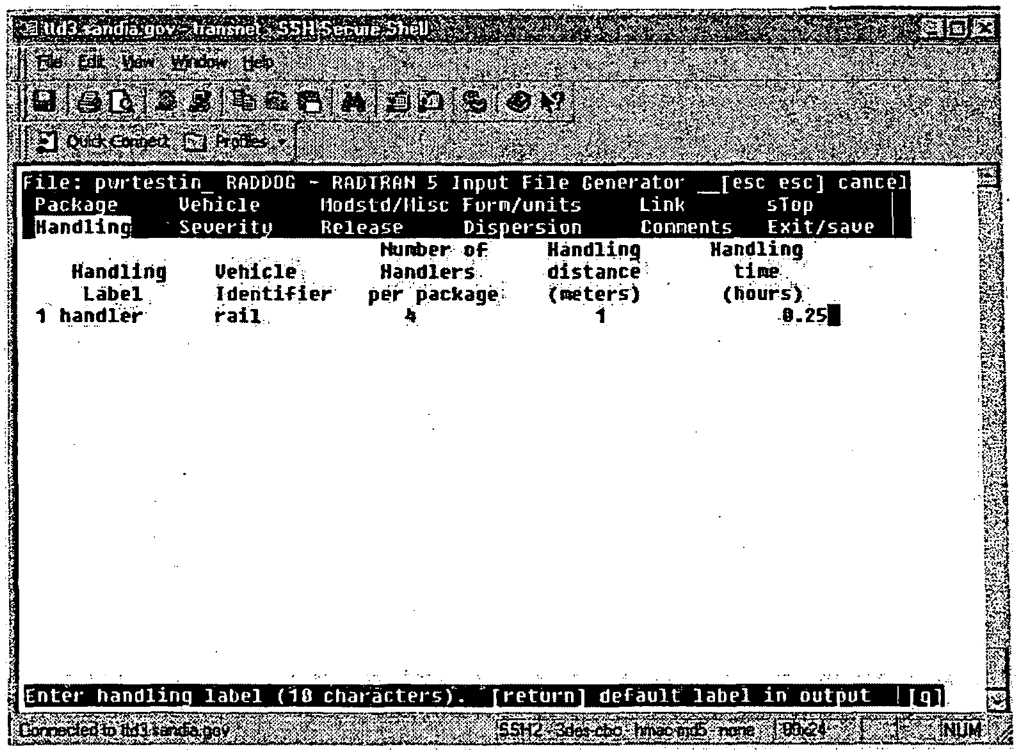

Figure 3-10. Handling Menu

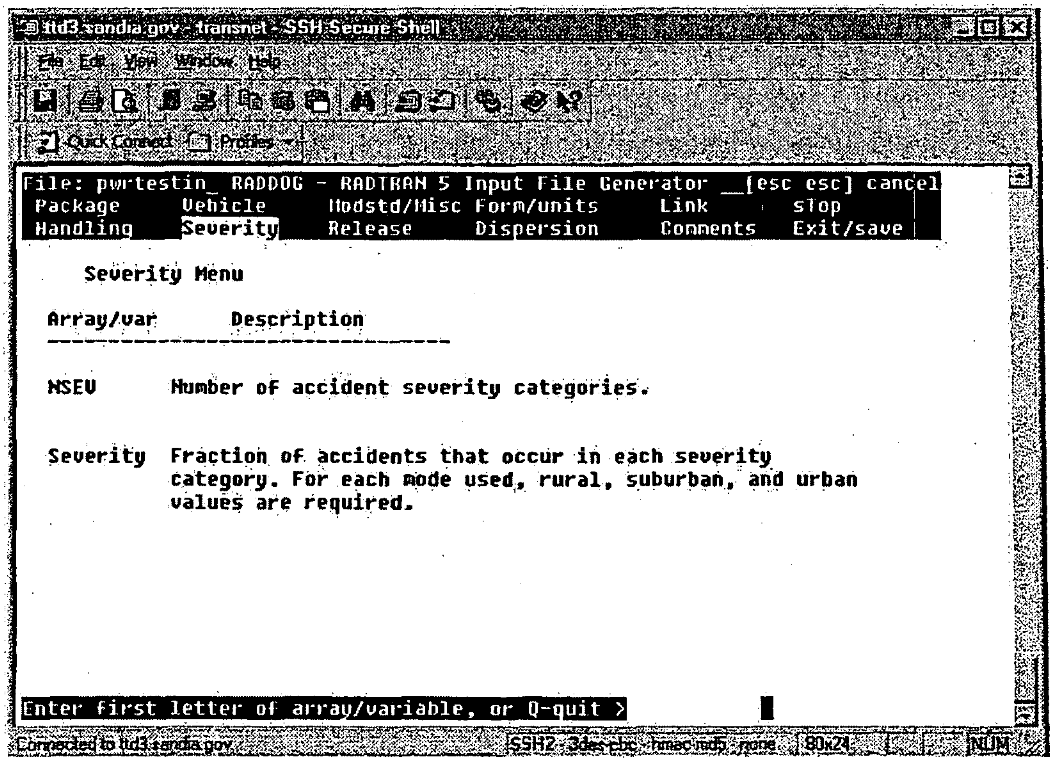

Figure 3-11. First Severity Menu

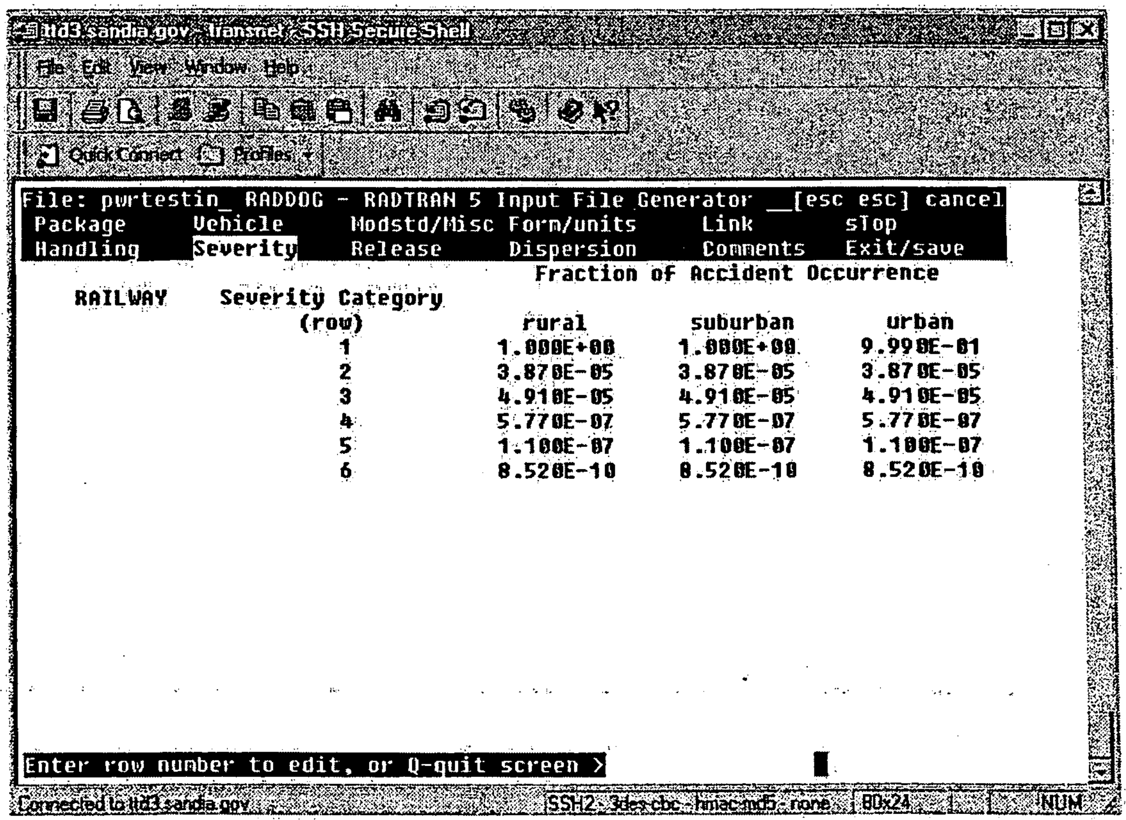

Figure 3-12. Second Severity Menu

On each row, the analyst enters the *severity fraction* for that particular severity category. The *severity fraction* is the conditional probability that, if an accident occurs, it will be an accident of that particular severity. The severity fraction can also be considered the frequency of accidents of that particular type. In the example of three severity categories, for Category 1, minor accidents with no release, the severity fraction could be 0.999. For Categories 2 and 3, the severity fractions could be 0.0007 and 0.0003, respectively.

RADTRAN 5 requires that severity fractions be entered for rural, suburban, and urban accident scenarios, even if the severity fractions are the same for a particular severity category; e.g., for Category 1, in the example, the rural severity fraction, the suburban severity fraction, and the urban severity fraction, would all be 0.999). Although there would appear to be more minor accidents on urban than on rural route segments, and fewer, but very severe, accidents on rural than on suburban route segments, data are not generally available to support different severity fractions. Severity fractions and the sources where they may be obtained are discussed further in Chapter 5.

3.4.9 Release Fraction, Aerosol Fraction, Respirable Fraction Menus

Selecting "R" on the Main Menu opens the Release Menu shown in Figure 3-13.

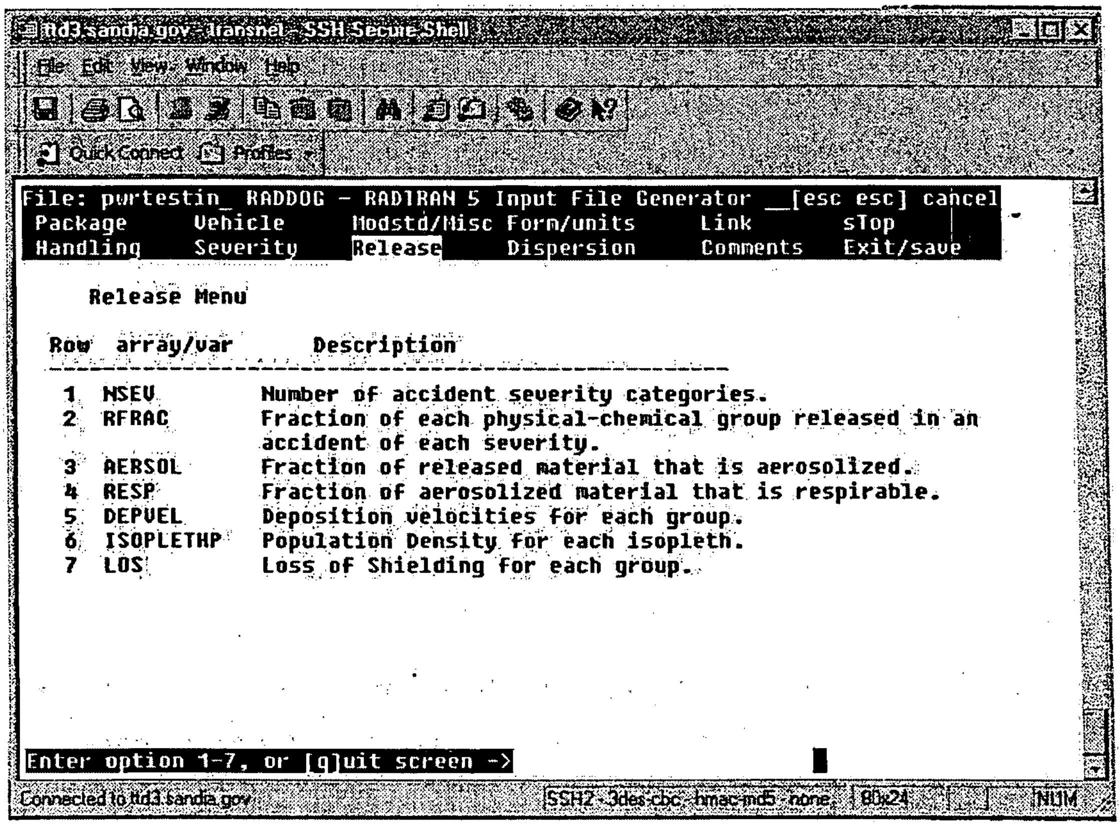

Figure 3-13. Release Menu

The screen show in Figure 3-13 opens windows for the analyst to indicate the release, aerosol, and respiratory fractions associated with each severity fraction, and the deposition velocities for each physical/chemical group. Figure 3-14 is the screen that opens when 2 (RFRAC) is selected from the screen of Figure 3-13. A similar screen is opened when 3 (AERSOL) or 4 (RESP) is selected. Selecting any of the physical chemical groups shown in the screen of Figure 3-14 will open a screen like that of Figure 3-15.

Selecting 5 from the Release Menu (Figure 3-13) opens the screen of Figure 3-16 to allow selection of deposition velocities.

3.4.10 Dispersion Menus

Selecting "D" from the Main Menu opens the dispersion screen shown in Figure 3-17. The analyst can select one of two ways to model air dispersion (of material released in an accident). Selecting "C" from the menu shown in Figure 3-17 opens a screen showing isopleth areas, dilution factors, and isopleth centerline distances from the source to 120 km. downwind of the source, calculated for national average meteorology. The analyst can substitute values that have been calculated externally to RADTRAN if he or she so desires.

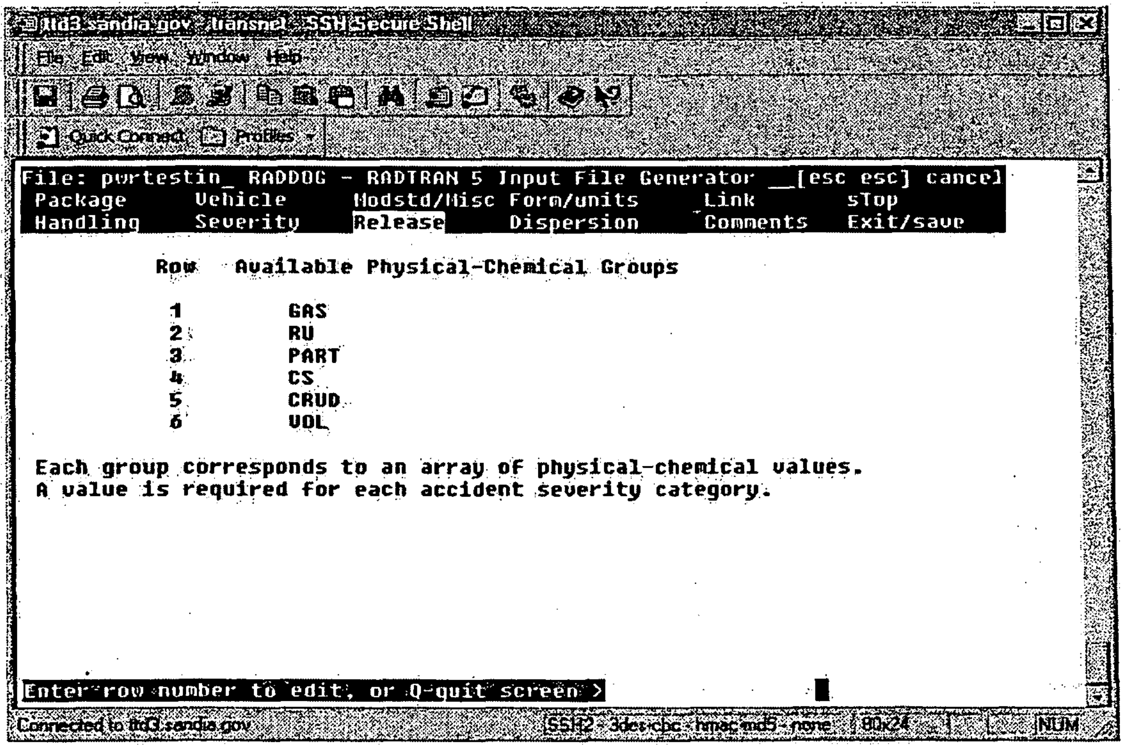

Figure 3-14. Main Release Fraction Screen

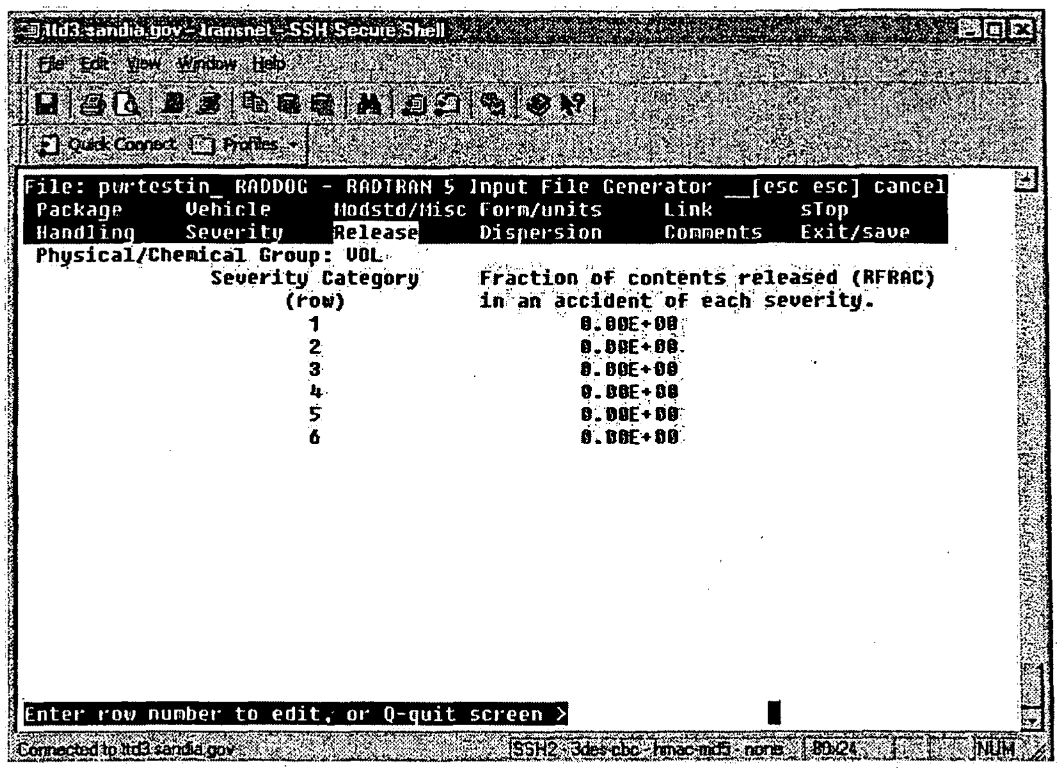

Figure 3-15. Release Fraction Screen for Volatile Substances

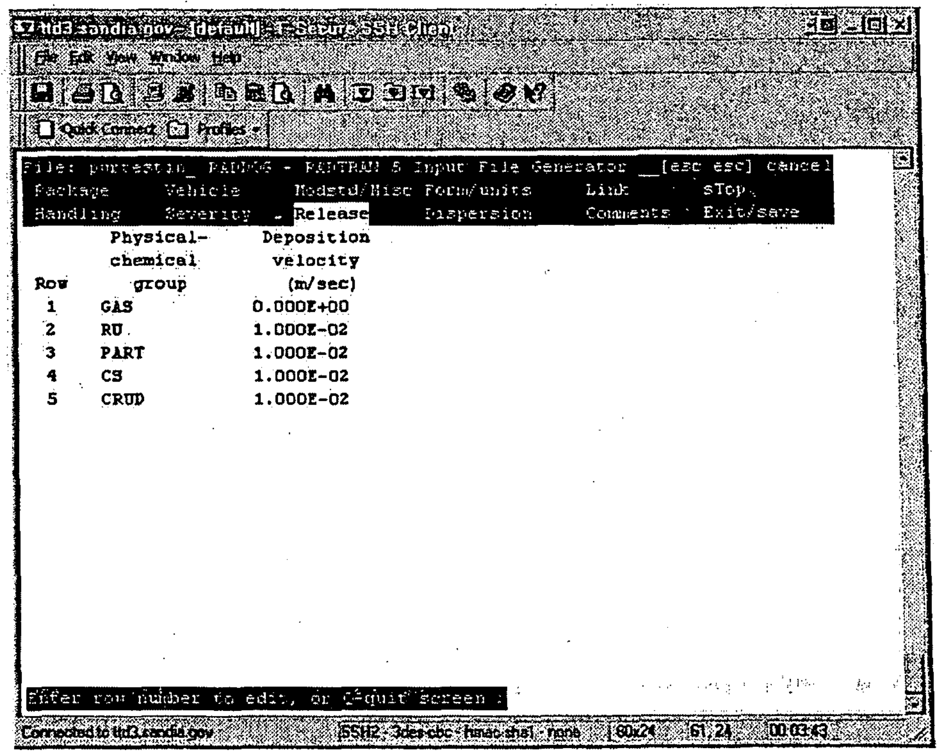

Figure 3-16. Deposition Velocity Screen

Alternatively, the analyst can select "P" and open the screen shown in Figure 3-18, which allows input of the fractional occurrence of each Pasquill stability class.

3.4.11 Comments

Selecting "C" from the Main Menu opens the "Comments" screen shown in Figure 3-20. Within "Comments," the analyst may type up to 60 lines of text to indicate the nature of the analysis being performed. Comment lines document the purpose and pertinent technical details of an input file. They are an excellent record-keeping tool that the analyst is strongly encouraged to utilize. Later sections of this chapter contain information about the types and sources of input data.

3.4.12 Completing the RADTRAN Input File

When data entry is complete, select the final Main Menu heading, "Exit/save." The analyst is prompted to enter a title for the file. Since the completed file is read into the RADTRAN 5 input file RT5IN.DAT, and RT5IN.DAT is overwritten by each new input file, the analyst is also prompted to save the file as MYFILE.in5. This MYFILE.in5 file is then saved in the analyst's file area on TRANSNET and may be called up as an "old input file" using the TRANSNET Main Menu (see Figure 3-1). Note that the file created with the menu system is not saved until

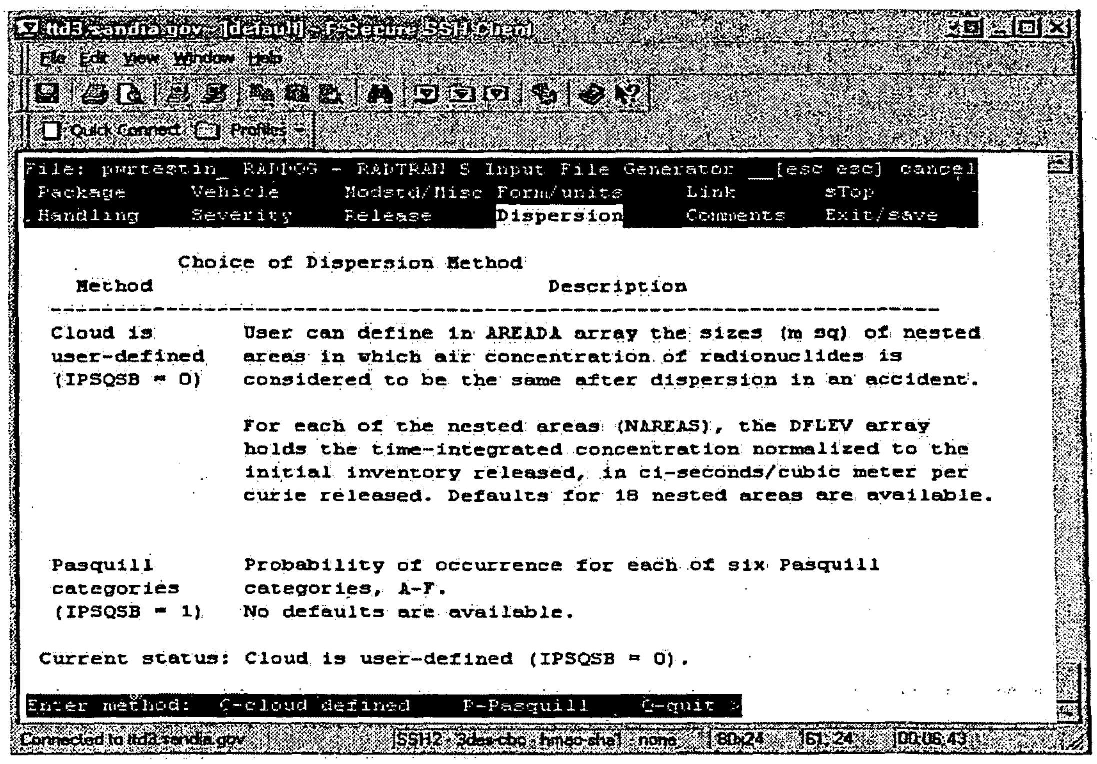

Figure 3-17. First Dispersion Screen

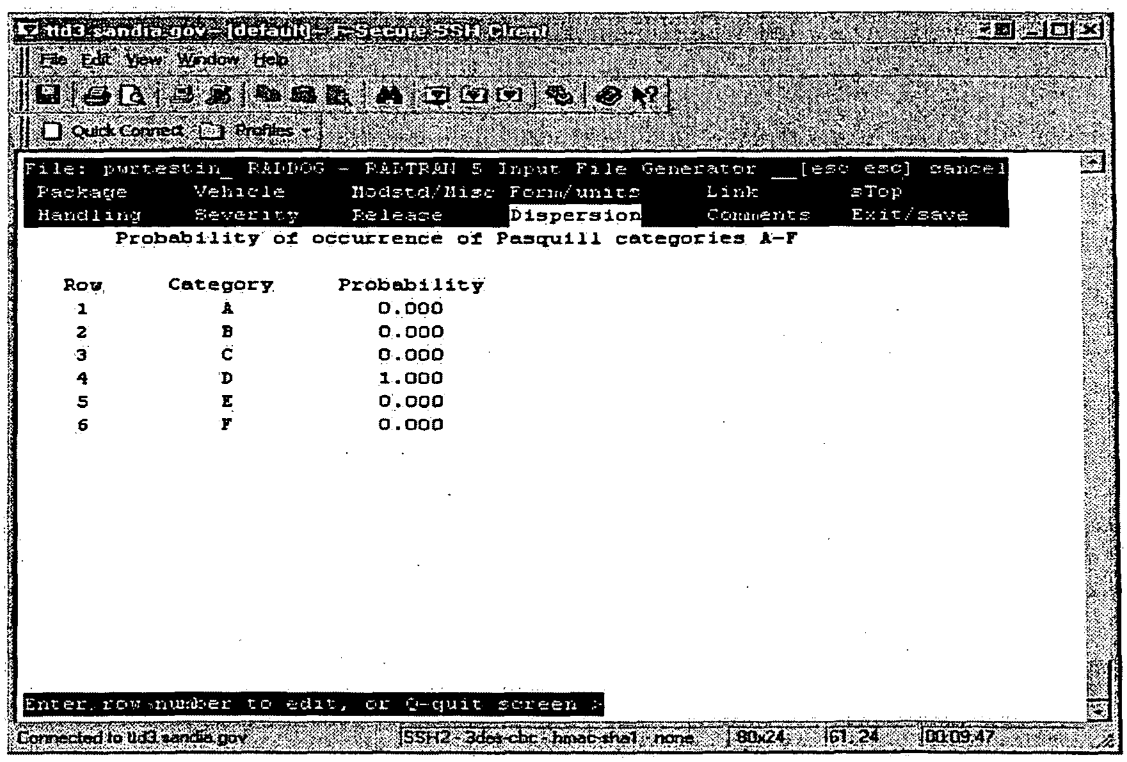

Figure 3-18. Pasquill Stability Class Menu

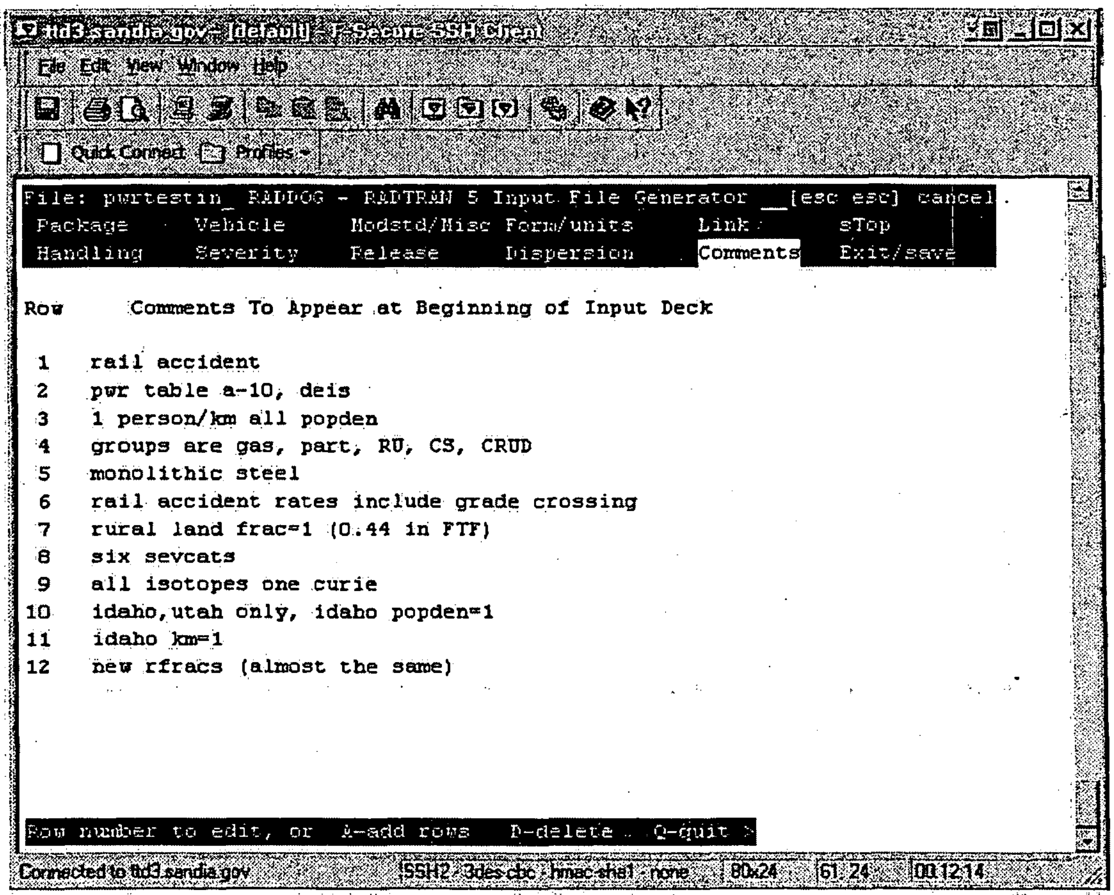

Figure 3-19. Comments Screen

the Exit/save menu is invoked. Further instructions for running the file in RADTRAN may be found in Section 3.5. A typical input text file may be found in Chapter 4, Figures 4A to 4D.

3.5 Running RADTRAN 5 on TRANSNET

Exiting the "Exit/save" screen returns the analyst to the RADTRAN 5.2.5 Control Menu (Figure 3-1).

To run the newly created input file in RADTRAN, select "Run RADTRAN 5 with the specified input file." The analyst will then be prompted for the level of output (see Section 3.6.3 and the description of PARM therein), and should recognize that the nuclide specific BYISO.OUT file is output only for levels 2, 3, and 4. RADTRAN should take only a few moments to run. When the run is complete, the analyst will see the words SUCCESSFUL COMPLETION on the screen; then the prompt will reappear.

The name of the main RADTRAN output file is R5OUT.DAT. It can be viewed immediately by selecting 7 on the RADTRAN 5.2.5 Control Menu. It can also be viewed with an editor, renamed, copied, or deleted. The output file can be downloaded from the file listing of SSH2, or copied to a Word or Excel file from PuTTY. Regardless of the method used to create an input file, the output will always be in the format described in this chapter and in Chapter 4. The nuclide specific output file is BYISO.OUT. If this file is to be saved, it should also be renamed.

If a run cannot be completed successfully, the message 'INPUT ERROR' or the message 'ERROR - OUTPUT FILE INCOMPLETE' will appear on the screen. In the former case, the analyst is advised to examine the input echo in the output file (R5OUT.DAT) to see where execution stopped and then to correct the problem in the input file. In the latter case, the output file (R5OUT.DAT) should contain one or more additional error messages that describe the problem(s). Error messages and suggested correction strategies are listed in Appendix B.

3.6 Input File Structure

3.6.1 Creating Input Files Using a Text Editor

TRANSNET users may also create input files with a text editor (e.g., Microsoft™ Editor or Vi™) without using the menus. This is discussed further and in detail in Section 3.7. In fact, after they have gained some experience with the code, TRANSNET users often find that the text-editor method is faster than using the menus. If RADTRAN is run locally on a workstation or personal computer, the RADTRAN input file must be created using a text editor.

The first step is to create and name a blank input-data file (e.g., MYFILE.DAT or MYFILE.IN5). It should be an ordinary text file and be located in same directory as RADTRAN 5 when using a workstation, or uploaded to the analysts file area on TRANSNET. Before uploading a new input file for use with TRANSNET, it must have a .IN5 file extension in order for the menus to function properly. Any available text editor may be used to create the file. Consult the software manual for the specific editor you are using for necessary instructions. Data entry in RADTRAN 5 is in free format and is keyword-based. The keyword-based system allows most of the data to be entered with any number of intervening spaces or carriage returns. Keywords and data can appear anywhere in an 80-character line. After data entry is complete, the file should be copied and renamed as described previously.

3.6.2 RADTRAN 5 Input File Structure – Fields, Field Values, Delimiters, and Keywords

A RADTRAN input file is an ASCII text file that consists of keywords, numbers, and alphanumeric labels entered as fields of ten characters or less which are separated by one or more of the following delimiters: a blank space, comma, equal sign, or right and left parentheses. The term *field value* may refer to a keyword, a number, or a label. Fields may appear anywhere in the 80-character line, but may not be split and continued on the next line. Field values must not contain embedded blanks, commas, equal signs, or parentheses, because these are delimiter characters that denote the end of a field.

A master list of all keywords is included at the end of this chapter in Section 3.11. First-level keywords must be entered before any associated second- and third-level keywords. Following the entry of a first-level keyword and a space, second-level keywords, followed by third-level keywords, may be entered on the same line or the following line(s); each is followed by the required data. A first-level keyword is not always followed by a second- or third-level keyword. As the DIMEN keyword in the Master List illustrates, data may directly follow a first-level keyword, separated by spaces or other delimiters. The "or" separating two keywords in the Master List indicates that the analyst may enter one of the keywords, but not both, in a single analysis. Finally, the Description column of the Master List briefly describes the type of data to be entered after each keyword and gives the units that must be used. Where an array of numbers must be entered, the array is described in detail in the following text.

Integer data can be entered as real numbers; they will be truncated. Real variables can be entered as integers, in which case they will be converted internally. Entry format can be either exponential (e.g., 9.99E+1, see Box 3-2) or decimal (e.g., 99.9).

A special delimiter character, the asterisk [*], may be entered in numeric-array fields to designate a repeat character. For example, to repeat the number 10.1 six times, enter 6*10.1. Blanks cannot separate the numbers and the asterisk delimiter. The asterisk must ***not*** be used in the data for DIMEN or PARM or in any alphanumeric-label field.

Box 3-2 EXPONENTIAL NOTATION

Exponential notation is the most convenient means of writing very large and very small numbers.

For example, the small number 0.00000052 can best be expressed in exponential form. That is, as 5.2E-7. The notation means the number 5.2 is multiplied by the number 10^{-7} (0.0000001), which is 10 with the exponent –7.

Exponential notation may be used to express any number in RADTRAN 5. It must be used to enter numbers with more than 10 characters.

Any field consisting of two ampersands (&&) followed by a delimiter (usually a space) causes all subsequent information on that line, regardless of its content, to be entered as a comment line. Examples of the use of comment lines are given in sample files later in this chapter.

Special keywords that are never followed by data are also noted in the Master List. They are EOF (End of File), EOI (End of Input), and END (marks end of data entry for keyword PACKAGE).

3.6.3 Required Keywords Begin an Input File

To begin building a data set, five first-level keywords are usually entered: TITLE, INPUT, FORM, DIMEN, and PARM. TITLE, INPUT, FORM, and DIMEN are always entered. Values are entered for PARM when the choice for INPUT is entered (see below); therefore, this keyword is only entered if the analyst does not wish to accept them. Each of these keywords is discussed below.

TITLE. The first input line must be a title record. The line must begin with the keyword TITLE followed by at least one space. Since entry is on an 80-character line and since fields may not be continued on a second line, this means that the actual letter count of a user-assigned title may not exceed 74 alphanumeric characters in length. The analyst will find that it pays to develop as descriptive a title as possible.

INPUT. The second line of the input file must start with the keyword INPUT followed by either the keyword STANDARD or the keyword ZERO. STANDARD will bring up values for a number of RADTRAN 5 parameters; these are mainly parameters with values that are seldom altered (e.g., breathing rate, building shielding factors). These are discussed in greater detail in Section 3.9. ZERO initializes all input-data values to zero. The analyst then must enter specific values for the parameters under keywords MODSTD and FLAGS, which are described later in this section.

FORM. The third line of the input file must start with the keyword FORM followed by at least one space and either UNIT or NONUNIT (second-level keywords). This determines the form of the output: either UNIT for population dose or NONUNIT for health effects.

Box 3-3 DIMEN Example
DIMEN 6 10 18

DIMEN. Three ordered numeric fields each separated by a delimiter (see Box 3-3) must follow DIMEN. They specify the dimensions of the following arrays:

- NSEV Field. The number of accident-severity categories that will be used in the analysis (maximum = 30);

- NRADIAL Field. The number of radial distances to be used in nondispersal accident analysis (maximum = 15);

- NISOPLETH Field. The number of downwind dose and deposition areas to be used in dispersal accident analysis (maximum = 30).

PARM. With PARM, the analyst selects settings for four flags, which in turn control certain code functions. The flags, in order of entry, are:

- The plot flag for placing data in output files for probability-consequence plots; the STANDARD value is yes (1); to not produce those files, set flag to zero.

- The selection flag with which the analyst selects incident-free analysis (1), accident analysis (2), or both (3); the STANDARD value is both (=3);

- The output flag for choosing the level of output; the STANDARD value is the full output (3). If set to 1, a short summary is printed; if set to 2, the output contains more detailed tables of input and results; if set to 3, consequence tables are added to level 2 output; if set to 4, sensitivity analysis is added to level 3 output. If the output flag is set to 2, 3, or 4 (but not 1), the accident dose risk for each radionuclide is output in a file called BYISO.OUT.

- The Pasquill flag for selecting Pasquill stability categories (1) or user-supplied time-integrated concentration isopleths and areas (0); the STANDARD value is zero.

If the analyst wishes to alter the settings of any of the flags subordinate to PARM, the keyword PARM should be entered and followed by four numbers indicating the new settings. If the analyst omits PARM, then the standard settings for all flags are used.

3.6.4 Flags

In addition to the flags already discussed under keyword PARM, an additional flag, the Exclusive Use flag, is associated with the keyword VEHICLE.

Exclusive-Use Flag

An exclusive-use shipment is a shipment that carries only radioactive-material packages and no other cargo. Exclusive use is denoted by placing a negative sign in front of the mode designator in the VEHICLE array. In the absence of a negative sign, the shipment is considered non-exclusive-use for regulatory check purposes.

Several flags may be found in the STANDARD (RT5STD.DAT) file and may be reset under the keyword MODSTD. They are described in this section.

Flags in the STANDARD file

1. IACC. The standard value for the IACC flag is 2. This setting directs the code to work through all exposure pathways associated with atmospheric dispersal of package contents during an accident. The alternative value of IACC = 1, denotes non-dispersal and is used to examine particular scenarios such as loss-of-shielding or accidents involving non-dispersible package contents (also called "special form" materials).

2. ITRAIN. This flag, used only for rail mode, denotes whether shipment is by general freight (ITRAIN = 1) or by dedicated rail (ITRAIN = 2). The standard setting is 1. The main difference between the two options is the exposures of rail workers in railyards. The rail-worker dose is the weighted sum of the doses for all close-proximity rail-worker groups. The doses are calculated primarily with a line-source model. Occasionally a point-source model for worker groups that are consistently present but are somewhat distant from the RAM car(s). For general freight, dose is calculated with the modifying factors b_1 through b_7, which have units of person-hr/km and are derived from Wooden (1987) as described in Appendix B of the RADTRAN 5 Technical Manual (Neuhauser, Kanipe, and Weiner, 2000). For dedicated rail, worker dose is calculated with factors b_8 through b_{11}. If no rail-mode transportation is to be analyzed, then the flag setting is ignored.

3. IUOPT. This flag is used to select a building shielding option. For the STANDARD value (IUOPT = 2), persons in buildings are exposed at reduced rates and the reduction in dose rate is a function of the shielding factors RR, RS, and RU, which are described later in this chapter. Setting the IUOPT flag to 1 is equivalent to full shielding (everyone indoors is fully shielded and receives no dose). Setting the IUOPT flag to 3 is equivalent to no shielding (being indoors provides no protection and is the same as being outdoors). If the STANDARD setting is accepted, the analyst may still separately alter the values of the individual shielding factors.

4. REGCHECK. The STANDARD setting is REGCHECK = 1, which causes a series of regulatory checks to be performed. If any circumstances are identified that violate the regulatory requirements (e.g., package dose rate exceeds regulatory maximum), then the appropriate parameter values are reset to the regulatory maximum and the calculation continues. A message informing the analyst is printed in the output. The analyst may set REGCHECK = 0, which bypasses the regulatory-check subroutine. This flag setting can be useful for analysis of a shipment operating under waivers of various types (e.g., certain radiopharmaceutical shipments (Finley, McClure and Reardon, 1988)).

3.6.5 Accident-Related Keywords and Parameters

After TITLE, INPUT, FORM, DIMEN (and sometimes PARM) have been entered, the first-order keywords SEVERITY and RELEASE, with associated second- and third-order keywords are entered as shown in Box 3-4.

NPOP=1, 2, 3 refers to rural, suburban, and urban populations, respectively. NMODE=1 is highway, NMODE=2 is rail, etc., as shown in Table 2-1. The numbers listed under NMODE are the severity fractions (NSEV=4 in the example in Box 3-4).

Potential releases of radioactive material in accidents, and the fractions of material aerosolized and respirable, depend on the physical and chemical behavior of the radionuclides released, rather than on their radiological characteristics. The second order keywords GROUP are listed under RELEASE, and the third order keywords RFRAC (released fraction), AERSOL, and RESP (respirable fraction) are listed following each GROUP. The numerical values are that fractions of the transported material in each category. The third order keyword LOS refers here to the fraction of shielding lost, and is part of a loss-of-shielding model in RADTRAN that is not generally used (loss of lead shielding is discussed in greater detail in Chapter 5. DEPVEL is the deposition velocity and is also a function of physical and chemical behavior.

The first order keyword PSPROB is entered if the analyst elects to specify the fraction of each Pasquill stability class. If the analyst uses the isopleths and dilution factors for national average meteorology, PSPROB need not be entered. National average meteorology values are part of the STANDARD values.

Box 3-4 Example of Data Entry under Keywords SEVERITY and RELEASE

```
SEVERITY
   NPOP=1
     NMODE=1
       1.00E+00  6.06E-05  5.86E-06  4.95E-07
   NPOP=2
     NMODE=1
       1.00E+00  6.06E-05  5.86E-06  4.95E-07
   NPOP=3
     NMODE=1
       1.00E+00  6.06E-05  5.86E-06  4.95E-07
RELEASE
   GROUP=GAS
      RFRAC
 0.00E+00  1.96E-01  8.39E-01  8.00E-01        AERSOL
       1.00E+00  1.00E+00  1.00E+00  1.00E+00
      RESP
       1.00E+00  1.00E+00  1.00E+00  1.00E+00
     LOS
      0.00E+00  0.00E+00   0.00E+00    0.00E+00
      DEPVEL 0.000000
    GROUP=VOLATILE
       . . . . .
PSPROB
      0.00E+00  0.00E+00  0.00E+00  1.00E+00  0.00E+00
```

The next first-level keyword is DEFINE. The syntax for any user-added radionuclide is, e.g. DEFINE Se-79, and the parameters for each radionuclide are listed in the DEFINE statement for that radionuclide. This is discussed further in Section 3.8.

3.6.6 Package and Incident-Free Parameters

The hierarchical relationship between keywords is:

- a package must be described before it can be associated with a VEHICLE;
- a vehicle must be described before it can be associated with a LINK; and
- a nonstandard radionuclide (i.e., one described under keyword DEFINE) must be described before the assigned radionuclide can be associated with a material or a package.

The hierarchical relationship between the keywords must be observed.

Package-Specific Parameters

Since it is impossible to predict in advance what combination(s) of packaging and contents will be analyzed, all package-specific parameters must be provided by the analyst. Values for the following five parameters are entered after the keyword PACKAGE (Box 3-5).

1. Alphanumeric identifier, up to ten characters in length (e.g., SPENTFUEL)
2. Package dose rate 1 m from surface of package (mrem/hr)
3. Fraction of dose rate that is gamma radiation
4. Fraction of dose rate that is neutron radiation
5. Characteristic Package Dimension (m). Assignment of characteristic package dimension is discussed in Chapter 4.

A list of the radionuclides in a package must appear below the PACKAGE line. Data for each radionuclide must be entered on a separate line. Three pieces of information, each separated by a space must appear on each radionuclide line. They are:

1. Radionuclide name in required format
2. Amount of the radionuclide in the package (Ci)
3. Identifier for physical-chemical group to which the radionuclide is assigned (e.g., VOLATILE)

The radionuclide list must be terminated by the keyword END as shown in Box 3-5.

Box 3-5 Example of Data Entry under Keyword PACKAGE

```
PACKAGE SPENTFUEL 1.368E+001 1.000 0.000 5.20
    CO60    9.220E+001 CRUD
    KR85    6.100E+003 GAS
    SR90    5.960E+004 FPROD
    RU106   1.620E+004 RUTHENIUM
    CS134   2.740E+004 VOLATILE
    CS137   8.760E+004 VOLATILE
    CE144   1.220E+004 CE_EU
    EU154   7.000E+003 CE_EU
    PU238   2.960E+003 ACTINIDE
    PU239   4.100E+002 ACTINIDE
    PU240   4.680E+002 ACTINIDE
    PU241   1.260E+005 ACTINIDE
    AM241   1.290E+003 ACTINIDE
    AM243   1.990E+001 ACTINIDE
    CM244   1.790E+003 ACTINIDE
    END
```

Vehicle-Specific Parameters

The following are entered following the keyword VEHICLE:

- Mode number (see Table 2-1) modified by the Exclusive-Use Flag (a negative sign) if necessary (see Section 3.3.1.3).
- Alphanumeric vehicle identifier, up to 10 characters in length (e.g., PHARM_1).
- Dose rate at one meter from the surface of the vehicle (mrem/hr)
- Fraction of dose rate that is gamma radiation
- Fraction of dose rate that is neutron radiation
- Characteristic vehicle dimension (m)
- Number of shipments to be carried out in the specified vehicle type
- Number of crew members
- Average distance (m) of crew members from the geometric center(s) of one or more radioactive-material package(s)
- Crew Modification Factor, a fractional multiplier that can be used to account for mitigating factors such as shielded crew cabs in semi-trucks. If there are no such mitigating factors then the Crew Modification Factor should be set to unity.
- Crew View Package Dimension (m), which accounts for situations in which the regular Characteristic Package Dimension (e.g., the length of a cylinder) would overestimate dose rate to crew compartment (in the example, the diameter of the cylinder would give a better estimate). This is discussed more fully in Chapter 5.

The VEHICLE line must be followed by any package identifiers (alphanumeric identifiers that the analyst creates under keyword PACKAGE), which indicate what kinds of packages are carried in the specified conveyance. Each package type is listed on a separate line; the package identifier is followed by at least one space and a numeral indicating the number of packages of that type being carried in the vehicle. In the example in Box 3-6, four packages of type PHARM_1 and five packages of type PHARM_2 are being carried by non-exclusive-use highway mode in a vehicle identified as VAN. The vehicle (VAN) has a maximum dose rate of 1.9 mrem/h (measured at 1 meter from the side of the van) that is 100% gamma radiation and 0% neutron radiation. The remaining values tell us that:

- the van is 3.5 m in length;
- one (1) shipment is being analyzed;
- there is one (1) crew member (driver),

- who averages a distance of 2.0 m from the packages,
- who is unshielded (i.e., the cab has a shielding factor of 1.0),
- and who is exposed, in this case, to a close-packed array of packages with an overall characteristic dimension of 1.5 m.

Box 3-6 Example of Data Entry under Keyword VEHICLE

```
VEHICLE 1 VAN 1.9 1.0 0.0 3.5 1 1 2.0 1.0 1.5
 PHARM_1 4
 PHARM_2 5
```

Keyword MODSTD

The first order keyword MODSTD follows keyword VEHICLE. As previously discussed, the analyst lists under MODSTD the value of any STANDARD parameter that is changed from the STANDARD value, as shown in Box 3-7. SRANDARD values are discussed in greater detail in Section 3.9. If all STANDARD values are accepted, the keyword MODSTD need not be used. If the ZERO file was chosen in place of the STANDARD file, values must be entered under MODSTD for all STANDARD parameters needed for the particular analysis.

Values for the flags that differ from the STANDARD values are entered under the keyword FLAGS which follows MODSTD, as shown in Box 3-7. EOF must follow the last data entry of these three: FLAGS, MODSTD, or VEHICLE .

Box 3-7 Example of Data Entry under Keyword MODSTD

```
MODSTD
   BDF 1.000E+00
   UBF 1.000E+00
   USWF 0.000E+00
   FMINCL 1.000E+00
   RR 1.000E+00
   RS 1.000E+00
   RU 1.000E+00
FLAGS
   REGCHECK 0
   IUOPT 3
EOF
```

3.6.7 Route-Specific Parameters

The keyword EOF must appear before values entered with the route-specific parameters LINK, STOP, and HANDLING are entered but after all other data have been entered.

Keyword LINK

Following the keyword LINK (which follows the last EOF), an array of twelve parameters is entered for each route-segment. Each route-segment array must be on a separate line. Two of the parameters, fraction of land under cultivation and vehicle occupancy, are new to the LINK array. The full array now is:

- Alphanumeric segment identifier (user-defined)
- Vehicle identifier (must be previously defined; see Section 3.4.2)
- Segment length (km)
- Velocity (km/hr)
- Vehicle occupancy (persons/vehicle)
- Population density (persons/km^2) of area surrounding route segment
- Vehicle density (persons/vehicle)
- Accident rate (accidents/vehicle-km)
- Segment character (R=rural, S=suburban, U=urban)
- Segment type (1=interstate; 2 = non-interstate; 3 = any other mode)
- Fraction of land under cultivation (for rural segments only).

Keyword STOP

Following the keyword STOP, an array of seven parameters is entered.

Each stop must be described on a separate line. The stop parameter array is:

- Alphanumeric stop identifier, up to 10 characters (user defined)

- Vehicle identifier (previously defined)

- Option #1 - population density (persons/km^2) or Option #2 - number of persons

- Minimum radius of annular area

- Maximum radius of annular area; if the minimum radius is the same as the maximum radius, RADTRAN will recognize the population as the number of persons. If the minimum and maximum radii are different, RADTRAN will recognize the population as persons/km^2.

- Shielding fraction

- Stop time (hr).

Keyword HANDLING

Following the keyword HANDLING, an array of five parameters is entered.

Each handling must be described on a separate line. The handling parameter array is:

- Alphanumeric handling identifier, up to 10 characters (user-defined);
- Vehicle identifier (previously defined);
- Number of handlers;
- Average source-to-handler distance (m);
- Handling time per package (hr/package).

End of the Input File
Following the keywords LINK, STOP, or HANDLER, whichever has the last data entry, and after all data has been entered, EOF (end of file) and EOI (end of input) must be entered. The keyword EOI must be entered on the last line of the input file.

3.7 Running RADTRAN 5 On a Workstation or With a Text File

An input file must be named R5IN.DAT if it is run in RADTRAN5 on a workstation. It can be uploaded to the analyst's file area on TRANSNET as a *filename*.in5 file. The RADTRAN 5 output file is always initially named R5OUT.DAT. When running on a workstation and dealing with many separate input files, which have been saved under other filenames, it is best to copy one file at a time just before beginning to run each one. The corresponding output file also should be renamed at once, as described in the following section. To begin a run on a workstation with the properly named input file, type the name of the executable RADTRAN 5 file, usually "rt5." On TRANSNET, after uploading the file, the analyst selects 3 ("use old input file") from the RADTRAN 5.2.5 Main Menu (Figure 3-1), selects the file just uploaded, does not open it, and when the Main Menu reappears, runs RADTRAN.

The code should take only a few moments to run. When the run is complete, the analyst will see the words SUCCESSFUL COMPLETION on the screen; then the prompt will appear. The name of the main RADTRAN output file is R5OUT.DAT, and the name of the radionuclide-specific accident dose risk output file is BYISO.OUT. Both files can be printed, viewed with an editor, renamed, or copied.

If a run cannot be completed successfully, the message 'INPUT ERROR' or the message 'ERROR – OUTPUT FILE INCOMPLETE' will appear on the screen. In the former case, the analyst is advised to examine the input echo in the output file (R5OUT.DAT) to see where execution stopped and then to correct the problem in the input file. In the latter case, the output file (R5OUT.DAT) should contain one or more additional error messages that describe the problem(s). Error messages and suggested correction strategies are listed in Appendix D.

If the analyst wishes to save an output file, then the file must be renamed. Otherwise, the file will be overwritten after subsequent runs. Workstation users must remember to copy and rename the file; they will not be prompted as TRANSNET users are. The analyst also should be aware that additional output files are generated for each run which are not normally displayed but which the analyst may wish to save. They contain the probability-consequence data pairs used in accident-risk calculations. These data also may be used to generate tabular or graphic displays of probability-consequence relationships, as discussed in Appendix C. The output files are:

- R5INTERM.DAT, which contains unsorted intermediate data.
- R5PLOT0 .DAT, which contains the sorted dose (person-rem) or latent cancer fatality consequences with summed probabilities;
- R5PLOT1.DAT, which contains the sorted genetic effects consequences with summed probabilities; and
- R5PLOT2.DAT, which contains maximum individual doses with summed probabilities.
- INGVAL.OUT, which contains the raw output data from COMIDA2 for ingestion dose calculation.

These files must be separately copied and renamed if the analyst wishes to save them as well.

3.8 RADTRAN 5_PC: Running Locally on a Personal Computer

RADTRAN 5_PC, a version of RADTRAN 5 that can be run locally on a personal computer, is available from Sandia National Laboratories.[8] The program runs RADTRAN 5 in a DOS window from a batch file, RT5.BAT, which reads RADTRAN input files with a *.in5 file extension. At present, RADTRAN 5_PC will run only under Windows 2000 or Windows XP. Input files may either be generated directly as text files, structured according to Section 3.6, or may be copied from the analyst's TRANSNET file area. To perform an analysis using RADTRAN 5_PC:

- Copy input files (*filename*.in5) into the directory that contains RT5.BAT.
- Click on the RT5.BAT icon. A DOS (command line) window will open.
- Following directions on the DOS window, type in the name of the input file without the .in5 file extension.
- A message indicating normal execution will follow.

---

8 To obtain a copy, contact the Principal Investigator, RADTRAN, Department 6141, Sandia National Laboratories Mail Stop 0718, Albuquerque, NM 87185-0718.

- The output file (*filename*.out) will be located in the same directory and can be opened with Notepad, WordPad, Excel, or Word. If the output flag under PARM (Section 3.6.3) is set to 2, 3, or 4, the BYSIO.OUT file will be appended automatically to the output file.

3.9 Radionuclide Data

Values of radionuclide-specific parameters are available for 60 commonly encountered radionuclides in an internal database in RADTRAN 5. The values are based on the radiation risk approach in ICRP Publication 26 et seq. (ICRP, 1977, 1979-1982, 1984, and 1986) as updated in BEIR V (NAS/NRC, 1990). Half-life of each Radionuclide is in days. The doses are total effective dose equivalents, which are sums of the effective dose equivalents for external exposures and committed effective dose equivalents (CEDEs) for internal exposures and are presented in conventional units (rem per curie). The analyst may substitute values for any or all of these parameters by means of the DEFINE keyword. Any values supplied by the analyst should be in rem/curie for radiation doses and days for half-life.

ICRP Publications 60 and 68 (ICRP, 1991, 1994) use modified organ weighting, express total effective dose equivalent as effective dose, and express CEDE as equivalent dose. The ICRP findings, when adjusted for low-dose and low-dose rate, yield nearly the same total risk factor for fatal cancer as BEIR V (1990). Although "there is much uncertainty and a certain arbitrariness in the determination of the distribution of fatal cancer probability among tissues and organs," [ICRP Publication 60 (p. 123)], the same source notes that "The total risk of fatal cancer, on the other hand is comparatively robust."

In both models the dose-effect relationship conforms to the linear, no-threshold "hypothesis" (LNTH). Use of the LNTH has the advantages of mathematical simplicity and acceptability for demonstrations of regulatory compliance, but effects at low doses are overestimated, possibly to a significant degree.[9] Thus, latent cancer fatality estimates derived from both models are conservative, especially for the rather low doses typically associated with potential transportation-related exposures.

In previous releases of RADTRAN, 1-year organ doses attributable to the inhalation pathway were calculated for lung, marrow, gonads, and thyroid (radioiodines only). The results were used to estimate early effects. In order to achieve the early-effects threshold for the gonads (7 rem), however, a receptor would have to inhale many curies of any of the commonly encountered radionuclides. Threshold dose to the most sensitive organ, bone marrow, would usually be exceeded at inhalation levels well below what is required to reach this gonad threshold. Thyroid doses from radioiodine inhalation, however, can be significant even if relatively small amounts are inhaled. For these reasons, early effects continue to be estimated for inhalation-pathway doses to the lung, marrow, and thyroid, but gonad dose calculation is omitted.

[9] There is an ongoing controversy in the health physics community regarding the LNTH and its applicability at low doses.

3.9.1 Structure of the RADTRAN 5 Radionuclide Library

The RADTRAN 5 radionuclide library contains values for the parameters listed in each subsection of this section. The entire radionuclide-data library is printed in Appendix D.

Half-life (days)
In RADTRAN 5, the unit for half-life is days. All values are taken from ICRP Publication 38 (ICRP, 1983).

Photon energy (MeV/disintegration)
The energy value of photons emitted by a radionuclide is used to calculate groundshine dose for that radionuclide. The units are million electron volts (MeV)/disintegration. All values are taken from ICRP Publication 38 (ICRP, 1983). To simplify the analysis, each decay, regardless of whether it is a single photon or a cascade, is treated as a single photon decay with an energy equal to the difference between the initial and ground states of the radionuclide. The values given are derived from the column titled "y(i)xE(i)" (i.e., the average energy emitted per transformation) in Section 3 of ICRP Publication 38.

Photons emitted by short-lived daughter products (half-life less than a few hours) of certain radionuclides have been added to the nominal photon energy (if any) of the parent radionuclide, but the half-life of the daughter is neglected. In other words, the parent radionuclide is treated as though every transformation produced a photon equal in energy to that of the parent (if any) plus that of the daughter. This approach was used only for radionuclides that have half-lives that are large in comparison with the half-lives of the daughter nuclides; this gives a conservative value for photon energy for the analyses performed by RADTRAN 5 without complex calculations. In cases where the daughters are gamma emitters while the parent nuclides are not, potentially important sources of gamma radiation are adequately accounted for with this approach.

Radionuclides for which short-lived daughter decays have been included are the following:

- molybdenum-99, which has a daughter, technetium-99m (87.6 percent yield), with a half-life of 6 hr and a photon energy of 1.26E-01 MeV/transformation;

- ruthenium-103, which has a daughter, rhodium-103m (99.7 percent yield), with a half-life of 56 min and a photon energy of 1.75E-03 MeV/transformation;

- ruthenium-106, which has a daughter, rhodium-106 (100 percent yield), with a half-life of 29.9 sec and a photon energy of 2.01E-01 MeV/transformation;

- cesium-137, which has a daughter, barium-137m (94.6 percent yield), with a half-life of 2.6 min and a photon energy of 5.96E-01 MeV/transformation; and

- cerium-144, which has a daughter, praseodymium-144 (98.2 percent yield), with a half-life of 17.3 min and a photon energy of 3.18E-02 MeV/transformation. The remainder of the yield is also a short-lived radionuclide, praseodymium-144m, but its photon energy is very low and is neglected here.

Cloudshine dose factor (rem-m^3/Ci-sec)

The units of this parameter are rem-m^3/Ci-sec. This factor is the effective dose-rate factor for immersion in air uniformly contaminated with the specified radionuclide, and it is used to calculate cloudshine dose. All values were taken from DOE-0070 (DOE, 1988a) and converted from mrem-m^3/μCi-yr to rem-m^3/Ci-sec.

Groundshine dose factor (rem-m^2/μCi-day)

The units of this parameter are rem-m^2 /μCi-day. This factor describes the effective dose rate 1 meter above a uniformly contaminated plane surface. All values are taken from Federal Guidance Report 12 (EPA, 1993). No credit is taken for surface roughness.

50-yr committed effective dose equivalent for inhalation (rem/Ci inhaled)

This parameter describes long-term whole-body internal radiation dose (50-yr-dose commitment) resulting from inhalation of respirable aerosol particles of each radionuclide. Units are rem/Ci of respirable aerosol inhaled. Most values are for 0.3 micron AMAD (activity median aerodynamic diameter) particle size, calculated with the equations in Section 1.2.2 of DOE-0071 (DOE, 1988b), which was also the source of values for this parameter (for the highest lung retention class for each radionuclide).

The activity mean aerodynamic diameter (AMAD) of 0.3 micron was selected for a specific reason. A population of aerosol particles of plutonium or other dense material with an AMAD of 0.3 micron has a particle-size distribution such that virtually all the particles could lodge in the pulmonary region of the lung (i.e., are less than 10 microns and greater than 0.1 micron in diameter) (ICRP, 1977). This particle-size assumption was considered somewhat conservative for dense materials such as uranium, plutonium, other transuranics, and spent-fuel particulates. Since they are also among the most frequently analyzed materials, 0.3-micron AMAD values were used for the internal library data. The newest ICRP model, however, no longer supports use of such low AMADs, and future inhalation dose factors will be calculated on the basis of 1 micron AMAD particles, the minimum now recommended by the ICRP (ICRP, 1994, p.3). The analyst may redefine an radionuclide already in the library for a new particle-size distribution by use of the DEFINE function of RADTRAN 5.

Particle size is not a factor for those radionuclides that would be in the gaseous state if released: tritium gas (H3GAS), carbon-14 dioxide gas (C14GAS), and the noble gases. A 1.0-micron AMAD particle size was assigned to two additional materials in the database: tritiated water (H3WTR) and organic forms of carbon-14 (C14ORG). The former would be in vapor or microdroplet form; and the latter usually would be in soot or particulate form.

50-yr committed effective gonad dose for inhalation (rem/Ci inhaled)

This parameter describes long-term organ dose (50-yr-dose commitment) to the gonads resulting from inhalation of respirable aerosol particles of an radionuclide. Units are rem/Ci of respirable aerosol inhaled. The value is used in calculation of genetic effects.

1-yr lung dose for inhalation (rem/Ci inhaled)

The units are rem/Ci inhaled. This parameter describes the one-year committed dose to the lung from inhalation of respirable aerosol of a given radionuclide. It is used to calculate early fatalities and early morbidities. The values are taken from Dunning (1983) for the highest lung retention class for which values were given for each radionuclide.

1-yr marrow dose for inhalation (rem/Ci inhaled)
The units are rem/Ci inhaled. This parameter describes the one-year committed dose to bone marrow from inhalation of respirable aerosol of the given radionuclide. It is used to calculate early fatalities and early morbidities. The values were taken from Dunning (1983) for the highest lung retention class for which values were given for each radionuclide.

Alphanumeric identifier for ingestion model (not functional)
This identifies the radionuclide for the ingestion-dose calculations. COMIDA-derived dose factors (person-Sv/m^2 and Sv/m^2) are converted to person-rem/m^2 and rem/m^2 and are used to calculate ingestion doses.

3.9.2 Radionuclide Names and Values and the DEFINE option

To analyze a package containing nuclides not found in the internal library, the analyst must employ the DEFINE capability of RADTRAN 5 to add new nuclides to the internal library. The DEFINE capability may also be used to define composite "radionuclides" that are weighted-averages of several radionuclides.

Radionuclide names must be in standardized format to call the proper values for half-life, photon energy, etc. from the internal radionuclide-data library. Analysts always have the option of defining radionuclides; the only restriction on names assigned to user-defined radionuclides is that they may not exceed 10 alphanumeric characters.

3.10 STANDARD Parameters and MODSTD Data

STANDARD values are available for a large number of input variables used in incident-free dose calculations. Although the STANDARD values appear in the menu system under the Main Menu selection "Modstd/Misc" (e.g. Figures 3-6 and 3-7), they are not included in the input file (R5IN.DAT). They are called by RADTRAN with the keyword STANDARD from an input text file called RT5STD.DAT. If the analyst uses the menu system to change any of the STANDARD values, the value input by the analyst is written, with its keyword, under the first-level keyword MODSTD (the STANDARD values do not change). An analyst creating a file without using the menu system should take care to write his or her user-input value, with its keyword, under the keyword MODSTD. Table 2 shows the data in the MODSTD array and gives the associated second-level keywords for workstation users. The analyst may accept none, some, or all of the STANDARD values. The input variables and their values are listed and described in this next section

<u>ADJACENT</u> See DISTON

CAMPAIGN This keyword specifies the duration of the shipping campaign in years. The value calculated with CAMPAIGN is the total number of off-link persons exposed. This result may be used to perform external calculations of annual off-link dose. Annual dose values may be compared with total dose in multi-year shipping campaigns and are useful for assessing regulatory compliance with standards based on annual doses. The STANDARD value is 1.0 year, meaning a period of 365.25 consecutive days.

DDRWEF This keyword applies to rail mode only and specifies the Distance Dependent Rail Worker Exposure Factor. This factor is used to calculate the component of rail-worker dose that depends on distance traveled (e.g., exposure related to engine changes, crew shift-changes, etc., while en route). The STANDARD value of 0.0018 inspections/km is taken from Ostmeyer (1986).

DISTOFF This keyword specifies a set of three distances, in meters, used in off-link dose calculations for highway, rail, and barge modes. The three distances are: (1) the minimum perpendicular distance over which the off-link dose calculation will be integrated; (2) the minimum pedestrian-walkway width, for instances in which dose to pedestrians beside the link is calculated (see RPD for discussion of pedestrian density); and (3) the maximum perpendicular distance over which the off-link dose calculation will be integrated. DISTOFF must be followed one or more keywords that specify values for various link types. The STANDARD values, which are supplied for each link type, are from NUREG-0170 (NRC, 1977). The link types and values for each are:

FREEWAY Any limited-access divided highway. [30, 30, 800]

SECONDARY Any non-limited-access highway that is not a city street (27, 30, 800)

STREET Any city street. [5, 8, 800]

RAIL Any rail right-of-way in the U.S. [30, 30, 800]

WATER Any vessel. [200,200,800]

Note that the values are the same for FREEWAY and RAIL. Setting the first two values equal to each other is equivalent to a sidewalk width of zero and means there are no sidewalks or similar close-in areas where unshielded persons (pedestrians, bicyclists, etc.) may reasonably be expected to be found. For STREET, the sidewalk is modeled as being 3 m wide (Finley et al. 1980). The values for WATER conservatively model a narrow navigable waterway (e.g., Houston Ship Channel) and are taken from NUREG-0170 (NRC, 1977). The WATER values are the ones most likely to require modification by the analyst since other bodies of water that might be modeled have ship-to-shore distances that greatly exceed 200 m and even 800 m.

DISTON This keyword specifies a perpendicular distance (i.e., a distance measured along a line at right angles to the line of travel of the RAM shipment) between the RAM shipment and other traffic lanes, in meters. For three link types, DISTON represents the *average* perpendicular distance between the shipment *centerline* and the *centerline* of oncoming traffic lanes(s). In the passing-vehicle case, DISTON represents the distance between the shipment *centerline* and the *centerline* of adjacent passing vehicles (HIGHWAY mode only). DISTON must be followed by a second keyword that specifies the link type. The STANDARD values in parentheses in the following list are taken from Madsen et al. (1986, p. 36-37).

FREEWAY Any limited-access, divided highway [15.0 m];

SECONDARY Any non-limited access highway [3 m]; STREET Any city street [3 m];

RAIL Any rail right-of-way [3 m].

An additional parameter for highway mode only is ADJACENT It represents the minimum perpendicular distance between shipment centerline and centerline of adjacent passing vehicles [4 m].

The FREEWAY value is based on the Madsen et al. (1986) model of a minimal Interstate configuration of four lanes with an average lane width of 5 m, in the most typical traffic configuration. The latter refers to the RAM shipment being in the outside lane, oncoming traffic in the corresponding outside lane, and passing vehicles in the inner lanes. The SECONDARY and STREET values are smaller because these roadways are modeled as being only 2 lanes wide with an average lane width of 3 m. The RAIL value is based on the minimum clearance between passing trains on double rail segments. The ADJACENT value represents the median value for all Interstate and secondary-road lane widths.

<u>FMINCL</u> This keyword is applied to rail mode only and specifies the minimum number of railcar classifications or inspections per one-way trip. The STANDARD value is 2 since there are always at least two inspections per one-way trip – one at the beginning and one at the end of each trip (Wooden, 1986).

<u>FNOATT</u> This parameter is applied to passenger-air mode only and specifies the Number of Flight Attendants. The STANDARD value is 4 (NRC, 1977).

<u>FREEWAY</u> See DISTOFF and DISTON

<u>MITDDIST</u> This parameter is used to calculate the maximum individual "in-transit" dose to a member of the public; it represents the minimum perpendicular distance, in meters, from the shipment centerline to an individual standing beside the road or railroad while a shipment passes. The STANDARD value is 30.0 m (NRC, 1977).

<u>MITDVEL</u> This parameter is used to calculate the maximum individual "in-transit" dose; it represents the minimum velocity, in km/hr, of a shipment. The STANDARD value is 24.0 km/hr (15 mph) (NRC, 1977).

<u>RAIL</u> See DISTOFF and DISTON

<u>RPD</u> This parameter is the Ratio of Pedestrian Density. It is used to calculate the density of unshielded persons on sidewalks and elsewhere in urban areas when the IUOPT Flag is not equal to 3 by indexing it to the population density of the surrounding area. RPD is also used in the

calculation of accident consequences. The STANDARD is 6.0, which is based on empirical data from New York City (Finley, 1980). It means that the pedestrian density is six times the residential population density. This figure is likely to be conservative for most other urban areas, but similar data are seldom collected in other cities.

RR This parameter specifies the Rural Shielding Factor. The STANDARD value is 1.0 (i.e., no shielding). Although even wood-frame construction provides some shielding, the Rural Shielding Factor is set to 1.0 to conservatively account for the fact that rural economies involve a relatively large fraction of outdoor employment (farming, ranching, etc.). RR is used in incident-free dose and in dose-risk calculation for non-dispersal accidents.

RS This parameter specifies the Suburban Shielding Factor. The STANDARD value is 0.87, which represents a residential structure of wood-frame construction (Taylor and Daniel, 1982, p.12). RS is used in incident-free dose and in dose-risk calculations for non-dispersal accidents.

RU This parameter specifies the Urban Shielding Factor. The STANDARD value is 0.018, which represents an urban commercial building constructed of concrete block (Taylor and Daniel, 1982, p.12). RU is used in incident-free dose and in dose-risk calculations for non-dispersal accidents.

SECONDARY See DISTOFF and DISTON

SMALLPKG This parameter specifies the first Package Size Threshold. This parameter is used to determine the handling method that will be used for a package, which, in turn, is used in the calculation of handler dose. If a package is designated as "small" then an empirical algorithm for handling dose is used; if package dimensions exceed the threshold then another method is used. The STANDARD value for SMALLPKG is 0.5 m (Javitz, 1985). Although it is highly unlikely that this value will need to be altered, the analyst has the option to do so.

STREET See DISTOFF and DISTON

3.11 Data for Accident Risk Calculation by Mode and Material Type

3.11.1 STANDARD Values for Accident Risk Analysis

The most important arrays in accident-risk calculation do not have STANDARD values. They are:

- accident-severity fractions (keyword SEVERITY),
- shielding degradation fractions (keyword LOS)
- release fractions (second-level keyword RFRAC under keyword RELEASE),

Box 3-8	Population-Density Zones
Rural (NPOP=1)	Mean = 6 persons/km^2 (Range = 0 to 66 persons/km^2)
Suburban (NPOP=2)	Mean = 719 persons/km^2 (Range = 67 to 1670 persons/km^2)
Urban (NPOP=3)	Mean = 3861 persons/km^2 (Range > 1670 persons/km^2)

- aerosol fractions (second-level keyword AERSOL under keyword RELEASE), and

- respirable fractions (second-level keyword RESP under keyword RELEASE).

The package- and problem-specific nature of these parameters makes it impossible to develop values for them *a priori*. Severity-related parameters may be defined for up to three population-density zones (second-level keyword NPOP under keyword SEVERITY). NPOP has three values: NPOP =1 indicates rural; NPOP =2 indicates suburban; and NPOP=3 indicates urban. The mean and range for each population-density zone (see Box 3-8) are taken from the demographic model in NUREG-0170 (NRC, 1977).

3.11.2 Atmospheric Dispersion Parameters

STANDARD values are available for both atmospheric dispersion options. The analyst may select one of two alternative analytical models with the Pasquill flag under the keyword PARM. If the Pasquill flag is set to 1, then six sets of tabular data (area, downwind distance, and time-integrated concentration) for Pasquill atmospheric-stability categories A through F are called up. The values in the tables are for a conservative instantaneous release—a small-diameter (10 m), ground-level "puff"—and are derived from Gaussian dispersion calculations in Turner (1969). These values are fixed and may not be changed, but there are no pre-assigned values for the probabilities of occurrence, which must be assigned by the analyst.

If the Pasquill flag is set to 2 (or any integer other than 1), then a table of user-definable areas and time-integrated concentrations is called up. National-average values are supplied as STANDARD values (Table 3-1). Like the six Pasquill category tables, this option represents a conservative, idealized, small-diameter, ground-level dispersion pattern (no thermal buoyancy) and is also derived from Turner (1969). The innermost isopleth covers only about 460 m^2 (a little under 5000 ft^2) and has a maximum downwind extent of about 33 m (108 ft); the outermost isopleth covers 1.35 billion m^2 (about 521 sq. mi.) and has a maximum downwind extent of about 120 km (about 75 mi.). Since only one set of dispersion values is applied to the analysis in this option, probability of occurrence is not specified by the analyst.

3.11.3 Other Accident Parameters with STANDARD Values

Other accident-related parameters for which STANDARD values are available are listed in this section. Some of the values entered for these parameters are applied to all route segments in an analysis. Other parameters used in accident-risk calculations vary by route segment and can have no STANDARD value; they are discussed separately.

BDF This is the Building Dose Factor. This factor describes the entrainment of aerosol particles in ventilation systems (i.e., the fraction of particles of an external aerosol that remain in aerosol form after passing through a ventilation system). The BDF is used to modify inhalation doses to persons in urban structures. The STANDARD value of 0.05 represents a conservative average across a series of building types, including residential, office, and industrial structures (Engelmann, 1990). This value is about five times higher than the value for high-rise buildings with air-conditioning systems used by Finley et al., (1980) for New York City, which has been used in RADTRAN in the past.

BRATE This factor represents breathing rate and is used for calculation of inhalation doses. The breathing rate (BRATE = 3.30E-04 m^3/sec) of the Reference Man (70-kg adult male at light work) derived from Shleien 1992; Table 12.6) has been used as the STANDARD value. The value in the cited table has been converted from liters per hour to m^3/sec.

CULVL This factor describes Clean-Up Level, which is the required level to which contaminated surfaces must be cleaned up. The STANDARD value is the EPA guideline of 0.2 $\mu Ci/m^2$ (EPA, 1977). This value applies to the sum of deposited activity over all radionuclides of a multi-radionuclide material. Although never officially adopted by the EPA or superseded by another standard, this value has become a *de facto* standard (Chanin and Murfin, 1996). This is a controversial issue at present, and analysts who can justify use of more realistic values are urged to do so.

EVACUATION This parameter specifies evacuation time in days following a dispersal accident, where this includes time to respond to the accident and carry out a course of action. The STANDARD value is 24 h (one day). Mills et al. (1995) analyzed 66 verified hazmat accidents in which evacuations were carried out and found that the mean evacuation time was approximately one hour. Even when response time is added, a 24-hour (one-day) value for this variable is conservative. [For non-dispersal accident evacuation, see TIMENDE.]

GECON This parameter specifies the Genetic Effects Conversion Factor. The STANDARD value is 1.0E-04 genetic effects/rem. This value is consistent with the recommendations of BEIR V (NRC/NAS, 1990) and ICRP 60 (ICRP, 1991). Estimates based on the only genetic effects (untoward pregnancy outcome and F_1 mortality) to have been documented in the atomic-bomb survivors have extremely high statistical and model uncertainties. Animal data, which is more reliable, consistently yield lower estimates. As noted in BEIR V, the recommended value is "probably…too high rather than too low" (NRC/NAS, 1990, p. 77).

INTERDICT This parameter specifies the threshold value for interdiction of contaminated land. The STANDARD value is 40, i.e., a value 40 times greater than CULVL, and it was taken from NUREG-0170 (NRC, 1977).

Table 3-1. STANDARD Isopleths and Time-Integrated Concentrations ($Ci\text{-}sec/m^3/Ci$ released)

Isopleth Area (m^2)	Downwind Centerline Distance (m)	Time-Integrated Concentration
4.590E+02	3.345E+01	3.420E-03
1.530E+03	6.804E+01	1.720E-03
3.940E+03	1.051E+02	8.580E-04
1.250E+04	2.439E+02	3.420E-04
3.040E+04	3.694E+02	1.720E-04
6.850E+04	5.614E+02	8.580E-05
1.760E+05	1.018E+03	3.420E-05
4.450E+05	1.628E+03	1.720E-05
8.590E+05	2.308E+03	8.580E-06
2.550E+06	4.269E+03	3.420E-06
4.450E+06	5.468E+03	1.720E-06
1.030E+07	1.114E+04	8.580E-07
2.160E+07	1.310E+04	3.420E-07
5.520E+07	2.133E+04	1.720E-07
1.770E+08	4.050E+03	8.580E-08
4.890E+08	6.999E+04	5.420E-08
8.120E+08	8.986E+04	4.300E-08
1.350E+09	1.209E+05	3.420E-08

LCFCON This parameter specifies the Latent Cancer Fatality (LCF) Conversion Factors; units are LCFs per rem. The STANDARD values are 5.0E-04 LCF/rem for the general public and 4.0E-04 LCF/rem for workers. They have been adjusted for low-dose and low-dose-rate decrease in effects with a DDRRF (Dose and Dose Rate Reduction Factor) of 2. These values are consistent with the recommendations of BEIR V (NRC/NAS, 1990) and ICRP 60 (ICRP, 1991). The dose-response relationship is assumed to be linear with no threshold in order to agree with current regulations. However, the majority of available data indicate that the actual dose-response relationship at very low doses is likely to be considerably less and, as noted in BEIR V, is not incompatible with zero (NRC/NAS, 1990, p. 181). Thus, cancer risk estimates obtained from RADTRAN 5 will be generally conservative.

LOS The parameter is used to analyze loss-of-shielding accidents. It represents the fractional degradation of package shielding for each severity category in the analysis. Values may be any number between zero and 1.0.

<u>NE</u> This parameter is the neutron emission factor; it may be used to model neutron emissions following a loss-of-shielding accident. For commonly encountered radionuclides that spontaneously emit neutrons (curium-242, curium-244, and californium-242), the NE values are already available in the radionuclide library. All other radionuclides have no assigned NE factor. The NE keyword is applied only when the analyst wishes to assign a new value to an existing radionuclide or to a new material. The analyst must enter NE followed by the radionuclide name in standard format (or exactly as entered under keyword DEFINE) and the emission factor value in neutrons/s-Ci. The analyst must repeat the process (i.e., type NE followed by radionuclide name and NE factor value) for each radionuclide desired.

<u>RADIST</u> This parameter is used to specify an array of Radial Distances, which are used to define annular areas for dose-calculation purposes when the IACC Flag is set to 1.

<u>RPCTHYROID</u> This parameter is used to specify one-year CEDE (rem per curie) to the thyroid from inhalation of radionuclides of iodine for estimation of early-mortality risk. Radioiodine mainly travels to and irradiates a single organ, the thyroid. In previous releases of RADTRAN, however, the 50-year CEDE was used to approximate the one-year dose. One-year committed doses to the thyroid have been calculated directly for RADTRAN 5. This new parameter was not included in the internal radionuclide database, since it would have meant adding a new column containing zeros for all radionuclides but the radioiodines. The information has been included under the PRCTHYROID keyword instead. The STANDARD values are 1.27E+06 for iodine-131, 5.77E+06 for iodine-129, and 9.25E+05 for iodine-125.

<u>SURVEY</u> This parameter is used to specify the time (in days) required to survey contaminated land following a dispersal accident. The amount of deposited material removed by radioactive decay is calculated beginning with time of initial deposition. The longer a deposited material remains on the ground, the more is removed by decay and spread by forces such as wind and rain. The actual elapsed time between accident occurrence and completion of a survey is impossible to determine in advance, but is likely to be prolonged because of governmental and regulatory complexities. The STANDARD value is set to an unrealistically brief, but radiologically conservative, 10 days (NRC, 1977).

<u>TIMENDE</u> This parameter specifies the time, in days, required to effect evacuation following a non-dispersal accident. Three values are entered, one for each population-density zone (rural, suburban, and urban, in that order). TIMENDE represents the time required to move potentially exposed members of the public to safe distances beyond the areas specified by the RADIST keyword. The three STANDARD values are 0.67, 0.67, and 0.42 hours (Mills et al., 1995) [for dispersal accident evacuation, see EVACUATION]

<u>UBF</u> This parameter is the Urban Building Fraction; it describes either the fraction of the population that is indoors or the fraction of the area that is occupied by buildings, depending on the type of population model being used. The STANDARD value of 0.52 is for the latter model, and is taken from Finley et al. (1980). The value is most accurate for large cities such as New York and is somewhat conservative for smaller cities.

USWF This parameter is the Urban Sidewalk Fraction; it specifies the fraction of the population that is out of doors or the fraction of the population that occupies sidewalks, depending on the type of population model being used. The STANDARD pre-assigned value of 0.1 is for the latter model, and is taken from Finley et al. (1980). As with the UBF, this value is suitable for large cities and is conservative for smaller cities.

3.11.4 MASTER LIST OF RADTRAN 5 KEYWORDS

FIRST LEVEL	SECOND LEVEL	THIRD LEVEL	DESCRIPTION
TITLE	---	----	User-defined alphanumeric title; preferably descriptive
INPUT	STANDARD or ZERO	----	Analyst elects whether to use standard input values or not
DIMEN	---	----	Enter three (3) values: NSEV, NRADIAL, NISOPLETH
PARM	---	----	Sets four (4) flags
FORM	UNIT or NONUNIT	----	Analyst selects output format: dose (UNIT) or health effects (NONUNIT)
INGFILE	---	----	For ingestion dose; Enter COMIDA output filename if other than default
LOS	---	----	Enter shielding degradation fraction for each severity category
SEVERITY	NPOP	NMODE	Enter probabilities for NSEV severity categories for NPOP =1, 2, and 3 and for each Mode
RELEASE	GROUP	RFRAC	Release fraction for Group p
	---	AERSOL	Aerosol fraction for Group p
	---	RESP	Respirable fraction for Group p
	---	DEPVEL	Deposition velocity. for Group p
	CLINE	----	Centerline downwind distance (m)
	AREADA	----	Isopleth area (m^2) for n areas
	DFLEV	----	Time-integrated concentrations for n areas (Ci-sec/m^2)
	PSPROB	----	Pasquill probabilities (6 values)
	ISOPLETHP	----	Populations of NISOPLETH isopleths; see DIMEN)
DEFINE	---	----	Radionuclide name followed by 10 values
NONRAD	HIGHWAY GENERAL DEDICATED	NPOP NPOP NPOP	Highway fatality rates (km^{-1}) General rail fatality (km^{-1}) Dedicated rail fatality rates (km^{-1})
TRANSFER	GAMMA NEUTRON	----	Coefficients for gamma radiation Coefficients for neutron radiation
PACKAGE	[END]	-----	Enter 5-variable array for each package

FIRST LEVEL	SECOND LEVEL	THIRD LEVEL	DESCRIPTION
			type followed by radionuclide contents followed by END
VEHICLE	----	----	Enter 11-variable array for each vehicle type followed by the package(s) on the vehicle
MODSTD	SMALLPKG	----	Size of smallest package for nondispersal analysis
	TIMENDE	----	Evacuation time (3-number array), non-dispersal
	UBF	----	Urban Building Fraction
	USWF	----	Urban Sidewalk Fraction
	EVACUATION	----	Evacuation time (days)
	SURVEY	----	Survey interval (days)
	INTERDICT	----	Interdiction threshold
	DISTOFF	FREEWAY	Enter 3-variable array
	---	SECONDARY	Enter 3-variable array
	---	STREET	Enter 3-variable array
	---	RAIL	Enter 3-variable array
	---	WATER	Enter 3-variable array
	DISTON	FREEWAY	Minimum perpendicular distance to vehicle traveling opposite direction (m)
	---	SECONDARY	Minimum perpendicular distance to vehicle traveling opposite direction (m)
	---	STREET	Minimum perpendicular distance
	---	RAIL	Minimum perpendicular distance (m)
	---	WATER	Minimum perpendicular distance to vehicle Traveling opposite direction (m)
	MITDDIST	----	Distance for Maximum In-Transit Dose (m)
	MITDVEL	----	Speed for Maximum In-Transit Dose (m/s)
	CAMPAIGN	----	Campaign duration (years)
	DDRWEF	----	Distance-dependent rail worker exposure factor (inspections/km)
	RADIST	NPOP	Enter NRADIAL distances (see DIMEN) for loss-of-shielding exposure in NPOP = 1, 2, and 3
	BDF	----	Building Dose Factor
	CULVL	----	Clean-up Level (uCi/m^2)
	BRATE	----	Breathing Rate (m^3/s)
	FMINCL	----	Minimum no. of rail classifications and/or inspections
	RPD	----	Ratio of Pedestrian Density
	RR	----	Rural shielding factor

FIRST LEVEL	SECOND LEVEL	THIRD LEVEL	DESCRIPTION
	RS	----	Suburban shielding factor
	RU	----	Urban shielding factor
	FNOATT	----	Number of flight attendants
	NE	----	(radionuclide name) neutron emission factor (neutrons/sec/Ci)
	RPCTHYROID	----	1-yr dose to thyroid via inhalation (rem per curie)
	LCFCON	----	Latent cancer fatalities conversion factors (2-number array)
	GECON	----	Genetic effects conversion factor
FLAGS	ITRAIN	---	1=General freight; 2=Dedicated Rail
	IUOPT	----	Shielding Options
	IACC	----	1=nondispersal; 2=dispersal
	REGCHECK	----	1=regulatory checks performed 2=regulatory checks not performed
EOF			"End of File" special keyword
LINK	---	----	Enter 11-variable array for each link (route segment)
STOP	---	----	Enter 7-variable array for each stop
HANDLING	---	----	Enter 5-variable array for each handling
EOF			"End of File" special keyword
EOI			"End of Input" special keyword; terminates input

4. RADTRAN 5 OUTPUT

The RADTRAN 5 output consists of several types of results and tables. Output may be requested in short or long formats. The short or summary format is the first type. It consists of the Input Echo and summary tables of output. Full-length output consists of the Input Echo, all of the input data in tabular form, and detailed tables of output values as well as the summary tables.

4.1 The Input Echo

The first part of the output for any RADTRAN 5 run is the Input Echo, which is a repeat or "echo" of the input file. The echo shows the following:

- All STANDARD parameters with either the STANDARD values (analyst entered STANDARD after keyword INPUT) or with all values set to zero (analyst entered ZERO after keyword INPUT);
- User-defined values of parameters without STANDARD values;
- User-defined values of those parameters with STANDARD values which the analyst altered (following the keyword MODSTD); and
- All comment lines (lines beginning with &&).

The echo preserves all parameter values in an input file and, thus, is useful for quality-assurance purposes. The Input Echo is always part of the output file. Any RADTRAN 5 output lacking Input Echo pages should be considered potentially corrupt, incomplete and unsuitable for either publication or quality assurance.

The example in Figures 4A-4D illustrates how an input file for a complex material (in this example, spent nuclear fuel) might be constructed. A single input file has been divided into four functional parts to illustrate the roles of the disparate types of data that must be entered. The data in Figures 4A-4D are based an actual input file, but are used here for illustrative purposes only. The top of Figure 4A shows comment lines and the TITLE, INPUT, FORM, DIMEN, and PARM initialization lines. Then, beginning in Figure 4A and continuing in 4B are input for the accident-severity categories. Release, aerosol, and respirable fractions are defined for each physical-chemical group. In this example, five distinct physical-chemical groups have been defined (CRUD, GAS, VOLATILE, CE_EU, and RUTHENIUM). The use of the DEFINE function also is illustrated in Figure 4B with a cobalt radioisotope. Figure 4C shows how MODSTD parameters are assigned when the analyst does not wish to accept the STANDARD values. Settings under the keywords FLAGS and PACKAGE are also illustrated in this figure. Fifteen radionuclides and their properties are listed under the material SPENT FUEL, the only material in the package being analyzed. Finally, the package is assigned to a vehicle (TRUCK

```
&& Edited Fri Feb 21 11:07:45 1997
&& This file has been altered
&& The data contained in this input file are for test purposes only.
          TITLE EXAMPLE FILE
INPUT STANDARD
FORM UNIT
DIMEN 6 10 18
PARM 1 3 4 0
SEVERITY
 NPOP=1
  NMODE=1
 6.03E-001 3.94E-001 3.00E-003 3.00E-006 5.00E-006 7.00E-006
  NMODE=2
 6.23E-001 3.74E-001 3.00E-003 3.00E-006 5.00E-006 7.00E-006
 NPOP=2
  NMODE=1
 6.02E-001 3.94E-001 4.00E-003 4.00E-006 3.00E-006 2.00E-006
  NMODE=2
 6.22E-001 3.74E-001 4.00E-003 4.00E-006 3.00E-006 2.00E-006
 NPOP=3
  NMODE=1
 6.04E-001 3.95E-001 3.80E-004 3.80E-007 2.50E-007 1.30E-007
  NMODE=2
 6.24E-001 3.75E-001 3.80E-004 3.80E-007 2.50E-007 1.30E-007
RELEASE
 GROUP=CRUD
  RFRAC
0.00E+000 0.00E+000 1.20E-002 1.20E-002 1.20E-002 1.20E-002
  AERSOL
       0.00E+000 0.00E+000 1.00E+000 1.00E+000 1.00E+000 1.00E+000
  RESP
   0.00E+000 0.00E+000 5.00E-002 5.00E-002 5.00E-002 5.00E-002
  DEPVEL 0.0100
 GROUP=GAS
  RFRAC
   0.00E+000 0.00E+000 0.00E+000 1.00E-002 1.00E-001 1.10E-001
  AERSOL
   0.00E+000 0.00E+000 0.00E+000 1.00E+000 1.00E+000 1.00E+000
  RESP
   0.00E+000 0.00E+000 0.00E+000 1.00E+000 1.00E+000 1.00E+000
  DEPVEL 0.0000
```

Figure 4a. RADTRAN 5 Input Echo-Initialization and Accident Severities

```
GROUP=VOLATILE
    RFRAC
     0.00E+000 0.00E+000 0.00E+000 1.00E-008 2.00E-004 2.80E-004
AERSOL
     0.00E+000 0.00E+000 0.00E+000 1.00E+000 1.00E+000 1.00E+000
    RESP
0.00E+000 0.00E+000 0.00E+000 5.00E-002 1.00E+000 1.00E+000
    DEPVEL  0.0100
  GROUP=CE_EU
RFRAC
     0.00E+000 0.00E+000 0.00E+000 1.00E-008 5.00E-008 5.00E-008
AERSOL
     0.00E+000 0.00E+000 0.00E+000 1.00E+000 1.00E+000 1.00E+000
    RESP
     0.00E+000 0.00E+000 0.00E+000 5.00E-002 1.00E+000 1.00E+000
    DEPVEL  0.0100
  GROUP=ACTINIDE
    RFRAC
     0.00E+000 0.00E+000 0.00E+000 1.00E-008 5.00E-008 5.00E-008
    AERSOL
     0.00E+000 0.00E+000 0.00E+000 1.00E+000 1.00E+000 1.00E+000
    RESP
     0.00E+000 0.00E+000 0.00E+000 5.00E-002 5.00E-002 5.00E-002
    DEPVEL  0.0100
GROUP=RUTHENIUM
    RFRAC
     0.00E+000 0.00E+000 0.00E+000 1.00E-008 1.00E-006 4.20E-005
    AERSOL
     0.00E+000 0.00E+000 0.00E+000 1.00E+000 1.00E+000 1.00E+000
    RESP
     0.00E+000 0.00E+000 0.00E+000 5.00E-002 5.00E-002 5.00E-002
    DEPVEL  0.0100

DEFINE CO60
     1.93E+003 2.50E+000 4.60E-001 7.60E-004 3.50E+005 2.50E+004
     2.00E+000 0.00E+000 0.00E+000
```

Figure 4b. RADTRAN 5 Input Echo-Accident Severities (cont'd) and DEFINE

```
MODSTD
 UBF 6.000E-001
 USWF 5.000E-002
 MITDDIST 3.000E+001
 MITDVEL 2.400E+001
 DISTON FREEWAY  1.200E+001
 TIMENDE 1.000E+000 1.000E+000 2.500E-001
 CULVL 2.200E-002
 INTERDICT 4.000E+001
FLAGS
 REGCHECK 1
 IUOPT 2
 IACC 2
PACKAGE SPENTFUEL 1.368E+001 1.000 0.000   5.20
     CO60     9.220E+001 CRUD
     KR85     6.100E+003 GAS
     SR90     5.960E+004 ACTINIDE
     RU106    1.620E+004 RUTHENIUM
     CS134    2.740E+004 VOLATILE
     CS137    8.760E+004 VOLATILE
     CE144    1.220E+004 CE_EU
     EU154    7.000E+003 CE_EU
     PU238    2.960E+003 ACTINIDE
     PU239    4.100E+002 ACTINIDE
     PU240    4.680E+002 ACTINIDE
     PU241    1.260E+005 ACTINIDE
     AM241    1.290E+003 ACTINIDE
     AM243    1.990E+001 ACTINIDE
     CM244    1.790E+003 ACTINIDE
     END
VEHICLE  1  TRUCK    1.368E+001 1.000 0.000   5.20   1.00
               2.00  10.00 1.000   5.20
     SPENTFUEL    1.00
EOF
```

Figure 4c. RADTRAN 5 Input Echo-MODSTD; Flags; Package; Vehicle

```
LINK 1 RURAL  TRUCK  2915.34 88.6 2.0  6.00 470.00 1.37E-007 R 1
LINK 2 RURAL  TRUCK  971.78 88.6 2.0  6.00 470.00 1.37E-007 R 2
LINK 3 SUBURB TRUCK 623.03 88.6 2.0 719.00 780.00 3.00E-006 S 1
LINK 4 SUBURB TRUCK 207.68 40.3 2.0 719.00 780.00 3.00E-006 S 2
LINK 5 SUBURB TRUCK  69.22 44.3 2.0 719.00 1560.00 3.00E-006 S 1
LINK 6 SUBURB TRUCK  23.07 20.2 2.0 719.00 1560.00 3.00E-006 S 2
LINK 7 URBAN TRUCK  6.18 88.6 2.0 3861.00 2800.00 1.60E-005 U 1
LINK 8 URBAN TRUCK  0.33 24.1 2.0 3861.00 2800.00 1.60E-005 U 2
STOP STOP_TRUCK TRUCK  50.00 20.00  20.00 1.000 52.990
HANDLING LOAD    TRUCK   3.00   1.00  0.25
EOF
EOI
```

Figure 4d. RADTRAN 5 Input Echo-Route-Specific Data

under keyword VEHICLE). Figure 4D shows how route-specific features (links, stops, and handlings) are described. This sample file shows several features of RADTRAN 5, such as:

- separation of radionuclides in the material (listed under keyword PACKAGE) into more than one physical-chemical group (listed under keyword GROUP) and
- how data entered for route segments (keyword LINK), stops (keyword STOP), and handlings (keyword HANDLING) should appear.

4.2 Consequences of Incident-Free Transportation

After the input data summary tables, actual RADTRAN 5 calculational output begins with the heading "INCIDENT-FREE SUMMARY." The first table of output is titled "In-Transit Population Exposure in Person-Rem" (Box 4-1). Doses to passengers, crew, members of the public residing near the link (off-link) and sharing the link (on-link) for each route segment (link) are given in this table, as are subtotals for rural, suburban, and urban segments, and totals according to segment type and exposure group.

Box 4-1

INCIDENT-FREE SUMMARY

******** **** *******

IN-TRANSIT POPULATION EXPOSURE IN PERSON-REM

	PASSENGER	CREW	OFF LINK	ON LINK	TOTALS
RURAL1	0.00E+00	6.84E+01	4.02E-01	1.82E+01	8.69E+01
RURAL2	0.00E+00	2.28E+01	1.60E-01	1.50E+01	3.79E+01
SUBURB1	0.00E+00	1.46E+01	8.96E+00	6.44E+00	3.00E+01
SUBURB2	0.00E+00	1.07E+01	8.02E+00	2.62E+01	4.49E+01
SUBURB3	0.00E+00	3.25E+00	1.99E+00	5.94E+00	1.12E+01
SUBURB4	0.00E+00	2.37E+00	1.78E+00	2.39E+01	2.80E+01
URBAN1	0.00E+00	1.45E-01	9.87E-03	2.29E-01	3.84E-01
URBAN2	0.00E+00	2.85E-02	9.52E-02	4.27E-01	5.50E-01
URBAN3	0.00E+00	3.24E-02	2.20E-03	2.13E-01	2.47E-01
URBAN4	0.00E+00	6.87E-03	2.30E-02	4.32E-01	4.62E-01
RURAL	0.00E+00	9.12E+01	5.62E-01	3.31E+01	1.25E+02
SUBURB	0.00E+00	3.09E+01	2.07E+01	6.24E+01	1.14E+02
URBAN	0.00E+00	2.13E-01	1.30E-01	1.30E+00	1.64E+00
TOTALS:	0.00E+00	1.22E+02	2.14E+01	9.69E+01	2.41E+02

Doses incurred at stops and during handling are tabulated separately. The stop example shown in Box 4-2 is for a shipment of PWR spent fuel. The words "POINT-SOURCE DOSE" indicate that a point-source model was used to perform the calculation. The point-source model is selected when the analyst places receptors at radial distances from the shipment greater than two characteristic package dimensions. Box 4-3 shows a similar calculation for handling (e.g. loading of a spent fuel cask onto a truck by a crane). A line-source model is used in the latter case because of the handlers' proximity to the cask.

Incident-free doses are consequences. If the transportation event being analyzed actually takes place, then these types of doses will be incurred. In RADTRAN 5, the probability term is 1.0, although it is actually equal to 1.0 minus the very small probability of an accident. The analyst may request that dose output be multiplied by what are often called "stochastic risk factors" to

Box 4-2 SAMPLE OUTPUT TABLE FOR STOP DOSE: 1 STOP BY TRUCK

STOP EXPOSURE IN PERSON-REM

POINT-SOURCE DOSE STOP_TRUCK 9.6E-01

Box 4-3 SAMPLE OUTPUT TABLE FOR HANDLING DOSE: LOADING

HANDLING EXPOSURE IN PERSON-REM

HANDLING	VEHICLE	MATERIAL	DOSE
LOAD	TRUCK	SPENTFUEL	2.32E-01

TOTAL: 2.32E-01

estimate potential health effects (NONUNIT after keyword FORM). The resultant estimates of potential health effects are *risk estimates*, because a "stochastic risk factor" is itself a probability term. It means that, for a large population receiving a given collective dose, there will be, on the average, some number of excess health effects observed as a result of the exposure. The results of accident dose-risk calculations, which are discussed in the next section, are true risks. That is, each dose consequence term has been multiplied by a probability of occurrence. Dose risks can also be converted into health risks; doing so entails an additional multiplication by an additional probability (the risk factor). Health-effects risk estimates are secondary or derivative values and should not be reported alone without the associated dose-risk values.

4.3 Importance Analysis

An importance analysis is performed for incident-free doses on a link-by-link basis. The importance analysis describes the change in the output resulting from a 1% change in an input variable. All input variables that affect the incident-free dose calculation are listed in descending order from the largest positive change to the largest negative change. The actual value of the change in the output and the percentage change are listed in the output table (Box 4-4). This analysis will not yield accurate results if the package has a large neutron component because the method used to determined dose versus distance for neutron radiation is not amenable to the partial-derivative approach used to generate the importance analysis. However, for all applications where packages are modeled as emitting 100% gamma radiation, the importance analysis is reliable.

4.4 Population Risks and Consequences from Accidents

The primary accident-related output of RADTRAN 5 depends on whether UNIT or NONUNIT was entered under keyword FORM (see Chapter 3). If UNIT was selected, then the output consists of tables of dose risks and doses (primary consequences). A sample consequence calculation for spent fuel shipment by truck is shown in Box 4-5. The results are broken down by accident severity (rows) and by route segment (columns). When large numbers of route

Box 4-4 Example of Importance Analysis Output for a Single Link

INCIDENT-FREE IMPORTANCE ANALYSIS SUMMARY
ESTIMATES THE PERSON-REM INFLUENCE OF A ONE PERCENT INCREASE IN THE PARAMETER

LINK	PARAMETER	IMPORTANCE	CHANGE
SEG1			
	DOSE RATE FOR VEHICLE (TI)	8.693E-01	10.0000 %
	NUMBER OF SHIPMENTS	8.693E-01	10.0000 %
	DISTANCE TRAVELED	8.693E-01	10.0000 %
	NUMBER OF CREW MEMBERS	6.837E-01	7.8657 %
	K ZERO FOR CREW DOSE	6.837E-01	7.8657 %
	CREW DOSE ADJUSTMENT FACTOR	6.837E-01	7.8657 %
	K ZERO FOR VEHICLE	1.855E-01	2.1343 %
	NUMBER OF PEOPLE PER VEHICLE	1.815E-01	2.0881 %
	TRAFFIC COUNT	1.815E-01	2.0881 %
	SHIELDING FACTOR (RR,RS,RU)	4.020E-03	0.0462 %
	POPULATION DENSITY	4.020E-03	0.0462 %
	NUMBER OF FLIGHT ATTENDANTS	0.000E+00	0.0000 %
	RATIO OF PEDESTRIAN DENSITY (RPD)	0.000E+00	0.0000 %
	DIST DEP RAIL WORKR EXPOSR FACTR	0.000E+00	0.0000 %
	VELOCITY	-1.051E+00	-12.0881 %
	DISTANCE FROM SOURCE TO CREW	-1.367E+00	-15.7314 %

BOX 4-5 ACCIDENT CONSEQUENCES TABLE IN OUTPUT - EXAMPLE

RADIOLOGICAL CONSEQUENCES
50-YEAR POPULATION DOSE IN PERSON-REM

CATEGORY	SEG1	SEG2	SEG3	SEG4	SEG5	SEG6
1	000E+00	000E+00	000E+00	000E+00	000E+00	000E+00
2	000E+00	000E+00	000E+00	000E+00	000E+00	000E+00
3	2.53E+00	2.53E+00	3.03E+02	3.03E+02	4.97E+02	4.97E+02
4	2.53E+00	2.53E+00	3.03E+02	3.03E+02	4.97E+02	4.97E+02
5	2.69E+01	2.69E+01	3.23E+03	3.23E+03	5.29+03	5.29E+03
6	3.57E+01	3.57E+01	4.28E+03	4.28E+03	7.02E+03	7.02E+03

BOX 4-6 INGESTION CONSEQUENCES TABLE IN OUTPUT
(CALCULATED FOR RURAL LINKS ONLY)

RADIOLOGICAL CONSEQUENCES IN PERSON-REM
50 YEAR SOCIETAL INGESTION DOSE - EFFECTIVE

LINK	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
SEG1	0.00E+00	0.00E+00	1.72E+00	1.75E+00	3.01E+02	4.07E+02
SEG2	0.00E+00	0.00E+00	1.72E+00	1.75E+00	3.01E+02	4.07E+02

BOX 4-7 EXPECTED VALUES OF POPULATION RISK IN PERSON-REM

(By link, for groundshine, inhalation, resuspension, and cloudshine exposure pathways; ingestion calculated separately)

LINK	GROUND	INHALED	RESUSPD	CLOUDSH	TOTAL
SEG1	2.14E-03	2.61E-06	1.01E-05	1.75E-07	2.16E-03
SEG2	7.15E-04	8.71E-07	3.35E-06	5.83E-08	7.19E-04
SEG3	1.55E+00	1.71E-03	6.55E-03	1.29E-04	1.56E+00
SEG4	5.16E-01	5.69E-04	2.18E-03	4.29E-05	5.19E-01
SEG5	1.27E-02	1.39E-05	5.32E-05	1.06E-06	1.28E-02
SEG6	6.79E-04	7.41E-07	2.84E-06	5.65E-08	6.83E-04
RURAL	2.86E-03	3.48E-06	1.34E-05	2.33E-07	2.88E-03
SUBURB	2.30E+00	2.53E-03	9.70E-03	1.91E-04	2.31E+00
URBAN	1.49E-02	1.63E-05	6.24E-05	1.24E-06	1.50E-02
TOTALS:	2.31E+00	2.55E-03	9.78E-03	1.92E-04	2.33E+00

BOX 4-8 SOCIETAL DOSE RISK FOR INGESTION

(PERSON-REM)

LINK	GONADS	EFFECTIVE
SEG1	2.82E-03	2.57E-03
SEG2	9.40E-04	8.57E-04
TOTAL	3.76E-03	3.43E-03

SOCIETAL INGESTION RISK BY ORGAN - PERSON-REM

LINK	BREAST	LUNGS	RED MARROW	BONE SURF.	THYROID	REMAIN-DER
SEG1	1.62E-03	1.53E-03	1.80E-03	1.55E-03	1.48E-03	3.78E-03
SEG2	5.39E-04	5.10E-04	6.01E-04	5.17E-04	4.93E-04	1.26E-03
TOTAL	2.16E-03	2.04E-03	2.40E-03	2.07E-03	1.97E-03	5.04E-03

segments are analyzed in a single run, this part of the output can be many pages long. Because ingestion doses are societal (i.e., affect the general population rather than only the population under the plume footprint), they are calculated and tabulated separately (Box 4-6). Population dose-risks for all pathways except ingestion are given in the output table shown in Box 4-7 for the same sample file. Dose-risks are given for each route segment, broken down by exposure pathway. Non-ingestion consequence and risk results are summed by population-density category to give summations for the total rural, suburban, and urban links traversed by the shipments under analysis. Ingestion dose-risks can only be incurred if a dispersion accident takes place in an agricultural (rural) area and if no interdiction or other preventive measures are taken. For convenience, ingestion doses are assigned to rural route segments, although persons everywhere are potentially affected (Box 4-8). This should not be forgotten when the analyst is assessing dose-risks for the other areas. Ideally, the ingestion dose-risk should be distributed among all population groups on the basis of population weighting or other apportionment methods.

If NONUNIT was selected under keyword FORM, then the output consists of tables of projected health-effects (secondary consequences). An example is shown in Box 4-9.

Box 4-9 HEALTH EFFECTS OUTPUT - EXAMPLE

EXPECTED VALUES OF POPULATION RISK IN LATENT CANCER FATALITIES

	GROUND	INHALED	RESUSPD	CLOUDSH	TOTAL
Link 1	1.06E-06	1.09E-09	4.21E-09	8.86E-11	1.07E-06
Link 2	3.53E-07	3.63E-10	1.40E-09	2.95E-11	3.55E-07
Link 3	7.66E-04	6.93E-07	2.66E-06	6.52E-08	7.69E-04
Link 4	2.55E-04	2.31E-07	8.87E-07	2.17E-08	2.56E-04
Link 5	8.51E-05	7.70E-08	2.96E-07	7.24E-09	8.54E-05
Link 6	2.83E-05	2.57E-08	9.85E-08	2.41E-09	2.85E-05
Link 7	1.29E-05	1.15E-08	4.42E-08	1.10E-09	1.29E-05
Link 8	6.78E-07	6.06E-10	2.33E-09	5.79E-11	6.81E-07
Link 9	1.43E-06	1.28E-09	4.91E-09	1.22E-10	1.44E-06
Link 10	7.54E-08	6.73E-11	2.58E-10	6.43E-12	7.57E-08
RURAL	1.41E-06	1.45E-09	5.61E-09	1.18E-10	1.42E-06
SUBURB	1.13E-03	1.03E-06	3.94E-06	9.66E-08	1.14E-03
URBAN	1.51E-05	1.35E-08	5.17E-08	1.29E-09	1.51E-05
TOTALS:	1.15E-03	1.04E-06	4.00E-06	9.80E-08	1.16E-03

4.5 Interdiction Table

A table indicating how many, if any, isopleth areas would be interdicted for each accident-severity category also is included in the output. Interdiction is based on ground deposition levels. When an area is interdicted, persons in the affected area will already have received an inhalation dose and an external radiation (cloudshine) dose from passage of the plume, and be exposed to external radiation from ground-deposited particulates (groundshine) for the time that elapses prior to evacuation. The values in the interdiction table depend on user-supplied information on interdiction action levels and parameters describing atmospheric dispersion (if any) in each accident-severity category. See Section 4.5.2 for a sample dose calculation. An example of an interdiction table is shown in Box 4-10.

Box 4-10 INTERDICTION AREAS TABLE - EXAMPLE

```
AREAS WITH TOTAL CONTAMINATION RATIO GREATER THAN 40.000
(THE AREAS MARKED WITH AN 'X' ARE INTERDICTED AND HAVE
NO 50 YEAR GROUNDSHINE DOSE AND NO INGESTION DOSE.)

 AREA/SEVERITY  1  2  3  4  5  6
    1           -  -  X  X  X  X
    2           -  -  X  X  X  X
    3           -  -  X  X  X  X
    4           -  -  -  -  X  X
    5           -  -  -  -  X  X
    6           -  -  -  -  X  X
```

4.6 Early Fatality Calculations

Two other types of impacts are calculated regardless of whether UNIT or NONUNIT output was selected. They are:

- risk of early fatality (also known as nonstochastic or prompt effects) from radiation exposure, and

- risk of early fatality from nonradiological causes (i.e., from ordinary traffic accidents).

4.6.1 Radiological Early Fatality Risk

The example shown in Box 4-11 is an actual result from a sample file. Results are calculated for each route segment (identified by user-defined labels) under LINK column. The total is also calculated. In this example, **no** member of the public would receive a prompt dose exceeding the early-fatality threshold in any severity of accident. The example is typical of most analyses. Among the few instances in which non-zero fatality risks would be predicted in this category are loss-of-shielding accidents for medical gamma sources such as cobalt-60 or cesium-137.

Box 4-11 EARLY FATALITY OUTPUT

LINK	EARLY FATALITIES
SEG1	0.00E+00
SEG2	0.00E+00
SEG 3	0.00E+00

4.6.2 Nonradiological Fatality Risk

The results for nonradiological fatality-risk output formerly were broken down on the basis of "normal" and "accident," where "normal" refers to health risk from vehicle emissions, and "accident" refers to death from physical trauma following an accident. The emergence of considerable data regarding threshold values for the various chemical constituents of vehicle exhaust has made linear extrapolation untenable, and the "normal" factor is now omitted. Effects in the Normal Occupational category were always extremely small, and their omission will have no effect on the result at the recommended two-digit level of reporting. Results for accident-related fatalities are broken down into occupational (OCC) and non-occupational (NON-OCC) categories. There are two reasons for this:

- The probability of an effect and the population of radioactive shipment crewmembers are both very small.
- The sub-populations most at risk (e.g., persons with severe respiratory problems) are usually not employed in the transportation sector.
- The Accident Non-Occupational category reflects the chance of a member of the public being killed in a transportation accident in each of the various roadway-type categories. The Accident Occupational category values indicate expected driver/crew deaths from physical trauma. Standard values for both categories are obtained from national and state statistics, but the analyst may substitute other values available to him or her. Non-radiological risks are usually several orders of magnitude larger than other risks computed by RADTRAN

4.7 Individual Dose Calculations

4.7.1 Maximum Individual In-Transit Dose (incident-free)

The maximum individual in-transit dose for incident-free transportation calculates a dose to an individual located at a specified distance from a transport link (highway, railroad, and waterway) during the passage of one or more shipments at a specified speed. The user may define the distance and speed values. In previous releases of RADTRAN, distance and speed were fixed at 30 m and 15 mph, respectively; but are now definable by the user.

4.7.2 Maximum Individual Downwind Doses (following a dispersion accident)

Maximum individual downwind doses are calculated at the mean downwind centerline distance for each isopleth. The doses are the sums of individual doses from the three so-called "prompt" exposure pathways --- cloudshine, inhalation, and the first several hours of groundshine (exact number of hours determined by user-supplied value of the EVACUATION parameter). The output resembles the example in Box 4-12, where the downwind distance is given under the column heading CNTRLINE. Individual doses are given for each accident severity category in the analysis. The example gives a single row, but the actual output would contain as many rows as there were isopleths. The values may be used, for example, to determine whether Federal exposure guidelines might be exceeded and, if so, at what distances from an accident site.

4.8 Population Data in Output

RADTRAN 5 performs three calculations that provide the user with quantitative information about potentially exposed populations. They are listed and discussed in this section.

Box 4-12 Maximum Individual Dose Output: Example [only first row shown]

```
MAXIMUM INDIVIDUAL CONSEQUENCE (DOSE IN REM)
FROM INHALATION, CLOUDSHINE, AND GROUNDSHINE EXPOSURE
DURING EVACUATION

CNTR LINE   SEVER: 1  SEVER: 2  SEVER: 3  SEVER: 4  SEVER: 5
SEVER: 6
 3.34E+01   0.00E+00  0.00E+00  3.05E-02  3.20E-02  1.87E+00
2.76E+00
```

4.8.1 Population within User-Specified Distance of Route

Incident-free dose to the public is integrated over a user-specified perpendicular distance (in meters) from the shipment centerline. This distance is designated by keyword DISTOFF (STANDARD value for DISTOFF = 800m). Population density values are generally derived from census data either directly or by means of a routing code. RADTRAN 5 calculates the total population within the DISTOFF distance along each route segment from distance and population-density input. For multiyear shipment campaigns, however, a simple algebraic calculation will underestimate the total potentially exposed population because no account would be taken of the residence times of various fractions of the population. Therefore, RADTRAN 5 includes a model that uses 1990 census statistics to correct for the movement of persons into and out of a contaminated area (Smith et al, 1996).

4.8.2 Population Potentially Exposed to Radiation from Dispersed Particulates

Uniform Population Density

The total population within a user-specified dispersion isopleth pattern is calculated and written to a table in the output file. Unless the user specifies otherwise, this calculation proceeds on the basis of two simplifying assumptions:

- the distribution of population under the footprint of the dispersion cloud is uniform
- the population density within the bandwidth that is used in incident-free calculations is assigned to the entire area under the plume footprint.

Because of the simplifying assumption of uniform population density, wind direction has no effect on the results. Thus, wind direction is not a RADTRAN input variable. Furthermore, wind direction, even if known for all locations, would not greatly affect the results of a risk analysis over a long route (Mills and Neuhauser, 1999b). For very short routes, use of the simplifying assumptions could yield results different from, although not necessarily less than, actual values.

Non-Uniform Densities Defined with ISOPLETHP

In a new feature, users can examine potential doses calculated with a nonuniform population distribution under the plume footprint. RADTRAN 5 contains a separate, optional subroutine that allows the user to assign distinct population densities to each isopleth (second-level keyword ISOPLETHP under RELEASE). The resulting dose-risks are tabulated and printed in the output. There are no STANDARD values for this calculation, and the first alternative (uniform population distribution) is used if ISOPLETHP is not entered. ISOPLETHP is intended to be a supplementary tool to assist the analyst in assessing potential accident consequences at specific locations. For example, wind-direction related differences in downwind population densities might be examined with this tool. However, the lack of wind rose data for most locations on most routes limit this application to special cases.

4.9 Population Changes over Time

RADTRAN 5 allows the user to account for population in-migration and out-migration over time. The feature is intended for use in the analysis of multi-shipment campaigns that take place over more than one year. The user enters the duration of the campaign in years under keyword CAMPAIGN. By means of an algorithm based on Census Bureau demographic data, the total number of persons residing within the specified bandwidth around the transportation route(s) under analysis is calculated for the specified period of time (Smith and Neuhauser, 1995). The output of CAMPAIGN is the total population that has lived along the route during the shipping campaign, and does not provide the time that any segment of that population lived along the route. It should therefore not be used to calculate population doses, and is not incorporated into RADTRAN calculations.

5. ANALYSIS METHODS

Analysis procedures and strategies are considered in this chapter.

5.1 PACKAGE and SHIPMENT Values

5.1.1 Package and Conveyance Dimensions

All RAM packages have an external dose rate, but not all have a transport index (TI), although this is often confused with dose rate. TI is a regulatory quantity that applies only to certain package types, as defined in regulations of the International Atomic Energy Agency, the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission (NRC) (49 CFR Part 173 and 10 CFR Part 71, respectively). In 10 CFR Part 71 and elsewhere, TI is defined as the maximum radiation, in millirem per hour, at any point 1 meter from the external surface of a package. For exclusive-use shipments, however, the regulations abandon the TI concept. Instead, they regulate the dose rate at 2 m from the "vertical planes projected by the outer lateral surfaces" of the railcar or vehicle. Values for dose rate 1 m from the surfaces of package(s) and conveyance(s) must be entered in RADTRAN 5 regardless of which regulations govern the package(s) being analyzed.

RADTRAN is designed to take advantage of the fact that this dose rate at 1 meter from the package surface is a maximum and either is directly measured for regulatory compliance purposes or can be calculated from a similar maximum measured at 2 meters. Real 3-D packages, however, often have dose rates that are considerably less than the maximum at many other points on the package or conveyance surface (Figure 5-1A). For example, dose rates at 1 m from the surface of a Defense High Level Waste rail cask may vary by three orders of magnitude from 32.9 mrem/hr at cask midpoint to 0.02 mrem/hr at the corner (Wan & Scheringer, 1983). Differences of one order of magnitude for gamma readings and two orders of magnitude for neutron readings were recorded at the cask surface on a TN-24 spent-fuel-storage cask with aged fuel contents (EPRI, 1987).

RADTRAN 5 does not account for the dose-rate variation described above. No generalized method of predicting field shape from package shape now exists, even for isotropically radiating materials, and few package contents are isotropically radiating. Many package contents display complex field-strength variations (e.g., spent fuel). In the absence of a general method, the approach taken in RADTRAN is necessarily geometrically simple and conservative. The package is modeled as an isotropically radiating sphere that emits the effective dose rate at a radius equal to $\{[(0.5)\mathrm{CPD}] + 1\}$, where CPD is the Characteristic Package Dimension (Figure 5-1B). The CPD is an actual package dimension. For example, in cylindrical packages (e.g., most spent fuel casks), the characteristic package dimension is equal to length.[10] For a sphere, it is the diameter, and for a cubical package it is the longest internal diagonal.

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10 For analysis of a package or vehicle with a characteristic dimension greater than 4 m, the basic formula for calculating K_0 significantly overestimates the actual dose rate, and RADTRAN 5 automatically makes an adjustment. For a package dimension greater than 4 m, the

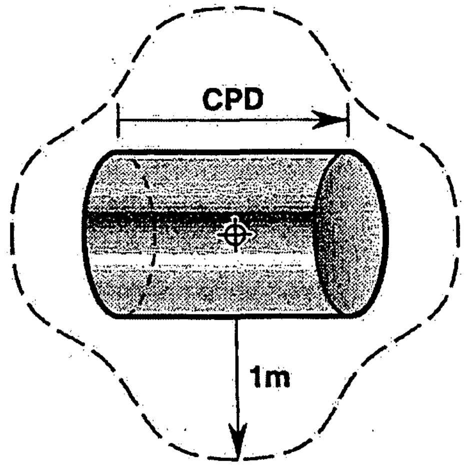

Figure 5-1a. Example of Realistic Radiation Field Strength Isobar [-----] Around a Cylindrical Package with a CPD Equal to Length and a Maximum Dose Rate at 1 meter as indicated. (Not to Scale)

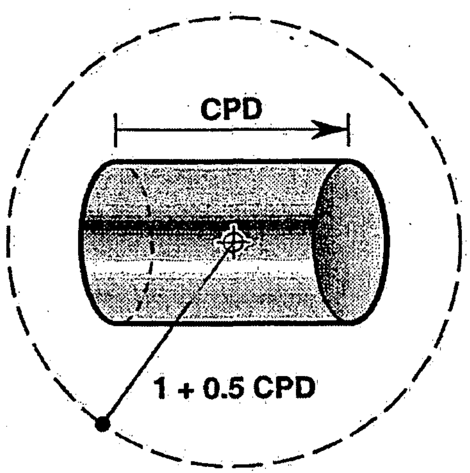

Figure 5-1b. Radiation Field is converted in RADTRAN 5 into a spherical, isotropically radiating field with its centerpoint at the geometric center of the package. The Field Strength at the radial distance of 0.5CPD + 1 is equal to the Maximum Dose Rate at 1 meter. (Not to Scale)

The RAM-carrying vehicle is also assigned a characteristic dimension. The user enters values for characteristic dimensions (in meters) for each package and vehicle type. The code calculates a coefficient, K_o, from the CPD. K_o is often called the 'shape factor,' and it is used in subsequent

---

value for the actual characteristic package or vehicle dimension is replaced with a value for an effective package dimension, which is calculated by RADTRAN 5 according to the following equation:

$$D_{eff} = 2 \cdot (1 + 0.5\, D_{act})^{3/4} - 0.55$$

where D_{eff} = effective dimension and D_{act} = actual dimension.

dose calculations.[11] RADTRAN incident-free results are highly sensitive to the value of K_o, and the user should select values of dose rate and CPD with great care.

The third type of CPD is "crew-view" CPD. It is the characteristic dimension of a package silhouette as viewed from the crew's vantage point. It is often markedly different from the silhouette of the same package for other exposure groups (e.g., handlers). For cubical packages the "crew-view" is the diagonal across one side; for spherical packages, it is the diameter, just as for the regular CPD (Figure 5-2). The application of the crew-view CPD is discussed in Section 5.1.3.

As noted above, the entire shipment also is assigned a characteristic vehicle dimension (CVD). For example, the trailer of a tractor-trailer carrying a packed array of radiopharmaceutical packages may be treated as a single entity for the purpose of calculating external radiation doses. Finley et al, (1988) contains an example of this application.

5.1.2 Package and Shipment Dose Rates

Dose-rate values are among the most important data entered in a RADTRAN 5 input file. Recall that the maximum dose rate in mrem/hr at any point 1 m from a package or at 2 m from the vertical planes projected by the outer lateral surfaces of the transportation vehicle is regulated by law. Recall also that the maximum dose rate at 1 m is a RADTRAN 5 input value, which is used to estimate conservatively the field strength around the package or shipment.

The field-strength estimate for each package is used to calculate handler dose. The field-strength estimate around a vehicle (shipment) is used to calculate doses to persons beside the transport link (off-link), doses to persons sharing the transport link (on-link), and doses to persons at stops. The following guidance indicates the best ways of handling various package/shipment configurations.

Single-Package Shipments.

This is the simplest case. The shipment dose rate may be set equal to package dose rate, which normally is conservative. However, if the package is significantly narrower or shorter than the conveyance in which it is transported, then the actual shipment-level dose rate should be calculated or measured and used instead. The source-to-crew distance is usually the distance from the center of the package to the crew compartment. However, if a distinct crew-view dimension is used, then the same dose rate is used but the source-to-crew distance is measured from the end of the package closest to the crew compartment.

Multiple-Package Shipments.

- **Arrays.** This configuration usually applies to small packages. In most cases, numerous packages fill the space available for cargo or palletized groups of packages are evenly distributed within the space. The shipment dimension (CVD) represents the conveyance

[11] For close-proximity exposure groups, a line-source model is used (Weiner & Neuhauser, 1992).

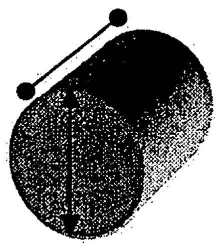

Figure 5-2a. The Characteristic Package Dimension (CPD) of a Cylinder Is Length (meters)[●——●] Crew-View CPD is Diameter (meters) [◄►]

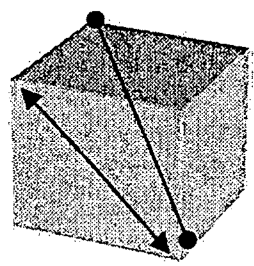

Figure 5-2b. CPD of a Cube is Longest Internal Diagonal (meters) Crew-View CPD is Diagonal on a Side (meters)

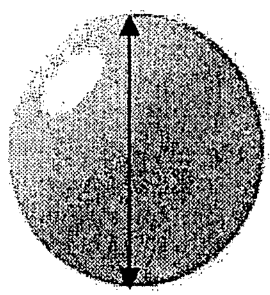

Figure 5-2c. CPD and Crew-View CPD of a Sphere are Both Equal to the Diameter (meters).

cargo space (usually trailer or railcar length). One should note that the estimate of dose rate at any given distance from a shipment increases nonlinearly with increasing shipment dimension for a fixed shipment dose rate (DR_v). Use of a shipment dimension greater than approximately 10 m is not recommended.

One still enters individual package dose rates as well as a shipment-level dose rate for the conveyance. The shipment dose rate is not equal to the sum of the package dose rates. It must be measured directly or calculated by hand because self-shielding usually makes the shipment dose rate significantly smaller than the sum of the individual package dose rates. An example of this approach may be found in Finley et al. (1988). Individual package dose rates also are required, however, because doses to handlers are always calculated on the package level.

- **Two or a Few packages.** These are often special cases involving Type B packages. Individual cobalt-60 pins for commercial irradiators, for example, might be shipped in the following configuration: one per package; two packages at a time; truck mode. The vehicle-level dimension selected by the user to represent such a shipment depends on package placement within the cargo space. Type B and other heavy packages are generally evenly spaced to distribute the load. For example, in the case of two packages shipped in a single trailer, they could be tied down at the centerpoints of the two halves (measured from front to back) of the trailer bed. Total trailer length could be the CVD for this configuration; the maximum dose rate 1 meter from the trailer edge midpoint would have to be measured or calculated DR_v (Figure 5-3, Option 1). Alternatively, one could model the same example as two shipments each with a CVD equal to half the trailer length and with shipment dose rates measured at 1 m from the midpoint of each trailer half (see Option 2). For a 7×3-m trailer and packages 1-m in diameter, Option 1, with the larger vehicle dimension, yields a dose result that is about 40% higher than for Option 2. This occurs because of the nonlinear nature of the k_0 and DR_v functions. As noted above, this nonlinearity tends to increasingly overestimate the dose-rate values as CVD increases. Therefore, Option 1 may be preferred for analyses where conservatism is desired, but Option 2 gives a better dose estimate.

- **Other Configurations.** There are many possible arrangements of packages within a vehicle, and RADTRAN permits all variations to be characterized. Among special cases one might encounter are those in which the edge of the trailer or railcar is coincident with the edge of the package (e.g., TRUPACT shipments to the Waste Isolation Pilot Plant). If it is a single package, the vehicle and package dose rates are equal. When a package occupies most or all of the cargo space available (e.g., many spent-fuel casks), the package CPD is set equal to the CVD.

Crew Shielding

Crew shielding may be directly accounted for in RADTRAN 5 by means of the crew modification factor. In previous releases of RADTRAN, crew shielding could only be accounted for indirectly by artificially increasing the source-to-crew distance. With the crew modification factor, the user can easily account for shielding that may be installed in cabs of semi-tractors or ship's bulkheads, for example. Data that must be supplied by the user are:

- The "crew-view" dimension. Conveyances such as combination trucks often have "crew-view" dimensions that are smaller than those used to calculate doses for members of the public.

- The crew-to-source distance, which should be measured from the closest edge of the package or packed array to the center of the closest location for a crewmember (usually the crew cabin).

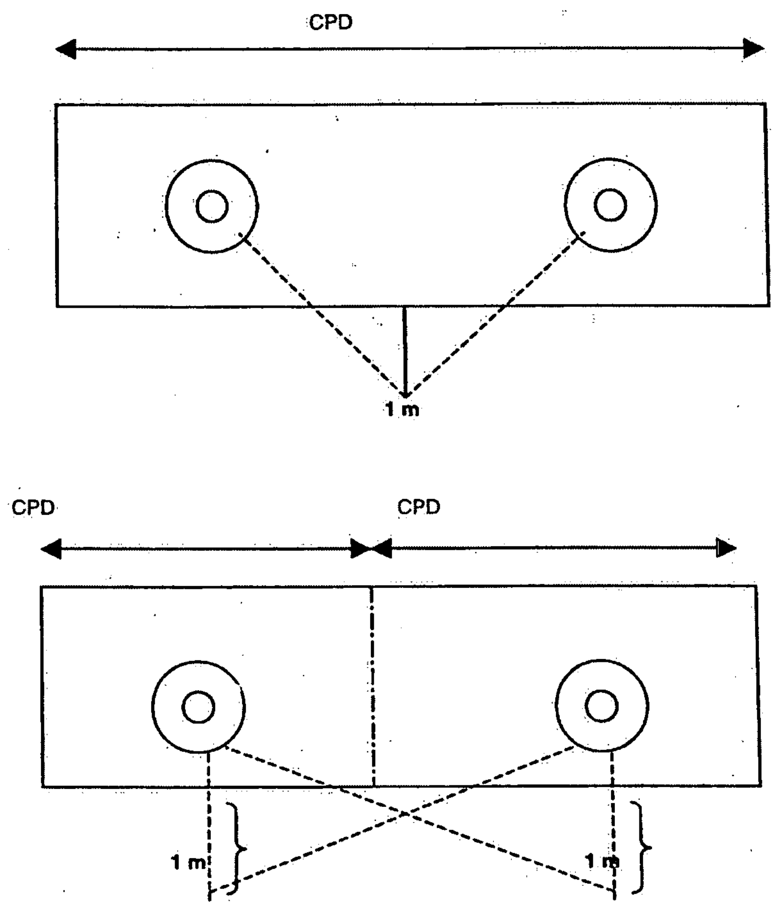

Figure 5-3. (a) Option 1 - Models Two or a Few Packages Widely Separated in the Same Conveyance - Model as Single Shipment with CPD Equal to Trailer or Railcar Length and Dose Rate Calculated at 1 m from Midpoint of Trailer or Railcar. (b) Option 2 – Models Two or a Few Packages Widely Separated in the Same Conveyance – Model as Two or More Separate Shipments each with CPD Equal to a Fraction of Trailer or Railcar Length and Dose Rate at 1 m from Midpoint of each Fraction of Trailer or Railcar.

5.2 Gamma and Neutron Components of Dose Rate

Values for a neutron component of dose rate for fission neutrons are available for use in RADTRAN 5. The derivation of these values was originally given in the RADTRAN 4 Technical Manual (Neuhauser and Kanipe, 1989). To summarize briefly, they were obtained with neutron cross-section data from the ENDF/B-V (Magurno, 1983) cross-section data library generated with the NJOY code (MacFarlane, 1982). The source was assigned an energy spectrum obtained from Oak Ridge National Laboratory calculations of the neutron flux at the surface of a lead-shielded spent fuel shipping cask. The neutron transport calculations were performed with the ONEDANT code, which solves the 1-D, multigroup, Boltzmann transport equation by the discrete ordinates method (O'Dell, 1982). The ENDF library, NJOY system, and

ONEDANT code are discussed and evaluated for use in transportation analysis by Parks et al. (1988).

To be compatible with the RADTRAN calculational strategy, the neutron rate as a function of distance is expressed in the following form

$$DR(x) = K e^{-\mu x} (1 + a_1 x + a_2 x^2 + a_3 x^3 + a_4 x^4)/x^2 ,$$

where

DR(x)	=	the dose rate as a function of x
x	=	distance in meters from the source
K	=	constant, and
μ	=	linear absorption coefficient for the surrounding medium (air).

The linear absorption coefficient for air (μ_{air}) was assigned a value of 7.42E-03 m^{-1} (Madsen et al., 1986; p. 43). Four unitless coefficients (a_1, a_2, a_3, and a_4) were then derived for fitting the shape of the dose rate-vs.-distance curve to the shape of the selected neutron transport curve in air at 50 percent relative humidity. These values are:

a_1 = 2.02E-02
a_2 = 6.17E-05
a_3 = 3.17E-08
a_4 = 0.0.

Although it is unlikely that another neutron transport curve might be appropriate, the user is allowed to enter new values for the coefficients into the input data file with keyword TRANSFER (see Chapter 3 for discussion of data entry). All four coefficients must be entered even if only one changes in value. Workstation/mainframe users enter them as the last four numbers in the five-number array under the second-level keyword NEUTRON and the first-level keyword TRANSFER (Table 3-2). The first number in this array is the linear absorption coefficient (μ), which also may be redefined by the user.

A similar treatment is possible for gamma radiation (second-level keyword GAMMA under TRANSFER), but the atmospheric effect (i.e., attenuation and buildup in air) is comparatively insignificant. Therefore, for gamma radiation the values of μ, a_1, a_2, a_3, and a_4 are set to zero in order to reduce the exponential term in the dose rate equation to unity. The equation for gamma thus reduces to the form used for a gamma point or line source in the RADTRAN calculational strategy, namely, $DR = K/x^2$ or $DR = K\infty/x$ (Madsen et al., 1986, p. 13).

Separation of dose rate into neutron and gamma components is useful only for packages in which a significant fraction of the external dose rate is attributable to neutrons (e.g., aged spent fuel). A breakdown of the gamma and neutron components of dose rate at 1 meter for representative truck and rail casks and fuel ages of from 5 to 25 years is given in Parks, Hermann and Knight (1985). For most materials, the user should treat the external radiation field as consisting solely of gamma radiation. The user always has the option of performing external transport calculations and curve fitting to obtain new coefficients. An analysis of a multiple-package shipment containing dissimilar packages should *not* rely on extrapolation from package-by-package gamma-neutron breakdown, because of differential shielding and absorption by surrounding packages. The calculated or measured *shipment-level dose rate* may be split into gamma and neutron components, if necessary, that are derived from measurement or modeling of the shipment configuration.

5.3 Multiple-Radionuclide Materials

5.3.1 Assignment of Physical-Chemical Groups

Few radioactive materials consist of single radionuclides; most are mixtures. The physical and chemical properties of radionuclides and their compounds vary widely, and the behavior of radionuclides and their compounds in response to mechanical and thermal forces potentially encountered during accidents depends strongly on these properties. The first step toward accounting for them is to list all of the important radionuclides in the package(s) being analyzed under the PACKAGE keyword. **The importance of an accurate radionuclide inventory cannot be underestimated.** When analyzing numerous small packages with variable contents, however, one may use statistical methods. Allow the code to automatically enter radionuclide-specific data directly from the internal radionuclide library whenever possible. Data entry is thereby simplified, and by reducing the amount of hand-entered data, the frequency of input errors is reduced. Complex materials containing up to 200 radionuclides can be modeled realistically. Methods are available, however, to reduce the number of nuclides considered without loss of accuracy, and are discussed in Section 5.2.2.

The second step is to determine whether physically and chemically distinct groups of elements are represented in the material(s) being considered. Examples of chemically distinct groups are noble gases (e.g., krypton), volatiles (e.g., cesium in various forms), and transuranic oxides (e.g., plutonium oxide). An element may fall into more than one group in a material. An example of an radionuclide that may be in two distinct groups is cobalt-60 in pressurized water reactor (PWR) spent fuel. The radionuclide is an activation product and is found (1) in metallic fittings of fuel assemblies and (2) in crud on the surface of the fuel rods. The former is in a non-dispersable form that does not contribute to potential releases in severe accidents, but the latter may be spalled off of the fuel rods following impact. The resulting particulates may then be available for release. Since cobalt-60 produces a high-energy gamma, it is very important to model this element correctly. Only the cobalt-60 in crud should be modeled as available for release in analyses of PWR spent fuel.

For a given material, only elements with similar release behavior in all accident-severity categories should be grouped together. For example, ruthenium and cesium are volatile elements which will behave similarly in many thermal environments, but ruthenium may undergo chemical changes in a severe fire and an oxidizing environment that cesium does not. Therefore, these two chemical species should be assigned to two separate physical-chemical groups.

The designed-in flexibility of RADTRAN 5 allows each group to be treated separately. Since as many as 15 physically and chemically distinct groups of elements may be used in a single analysis, even the most complex materials can be modeled. An example of a complex material (spent fuel) is given in the sample input file in Chapter 3.

Each physical-chemical group must be assigned appropriate values for the release fractions (RFRAC), aerosol fractions (AERSOL), respirable aerosol fractions (RESP), and deposition velocity (DEPVEL). The dispersibility categories used in earlier releases of RADTRAN are no longer used in RADTRAN 5. However, the table of former default values for these categories remains a reasonable guide to AERSOL and RESP values in the absence of any better information, and it is reproduced here from Neuhauser & Kanipe (1992).

Table 5-1. General Guide to AERSOL and RESP Values Suitable for All Severity Categories

Material Type	*Aerosol Fraction*	*Respirable Fraction*
Immobilized	1E-06	0.05
Loose Chunks	1E-02	0.05
Large Powder	1.5E-01	0.05
Small Powder or Nonvolatile Liquid	1E-01	0.05
Flammable	1E+00	1
Liquid	1E+00	1
Gas	1E+00	1
Undispersed (Loss-of-Shielding)	0	0

In summary, each radioactive element or compound is assigned to a group according to its physical and chemical properties. An element also may be assigned to more than one group if it appears in more than one physical-chemical form in the material being analyzed.

For shipments carrying packages with more than one type of contents, each package type must be separately characterized. The behavior of a multiple-package array in potential accident conditions is often different from the behavior of a single package, even if the packages are all identical. In an impact accident, for example, packages on the struck side of the vehicle generally will absorb more impact force than packages on the opposite side. Certain accident scenarios may involve what is referred to as inertial crush; when the force is translated from one package to the next in a manner such that package(s) distant from the impact point may be most affected. Packages also may act as thermal barriers in a fire accident, shielding other packages beyond them. Factors such as these must be considered and evaluated on a shipment-specific basis before assigning release fractions, etc.

5.3.2 Use of a Relative Hazard Index to Reduce Large Radionuclide Inventories

If the number of radionuclides in a material is large, as in spent fuel, for example, then radionuclides that contribute very small fractions to the overall hazard may be disregarded to simplify the analysis. The use of a relative hazard index for RAM transportation analyses was pioneered by Sandia National Laboratories. Various types of indices are discussed below.

Effective Dose Equivalent Factors

These factors give dose per unit intake for inhalation and ingestion for each radionuclide and are compiled and updated regularly by the DOE and the EPA (e.g., DOE, 1988a,b and EPA, 1993). When each is multiplied by the package inventory of the appropriate radionuclide, the resulting list represents the relative hazard of the material. For example, the data in DOE (1988b) was used to select those radionuclides that contribute to 99.9% of the total health hazard in a recent DOE EIS dealing with research reactor spent fuel (DOE, 1995).

Maximum Permissible Concentrations (MPCs) and similar metrics

Atmospheric dispersion generally represents the primary, and often the only, means of dispersing radionuclides beyond the immediate vicinity of an accident site, even in extremely severe accidents and even for waterway modes. For this reason, values such as the International Commission on Radiological Protection (ICRP) Maximum Permissible Concentrations in Air (MPCs), Annual Limits on Intake (ALIs), and Derived Air Concentrations (DACs) are attractive candidates for use in developing a relative hazard index. All three are described in ICRP (1979) and ICRP (1990). For example, Maximum Permissible Concentrations in Air (MPC_{air}) were used to develop a radiological hazard (RADHAZ) index for radionuclides present in ten-year-old PWR spent-fuel during analysis of repository alternatives (Wilmot et al., 1983). The authors used the following relationships:

$$\frac{\text{Inventory of radionuclide i (Ci)}}{MPC_{air}\text{ for radionuclide i}} = RADHAZ_i$$

and

$$\sum RADHAZ_i \text{ over all radionuclides in spent fuel} = \text{Total Radiological Hazard}$$
$$\text{(for inhalation pathway).}$$

Retaining only those radionuclides that contribute, by summation on a rank-order basis, to 99.9% of the total radiological hazard (inhalation), Wilmot et al. (1983) reduced the size of the radionuclide list entered into RADTRAN to less than 10 without noticeably affecting the result. The radionuclides that were retained were cobalt-60, strontium-90, ruthenium-106, europium-155, cesium-134, cesium-137, and several radionuclides of plutonium.

Activity Limits

A similar method, based on Activity Limits (particularly A_2 values) can be used. The International Atomic Energy Agency (IAEA) defines A_2 as "the maximum activity of radioactive material, other than special form radioactive material, permitted in a Type A package" (IAEA, Safety Series 6, 1985). A Type A package meets the General Requirements for All Packagings and Packages, but is not accident-resistant, as are Type B packages.

This approach yields a nuclide list similar to that obtained with MPCs for the spent-fuel example above. With five-year-old spent fuel, additional elements such as americium and curium are included in the list. None of these methods should be applied blindly, however. Krypton-85, for example, is generally included in the final radionuclide list for spent fuel (e.g., Wilmot et al., 1983; DOE, 1995). Although krypton-85 is inert and poses a relatively low hazard, it is present in spent fuel as a gas and much of the inventory would be released in the event of a severe accident, rather than remain trapped in the fuel and cask structures as many solids would. Thus, it is reasonable to include this radionuclide regardless of its hazard index. Similarly, radionuclides that are present in large amounts by mass, even thought their specific activities are low (e.g., uranium in spent fuel), or that are highly biologically active (e.g., tritium and iodine-131) should not be automatically excluded on the basis of a numerical hazard ranking alone.

In summary, the user may apply a relative hazard index to a multiple-nuclide material in order to simplify an analysis. However, special features such as gaseous state, mass fraction, and biological activity, should be considered when compiling a defensible final list.

Historical Methods

Two methods that were used to simplify computations when computers were less powerful and access to them more limited should be mentioned, although they are seldom, if ever, used today. The first was a weighted-average method, used to approximate the gamma source strength of spent fuel in NUREG-0170 for loss-of shielding accidents (NRC, 1977, Tables A-5 and A-6). Today, it is recommended that measured surface-dose-rate values be used.

Also in NUREG-0170, the entire inventory of volatile fission products in spent fuel was modeled as cesium-137, the single most hazardous radionuclide in this class (NRC, 1977, Table A-5). This historical method yields results that are too high. The practice is obsolete since it is now easy to realistically model the actual radionuclide inventories of spent fuels and most other complex materials.

5.4 Route Data

This section deals with analyses in which the routes being analyzed are defined by a set of route segments. Additional RADTRAN applications of route segments are discussed in Section 5.5.3.

5.4.1 Aggregate Route Segments and Other Data

An aggregate route segment is defined as the sum of all portions of a route that satisfy some predefined criterion. For purposes of analysis, it is treated as a single route segment. The resulting collective or aggregate route segment has all properties specified by the criterion except length. The length of the aggregate segment is equal to the sum of the portions as defined above.

Route-segment aggregates, however defined, must be jointly inclusive and mutually exclusive. In other words, (a) the sum of the lengths of all the various route-segment aggregates must equal the total length of the route and (b) no individual segment of the route can be a member of more than one aggregation class defined by the criteria.

The most common aggregation criterion is population density. This criterion was used in NUREG-0170 (NRC, 1977), and has been used in numerous risk analyses since (e.g., Wilmot et al., 1983; DOE, 1995). Aggregated population-density data are readily obtained from the output of transportation routing codes such as HIGHWAY (Johnson et al., 1993) for truck mode and INTERLINE 5.0 (Johnson et al., 1992) for rail mode. Both of these codes, developed at Oak Ridge National Laboratory (ORNL), yield aggregate data for each node-to-node interval along the route. That is, all the rural segments between two major intersections are summed, as are the suburban and urban segments, respectively.

Stops may also be treated in an aggregate manner, especially when several similar stops may occur in the course of a single shipment. Madsen and Wilmot (1983) provide this information for long-distance truck shipments. Similar data for rail operations in the Unites States was collated by Ostmeyer, 1986, from information found in Wooden, 1986. This is discussed at greater length in Section 5.3.4.

5.4.2 Linear Route-Specific Analysis

This section consists primarily of suggestions and useful information to assist the user in describing and analyzing route-related data. To perform linear route-specific analyses, a route is usually broken into

(a) links or segments, each of which represents a portion of the actual route,
(b) stops, each of which represents a stop along the route, and
(c) handlings, each of which represents a loading, unloading, or intermodal transfer event that occurs during the trip(s) being analyzed.

Up to 60 distinct route segments, seven stops, and eight handlings may be analyzed in a single computer run. If the number of route segments, stops, or handlings exceeds the maximum number per run for RADTRAN, then the user must perform multiple runs. The results of multiple runs may be collated in spreadsheets such as Microsoft Excel™ to yield total risk and consequence values for a complex problem.

5.4.3 Summation Check

As noted above, the sum of the segment lengths should equal the total route length. Because there can be no internal check to ensure that this condition is satisfied, the analyst must perform this check. This check is most easily performed when data are entered in a spreadsheet, which is another reason why the use of spreadsheets is recommended for keeping tracking of the large amounts of data required by RADTRAN 5. The use of spreadsheets in building input files is discussed in Neuhauser et al. (1995).

5.4.4 Population Density

High-resolution sources of population data are available. The Bureau of the Census is the single best source of digitized data for the United States. Census data must be converted into population-density values suitable for use in RADTRAN. The population density within a predetermined bandwidth (usually 1600-m) of the highway or railroad must be determined for overland modes. Population densities under a plume footprint must also be determined if the user is applying the ISOPLETHP option. Methods for developing these population data with a GIS (Graphical Information System) have been developed at SNL (Mills, Neuhauser, and Kanipe, 1995). ORNL also has updated its previous routing codes (HIGHWAY and INTERLINE) with a GIS platform, TRAGIS, that also includes 2000 U. S. Census figures (Johnson et al., 2000).

5.5 Accident Rate

The units for this variable are usually accidents per vehicle-kilometer. National accident-rate data are compiled and published annually by various groups in the U.S. Department of Transportation (USDOT) such as the National Transportation Safety Board (NTSB) and the Federal Rail Administration (FRA). Some of these data are available in electronic format (e.g., DOT, 1994). The relationship between accidents and railroad track class is discussed in McClure et al. (1988). The U.S. Coast Guard collects U.S. maritime accident data. Lloyd's of London maintains the Lloyd's Maritime Information Service accident reports, which are available for a fee.

Less comprehensive but locally more detailed data can sometimes be obtained from state and municipality highway or transportation departments (e.g., Smith, 1982).

In most cases, data collected in the United States are reported either in terms of accidents per one million vehicle-miles or in tabular form with two columns of data (total number of accidents and total millions of vehicle-miles traveled). The latter are often embedded in tables with various other data and must be extracted by the user. The data are not broken down into convenient rural, suburban, and urban categories. For example, the category labeled as URBAN by the USDOT usually is designated according to political boundaries (i.e., city limits) rather than actual population densities. Accident rates must be converted to metric units. Methods for developing rural, suburban, and urban rates are discussed in NRC (1977), Wilmot (1983), and DOE (2002a).

When analyzing carriage by a specific type of vehicle, an accident rate for that vehicle type should be used whenever available, rather than less vehicle-specific values. For example, nearly all Highway Route Controlled Quantity (HRCQ) shipments of radioactive materials by highway mode are carried by combination trucks (tractor-trailers), and USDOT data are available for this truck type. The latter should be used in preference, for example, to data from the All Vehicles category. The data source and category should always be stated in the documentation of an analysis.

Most data sources, whether they explicitly state so or not, include only reportable accidents (i.e., those that exceed some dollar value in damages or those that involved a fatality). Correcting for underreporting only serves to raise the fraction of accidents of low severity (and hence to lower the fraction of high-severity accidents) and so is usually neglected. Accident-rate data for more than one year may be averaged, if desired, and the use of multiple years of data is recommended.

The accident-rate parameter is sometimes written less than rigorously as accidents/kilometer, but this should not be interpreted to mean an accident count per kilometer of roadway or railroad. The number of accidents that have occurred in a given route segment, if left unadjusted for usage of that route segment, is an improper (and useless) value. The denominator should always be taken as referring to vehicle-kilometers unless explicitly stated otherwise.

For air and maritime modes, accidents per voyage or accidents per air transit are often the forms in which data are presented. They can be converted to accidents/vehicle-kilometer if nautical-mile or air-mile distance values, or average trip distances, or some similar parameter can also be obtained. If they are used without modification, comment lines should be added to any analysis that uses an alternative form of accident-rate data to make sure improper comparisons are not made with other risks calculated on a per vehicle-kilometer basis.

5.6 Vehicle Density and Vehicle Occupancy

The DOT sources cited above also supply data on vehicle density for highway mode travel. For most analyses performed at Sandia, average vehicle occupancy is conservatively set to two, although it is usually closer to one (e.g., DOT, 1994).

5.7 Segment Character Designation

Although segment-specific population densities must be entered, the user is asked, in addition, to indicate whether each segment is rural, suburban, or urban in character. The user enters R, S, or U to indicate rural, suburban, or urban character, respectively. Character designation controls the selection of accident-severity fractions, controls whether an ingestion-dose calculation is performed, and determines the selection of building-shielding factors (RR, RS, and RU [see Keyword Master List, Section 3.11]).

If the segment character designation is R, then the ingestion pathway is included, but if a segment is designated as S or U, ingestion is not calculated. However, the ingestion code (COMIDA) also gives a calculation for a so-called "maximum man," who is essentially a subsistence farmer (Abbott and Rood, 1994a,b). This dose value is always included in the RADTRAN output. It will bound any doses potentially incurred by a suburban resident with a backyard tomato plot, for example, in the unlikely event that the individual continues to grow and eat tomatoes subsequent to a contamination event.

In addition, if a segment is designated U, then expected values of total inhalation dose are modified to account for its two main components:

1. Dose for persons indoors, and

2. Dose for persons outdoors.

To obtain the first value, the baseline total inhalation dose is calculated on the basis of a uniform population density; then that dose is multiplied by the product of Urban Building Fraction (UBF) and Building Dose Factor (BDF). The UBF accounts for the fraction of persons indoors (or the amount of land surface occupied by buildings rather than streets, sidewalks, parking lots, parks, etc.), and the BDF accounts for the partial removal of particulates by building ventilation systems (Finley et al., 1980). The UBF has a STANDARD value of 0.9; the BDF has a STANDARD value of 0.05 (Englemann, 1990). Both the UBF and BDF may be altered, of course.

The second term, which accounts for inhalation dose to persons outside of buildings (e.g., pedestrians, shoppers, and commuters), is calculated separately. In this term, the base dose value is multiplied by the product of Urban Sidewalk Fraction (USWF) and Ratio of Pedestrian Density to residential population density (RPD). The STANDARD values for USWF and RPD are 0.1 and 6.0, respectively (Finley et al., 1980). The RPD allows the user to account for non-residents, and all of them are modeled as being out of doors. The sum of the two terms is the adjusted collective inhalation dose.

5.8 Link Type

Link type is used to distinguish between various roadway types for highway modes only (truck, commercial van, and passenger van). If the user sets the link type to 1, then the route segment is modeled as a limited-access divided highway (i.e., an Interstate highway or other highway built to similar engineering standards). If the link type is set to 2, then the combination of zone designation and link type determines how the roadway is modeled. If the link type is set to 2 and the zone is designated either R or S, then the roadway is modeled as a non-limited-access, non-divided highway (e.g., an U.S. highway). If the link type is set to 2 and the segment is designated as U in character, then the roadway in that segment is modeled as a city street. For all other modes, the link type is set to 3.

This scheme is diagrammed as follows.

Link Type 1 ⇒ Limited-Access Divided Highway; Any Population Density

Link Type 2 ⇒ Zone R or S ↣ U.S. Highway (non-limited-access, non-divided)

Zone U ↣ City Street

Link Type 3 ⇨ Any Non-Highway Mode

This flexibility is important even for highway-route controlled quantity (HRCQ) shipments such as spent fuel, which are required by DOT routing regulations to use interstate highways. Access routes to and from the interstates and state-designated alternate routes, which often must be evaluated in environmental documents, can be analyzed readily by use of the link-type settings. Differences in accident rates, population densities, traffic densities and other factors that may change according to road type, must be accounted for if the analysis is to be meaningful. In a recent example, an Interstate route from Florida to Washington State was compared with a route that avoided urban areas by traveling on U.S. Highways (Mills and Neuhauser, 1998).

5.9 Fraction of Land under Cultivation

The user may enter values from 0.0 to 1.0 for this parameter only if the link is identified as R (rural in character; see Link Type above). If a link is identified as S or U (suburban or urban), then the RADDOG input file generator code automatically enters a zero for this parameter. If the user is manually creating an input file, then he or she must enter a zero value for all non-rural segments. The variable is used in the ingestion-dose calculation and accounts for the fraction of area in agricultural production, as opposed to the area occupied by roads, driveways, dwellings, barns, commercial buildings, parking lots, parks, forests, etc. No account is taken of seasonal differences. There is no STANDARD value for this parameter. Maximum values for this parameter are available from publications of the U.S. Bureau of the Census, but only for counties, a relatively low level of resolution.

If one wishes to "force" calculation of an ingestion dose for a link that is actually suburban or urban in character, then the user can designate the link as rural and enter a value for the fraction of land under cultivation. The latter value should be at least a factor of 4 or 5 smaller than the rural value. For example, the *County and City Data Book* (USBC, 1988) lists St Louis County, Missouri, which includes the City of St. Louis, as having 42,000 acres in cropland. The total area of the county is 506 square miles and the average population density was 1962 persons per square mile in 1988. At that time the fraction of land under cultivation in this highly urban county was approximately 0.13 (13%). Nearby Atchison County, Missouri, on the other hand, which is predominately rural (population density was 14.6 persons per square mile) had a fraction of land under cultivation of 0.77 (77%) in the same year. That is over five times the value for St. Louis County.

5.10 Population under Plume

Accidents may occur that result in airborne dispersion of RAM package contents. These accidents are characterized with the user entries for accident rate, severity fraction, release fraction, aerosol fraction, respirable fraction, and meteorological conditions. As in previous releases of RADTRAN, the area under the dispersion plume, the so-called plume "footprint" can be modeled as having the same population density as the bandwidth around the transportation corridor. This is normally acceptable for probabilistic analysis purposes. The population density in this bandwidth (usually 1600 m wide) is the basis for designation as rural, suburban or urban; off-link populations for incident-free dose calculations are located within the bandwidth. However, this modeling assumption leads to excessively large overestimates of downwind population for urban route segments. It is possible, but less likely, that a plume originating in a rural or suburban route segment would encounter higher density areas shortly beyond the bandwidth boundary. In order to better characterize such specific situations, an individual population density for each downwind isopleth may now be entered under the ISOPLETHP keyword. The Bureau of the Census is the best source of digitized information on population distribution in the United States. The population data must be used in conjunction with a GIS system to obtain useful plume footprint values.

5.11 Nonlinear Applications

In the so-called nonlinear applications of RADTRAN 5, the links do not represent a sequential or aggregated set of route segments that define a route. This freedom to define route segments in nontraditional ways that has been built into RADTRAN 5 is extremely useful. The user can analyze and compare the same route or route segment(s) in a variety of conditions. Examples of applications include:

- comparisons of daytime and nighttime population densities (e.g., Mills and Neuhauser, 1999a);
- comparisons of rush-hour and non-rush-hour traffic conditions;
- comparisons of current and projected population densities (e.g., Neuhauser and Weiner, 1992a)
- doses in enclosed spaces such as airplanes from leaking radioactive material package(s) (Neuhauser, 1992).

This powerful analytical tool is limited in usefulness only by the quality and quantity of data available to the user.

5.12 Stop Data

To review from Chapter 3, for each stop (or an aggregate of similar stops), the user assigns values to the following stop parameters:

- alphanumeric identifier, up to 10 characters;
- vehicle identifier (previously defined under keyword VEHICLE);
- population density (persons/km^2) *or* number of persons (#);

- minimum radius of annular area (m);
- maximum radius of annular area (m);
- shield fraction;
- stop time (hr).

There are two alternative methods for estimating the size of the potentially exposed population. In the first method, the minimum and maximum radii are set equal to each other; this is interpreted by the code to mean that dose will be calculated at an *average radial distance* from the shipment. In this option, the third value in the array is interpreted to mean *number of persons present at the stop.* These persons are modeled as if they were located at the specified average radial distance from the shipment(s) for the duration of the stop. In the second method, the maximum and minimum radii are not equal. This is interpreted by the code to mean that it should compute the area of an annulus (with the vehicle at its center) that has an inner radius equal to the smaller of the two radius values and an outer radius equal to the larger of the two values. The third value in the array is then taken to be a *population density,* which is used to calculate the number of persons within the annulus (the product of the population density and the calculated annular area).

The user must be careful not to get the two stop options confused. For example, entering a population-density value, rather than a count, along with an average distance (i.e., making the two radial distances equal), would mean the density would be interpreted as a specific number of persons located at that average distance. The result would usually be considerably in error. Studies that provide information on the values of these parameters for highway mode include Madsen and Wilmot (1983) and Griego et al. (1996).

If more than one stop is expected (e.g., cross-country truck shipment) and if exact stop locations cannot be known in advance, then the total expected stop time may be allocated to a single "aggregate" stop with average parameter values. For materials shipped by common carrier, this is often the only workable method. For truck shipments the aggregated stop time has been conservatively estimated to be equal to 0.011 hours per kilometer of travel (Madsen and Wilmot, 1983). This value includes rest stops, meal stops, and overnight stops on long trips. The use of aggregate stops for highway mode is common because one can expect truck stop locations to be restricted or predesignated only when one is analyzing heavily controlled or monitored shipments. Most train stops are in railyards, and several reports have examined the potential for rail worker dose (Wooden, 1986; Ostmeyer, 1986; ORNL, 1990). In the case of carriage by vessel, port-call stops are usually known well in advance and may last 24 hours or longer (Neuhauser and Weiner, 1992b).

5.13 Use of Stop Model for LOS Analyses with Robust or Special-Form Materials

The LOS model in RADTRAN 5 is suitable for use with many RAM shipments such as radiopharmaceuticals, which are typically shipped in small amounts in non-accident-resistant Type A packages. For shipments of these materials, moderate to severe accidents can be expected to result in complete loss of contents of all affected packages. The LOS model in RADTRAN 5 is intended for such situations. The contents are presumed to be lying on the ground or on some vehicle surface in a manner that permits little self-shielding. Thus, the entire radionuclide inventory is multiplied by a gamma photon energy or neutron emission factor, as appropriate, to calculate a source strength. However, this approach is inappropriate for special-form materials and other robust materials such as spent fuel that can be expected largely to retain their structural integrity even in extremely severe accidents. In the latter case, the annular-area option of the stop model should be used to estimate LOS doses. The source strength should be estimated from the product of the surface dose rate of the material and whatever shielding factor is appropriate to account for only partial degradation of the packaging. "Virtual vehicles" can be set up to model different degrees of loss of shielding (DOE, 2002a, Appendix J).

5.14 Handling Data

To review the discussion in Chapter 3, for each handling, the user assigns values to the following parameters following the keyword HANDLING:

- alphanumeric identifier, up to 10 characters;
- vehicle identifier (previously defined under keyword VEHICLE);
- number of handlers;
- average source-to-handler distance (m);
- handling time per package (hr/package).

The values of the last three parameters listed are a function of package size. Large containerized packages that are handled by spreader crane require several handlers. To move such a package from a truck to a ship's hold, for example, requires a crane operator, a spotter, and four or more additional workers (Neuhauser and Weiner, 1992b; Weiner and Neuhauser, 1992a). The package is modeled as a line source or a point source depending on distance. The average source-to-handler distance may be only a few meters, in which case a line source model is used. For packages that are smaller than a spent fuel cask but still large enough to require movement by forklift or similar equipment, the average source-to-handler distance decreases but so does the number of handlers. Finally, small packages that can be picked up and moved by hand (e.g., many radiopharmaceuticals) are analyzed in RADTRAN 5 by use of an empirical factor that relates handling time per package, source-to-handler distance, and other factors (keyword SMALLPKG; see Section 3.6).

5.15 Use of HANDLING or STOPS to Model Inspector Dose

Highly regulated shipments (e.g., spent fuel) are often subjected to redundant radiological and mechanical inspections by various government entities, carrier representatives, shippers of record, etc. Each inspection adds an increment of inspector dose. Inspectors generally must be close to the package/conveyance being inspected; their exposure may be modeled by use of the HANDLING or STOPS subroutine. Suggested parameter values are discussed in Ostmeyer (1986) for rail mode and Weiner and Neuhauser (1992a,b) for ship and highway modes.

5.16 Evacuation Time

The time (in days) that is required to evacuate a nearby population from the vicinity of an accident location is entered under the keyword EVACUATION.[12] The time is composed of (a) response time (i.e., the time it takes responders to reach the accident site, assess the hazard and initiate evacuation), and (b) actual evacuation time. The STANDARD value is one day. Evidence exists, however, to support use of a considerably lower value. A distribution of actual evacuation times from actual hazardous materials accidents is given in Mills, Neuhauser, and Smith (1995), and the mode (the "mean" of a log-normal distribution) is approximately one hour (0.04 day). Using Latin Hypercube Sampling (LHS) methods (Iman and Shortencarier, 1984) to sample from this distribution or a similar one developed by the user is the best way to deal with the uncertainty in this parameter (see Mills, Neuhauser and Kanipe (1995) for applications of LHS to RADTRAN).

5.17 Post-Accident Options

RADTRAN 5 contains decision logic that is based on calculated ground deposition and user-defined action thresholds. There are three possible courses of action:

1. If the ground deposition (Ci/m^3) exceeds the minimum clean-up level (keyword CULVL, Section 3.6), then the area under the plume is modeled as being evacuated at the end of the time entered under keyword EVACUATION (see Section 4.4);
2. If the ratio of ground deposition to clean-up level exceeds the maximum threshold (keyword INTERDICT), then the area is modeled as being permanently interdicted. That is, no residents return to the area and no additional dose is accumulated by these residents beyond what was already received in the hours prior to evacuation;

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[12] The term "evacuation" in RADTRAN refers collectively to activities separately labeled as "evacuation" and "relocation" in the MACCS code used by the NRC for fixed site analysis.

3. If the first but not the second threshold value is exceeded, then the area is modeled as being cleaned to acceptable levels, after which returning population are modeled as being chronically exposed to residual material at the action-threshold level.

As noted previously, the STANDARD value of the time required for surveying potentially contaminated areas (keyword SURVEY) is 10 days, which is less, probably considerably less, than such an activity would be expected to take in reality (Chanin and Murfin, 1996). However, in view of the uncertainty in estimating this parameter value, the short 10-day value has been used because it is *radiologically conservative*; that is, it minimizes time for radioactive decay and thereby maximizes exposure from any short-lived radionuclides at all subsequent times. The time required for clean-up is not explicitly accounted for, but actual clean-up times are most likely to be years or even decades (Chanin and Murfin, 1996). Because it is assumed that cleanup would always result in subsequent exposure of returning population to contamination at the minimum action-threshold level, however, actual clean-up time does not greatly influence the population-dose calculation.

5.18 Output Options

There are two output formats: dose and health effect. Both types of output are usually desired for an analysis. Radiological risks should always be presented at a minimum in the dose format (expected population dose-risk) since it is the least derivative of the two values. Expected health effects (e.g., latent cancer fatalities) may be obtained by a second run of the code or by calculations external to the code. In both output options, early radiological fatality and nonradiological fatality calculations are always performed.

> ***Box 5-1***
>
> *RADTRAN 5 Exposure Pathways*
>
> **Direct Exposure to Package**
> Loss of Shielding (LOS)
> and
> **5 Dispersion Pathways:**
> Cloudshine
> Inhalation
> Groundshine
> Resuspension
> Ingestion (societal)

The population-dose output format is selected on the FORM menu screen. Workstation users should enter the keyword UNIT on the FORM line. Doses are calculated for the exposure pathways shown in the box. Three of the dispersion-pathways results are what are called "prompt" doses. That is, doses that occur during or within a few hours of cloud passage. They are cloudshine, inhalation, and groundshine during evacuation. For each radionuclide in a material, effective dose equivalents for inhalation, cloudshine, and ingestion are taken from the radionuclide library. Groundshine and LOS doses are calculated from radionuclide-specific photon-energy data (except for LOS doses for special-form materials; see Section 5.3.4). The resuspension pathway is merely a delayed, chronic inhalation pathway, corrected when necessary for clean-up, weathering, and radioactive decay.

The health-effects output format may be selected by either selecting it on the FORM menu screen or entering the keyword NONUNIT. If NONUNIT is selected, then STANDARD values of health-effects multipliers may be used for latent-cancer fatalities and hereditary disorders, or the user may supply others. As noted in Chapter 4, health-effect risks are given for each route segment and for each exposure pathway. Tables give the risks related to loss-of-shielding (LOS) exposures, all dispersion-related exposures except ingestion, and societal ingestion. The conversion factors, e.g. LCF per person-rem, are listed in the tabulations of input data. If the stop model is used to perform an LOS analysis, then the user must estimate early effects (morbidities and mortalities) externally.

5.19 Early Effects

Early or deterministic health effects only occur at high radiation doses. Their severity increases with increasing dose, and a threshold exists below which no effect is observed. They also may be called acute, deterministic, or prompt effects. Persons in close proximity to intense gamma and/or neutron sources during a loss-of-shielding accident could receive acute doses above the effects' thresholds; as could persons in the innermost isopleths who are exposed via the inhalation or groundshine pathways following a dispersal accident. Symptoms may appear within a few hours or days following exposure. Depending on dose, effects exhibit a range of severity from short-term anorexia or vomiting, hair loss, and erythema (skin reddening), which are accounted for in the morbidity estimates, up to and including mortality, which is accounted for separately.

5.19.1 Mortality

Mortality may be observed in a fraction of a population exposed to high doses delivered over short periods of time. Death may occur in days, weeks or months, depending on the magnitude of the dose, post-exposure medical treatment, and initial health status of the affected individual(s). The likelihood of mortality decreases if the dose is fractionated or protracted (ICRP, 1984). The one-year dose is calculated and used to estimate mortalities in RADTRAN 5. The probability of death for a given acute bone marrow or lung dose is listed in an internal data table in RADTRAN 5 (see Table 5-2). This table is used to estimate mortality associated with doses calculated in an analysis. The data are derived from Evans et al. (1985) and are consistent with those used in the MACCS2 code. A mortality estimate is performed and printed regardless of the output option selected.

5.19.2 Morbidity

Morbidities or non-lethal clinical effects are also estimated in RADTRAN 5. As in previous releases of RADTRAN, several organ-specific effects are evaluated for the inhalation pathway. The organs included are:

- Lung
- Upper Gastrointestinal Tract (stomach)
- Bone Marrow
- Thyroid (radioiodine only)

The bone marrow and upper GI tract (stomach) are relatively radiosensitive, and the morbidity thresholds are lowest for these two organs. Lung tissue is among the most radiation resistant, and it has the highest morbidity threshold. Thyroid morbidity (noncancerous nodules and hypothyroidism) results almost exclusively from intake of radioiodine.

Table 5-2. Mortality – Dose Relationship for Marrow and Lung Exposure

Marrow Dose (rem)	Fatality Incidence	Marrow Dose (rem)	Fatality Incidence	Lung Dose (rem)	Fatality Incidence
<160	0.00000	570	0.99482	<500	0.00000
160	0.00913	580	0.99679	525	0.00759
170	0.01234	590	0.99808	550	0.01050
180	0.01639	600	0.99889	575	0.01430
190	0.02143	610	0.99938	600	0.01922
200	0.02761	620	0.99967	625	0.02549
210	0.03510	630	0.99983	650	0.03341
220	0.04408	640	0.99992	675	0.04329
230	0.05475	650	0.99996	700	0.05548
240	0.06729	660	0.99998	725	0.07038
250	0.08188	6700	0.99999	750	0.08837
260	0.09872	>670	1.00000	775	0.10988
270	0.11797			800	0.13529
280	0.13977			825	0.16498
290	0.16425			850	0.19925
300	0.19150			875	0.23830
310	0.22155			900	0.28218
320	0.25438			925	0.33077
330	0.28990			950	0.38372
340	0.32798			975	0.44042
350	0.36838			1000	0.50000
360	0.41078			1025	0.56130
370	0.45481			1050	0.62293
380	0.50000			1075	0.68335

Table 5-2. Mortality – Dose Relationship for Marrow and Lung Exposure (continued)

Marrow Dose (rem)	Fatality Incidence	Marrow Dose (rem)	Fatality Incidence	Lung Dose (rem)	Fatality Incidence
390	0.54583			1100	0.74095
400	0.59172			1125	0.79420
410	0.63706			1150	0.84178
420	0.68123			1175	0.88274
430	0.72363			1200	0.91656
440	0.76371			1225	0.94326
450	0.80096			1250	0.96331
460	0.83499			1275	0.97755
470	0.86552			1300	0.98709
480	0.89237			1325	0.99306
490	0.91551			1350	0.99653
500	0.93502			1375	0.99840
510	0.95111			1400	0.99933
520	0.96406			1425	0.99974
530	0.97423			1450	0.99991
540	0.98199			1475	0.99997
550	0.98776			1500	0.99999
560	0.99192			>1500	1.00000

5.20 Unit-Risk Factors

The Unit-Risk Factor Method was developed in the early 1980s by Sandia National Laboratories, which also performed the first analyses in which this method was used (Wilmot et al., 1983; Neuhauser et al., 1984; Cashwell et al., 1986). Other analyses in which it has been used include DOE (1995; 2002a, b). The method is suitable for certain applications, such as comparisons of alternative packagings and content loading, or for instances where a very large number of different routes, different cargo inventories, or different types of receptor populations are analyzed.

A unit-risk factor is a quantitative transportation risk (e.g., dose-risk, fatality-risk) calculated by setting one or more of the RADTRAN input parameters equal to 1.0. Dose (consequence) from incident-free transportation may also be calculated using a unit factor which, for convenience, is also called a unit risk factor. Risk and dose are then calculated by multiplying the unit risk factor by the appropriate parameter values.

Table 5-1 shows examples of unit risk factors (DOE, 2002a). A different set of parameters was set to 1.0 for each unit risk factor, and each unit risk factor has a different set of units.

Table 5-3. Examples of Unit Risk Factors

Width Receptor	Route Segment Type	Unit Risk Factors		
		Barge	Rail	Truck
Off-link public [rem per (persons/km^2) per km]	R	1.72E-7	3.90E-8	2.89E-8
	S	1.72E-7	6.24E-8	3.18E-8
	U	1.72E-7	1.04E-7	3.18E-8
On-link public (person-rem per km per vehicles/hr)	R		1.21E-7	9.53E-6
	S		1.55E-6	2.75E-5
	U		4.29E-6	9.88E-5
Public at rest stops (person-rem/km	R			5.50E-9
	S			5.50E-9
	U			5.50E-9
Residents near rail classification stops [person-rem per (persons/km^2) per km^2]	S		1.59E-5	
Worker in a moving vehicle (person-rem/km)	R	2.11E-6		4.52E-5
	S	2.11E-6		4.76E-5
	U	2.11E-6		4.76E-5
Worker at classification stop (person-rem)			4.64E-2	

Off-link public dose

Number of shipments, kilometers for each route segment, and population density (persons/km^2) all =1.0. The unit risk factor is then multiplied externally (e.g., in a spreadsheet) by the number of shipments, kilometers, and population densities for each route segment.

On-link public dose

Number of shipments and kilometers for each route segment =1.0. The unit risk factor is then multiplied externally (e.g., in a spreadsheet) by the number of shipments and by kilometers for each route segment.

Dose to public at rest stops

Number of shipments, population density, and number of rest stops per km=1.0. Time density, and distance from the source were input for one rest stop. The unit risk factor is then multiplied externally (e.g., in a spreadsheet) by the number of shipments, the population density for each segment type, and by the number of rest stops per km.

The unit risk factor approach is useful when the analyst wishes to evaluate a large number of alternatives that differ from each other in only one or a very few package-related or route-related features.

To develop route-level unit-risk factors, reasonably consistent *route subclasses* must be identified. A route subclass can be defined as an aggregate of all portions of a route that have some common property or combination of properties. The term "property" means a route-related RADTRAN variable (e.g., population density between a specified range, traffic count within a specified range, etc.). The most common route subclasses are based on population density (rural, suburban, and urban).

External calculations are not covered by RADTRAN software QA, and it is incumbent on the user to demonstrate their correctness. In some cases, radiological unit-risk factors could not be used in the absence of a linear-no-threshold (LNT) hypothesis. The LNT hypothesis for health effects of radiation exposure is currently being reexamined by various national and international bodies.

Unit-risk factors for nonradiological fatalities do not suffer from a similar dependency on a linear hypothesis, with the exception of the so-called incident-free factor, which was intended to account for health effects of inhalation of diesel exhaust. The factor values were originally assigned on the basis of a rather generic assessment by Rao et al. (1981) in which an LNT relationship was assumed.[13] Beginning at about the same time, the effects of many components of diesel exhaust (e.g., benzene) had begun to be better characterized (Wark and Warner, 1981). Exposure thresholds have now been identified for most of these components (e.g., 10 ppm for benzene; see Calabrese and Kenyon, 1991). In view of these developments, the use of an incident-free risk factor for nonradiological fatalities based on an LNT hypothesis can no longer be justified. Therefore, no STANDARD value has been recommended for the incident-free risk factor for nonradiological fatalities in RADTRAN 5, and the variable may be removed in a future release of the code.

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[13] Values were assigned for urban areas only and were 1.0E-07 fatalities/vehicle-km for highway, 1.3E-07 fatalities/vehicle-km for commercial rail, and 6.5E-07 fatalities/vehicle-km for dedicated rail.

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APPENDIX A Glossary of Terms

Many of the definitions given in this section are taken from ***The Health Physics and Radiological Health Handbook*** (Shleien, 1992). Some have been abridged or otherwise edited.

Absorbed dose—The energy imparted by *ionizing radiation* per unit mass of irradiated material. The units of absorbed dose are the *rad* and the *gray.*

Activity Mean Aerodynamic Diameter (AMAD)—The diameter of a unit-density sphere with the same terminal settling velocity in air as that of an aerosol particle the radioactivity of which is the median for the entire aerosol.

Air modes—Carriage of *packages* by *cargo air craft* or *passenger air craft.*

Atom—The smallest particle of an element that cannot be divided or broken up by chemical means. An atom consists of a nucleus, which contains protons and *neutrons*, and *electrons* that orbit the nucleus.

Attenuation—The process by which a beam of radiation is reduced in intensity when passing through some material.

Attenuation Coefficient—Of a substance, for a parallel beam of specified radiation: the quantity μ in the expression μdx for the fraction removed by attenuation in passing through a thin layer of thickness dx of that substance. The *linear attenuation coefficient* is expressed in terms of length (meters).

Beta radiation—Charged particles emitted from atomic nuclei during *radioactive decay.* A negatively charged beta particle is identical to an *electron.*

Cask—A heavily shielded accident-resistant container (*packaging*) used to ship and/or store highly *radioactive materials* such as *spent fuel.*

Cargo air mode—Carriage of *packages* by cargo aircraft.

Carrier—A company engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier, or by civil aircraft.

Cloudshine—Gamma radiation from airborne materials in an airborne plume.

Collective Dose—The sum of the individual *doses* received in a given period of time by a specified population from exposure to a specified source of *radiation.*

Committed Dose Equivalent—The dose equivalent to organs and tissues that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. The ICRP defines this as the committed equivalent dose.

Committed Effective Dose—See *committed effective dose equivalent.*

Committed Effective Dose Equivalent (CEDE)—The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the *committed dose equivalent* to these organs or tissues. The ICRP defines this as the *committed effective dose.*

Contamination—The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel.

Conveyance—Any *vehicle, vessel* or *aircraft* that might be used for the transportation of *radioactive material.*

Crud—A colloquial term for corrosion and wear products (rust particles, etc.) that become *radioactive* under a radiation flux. Sometimes found on the exterior surfaces of *spent fuel.* Derived from the term Chalk River Unidentified Deposits, which relates to the Chalk River reactor in Canada where crud was first observed.

Cumulative Dose—The total dose resulting from repeated exposures to *radiation* of the same region or of the whole body over a period of time.

Curie—A unit used to describe the intensity of *radioactivity* in a material. The curie is equal to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of radium. Named for Marie and Pierre Curie who discovered radium in 1898.

Daughter Products—*Radionuclides* that are formed by the *radioactive decay* of some other radionuclide.

Decay, Radioactive—The decrease in the amount of any *radioactive* material with the passage of time, due to the spontaneous emission from the atomic nuclei of either alpha or *beta* particles, often accompanied by *gamma radiation.* (See *half-life; radioactive*)

Decontamination—The reduction or removal of contaminating radioactive material from a structure, area, object, or person.

Dose or Radiation Dose—A generic term that means *absorbed dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent,* or *total effective dose equivalent.*

Dose Equivalent—The product of the *absorbed dose*, the *quality factor*, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

Dose Rate—The *radiation dose* delivered per unit time, e.g., rem per hour.

Effective Dose Equivalent—The sum of the products of the dose equivalent to the organ or tissue and the *weighting factors* applicable to each of the organs or tissues that are irradiated.

Electron—An elementary particle with a unit negative charge. See *beta radiation.*

Element—One of the 103 known chemical substances that cannot be broken down further without changing its chemical properties. Examples are hydrogen, nitrogen, gold, lead, and uranium.

Evacuation—The urgent removal of people from an area to avoid or reduce high-level, short-term exposure, usually from an airborne plume or from deposited activity.

Exclusive-use—A term used to describe a shipment in which the conveyance carries radioactive-material packages exclusively and no other cargo.

Exposure—A measure of the ionization produced in air by X or gamma radiation; units of exposure in the air are the Roentgen or coulomb per kilogram (SI units).

Fission Gases—Those fission products that exist in the gaseous state. Primarily the *noble gases* (krypton, xenon, radon, etc.)

Flux—A term applied to the amount of some type of *radiation* crossing a certain area per unit time. The unit of flux is number of particles, photons, etc. per square centimeter per second.

Gamma Radiation—High-energy, short wavelength electromagnetic radiation emitted from the nucleus of an atom. Gamma radiation frequently accompanies alpha and beta particle emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded against by dense materials such as lead or uranium.

Gaussian—Pertaining to or having properties of the probability density function that is also called the Normal Distribution or bell curve; named after 19th Century German mathematician Karl F. Gauss.

Genetic Effect—An effect in a descendant resulting from the modification of genetic material in a parent.

Gray (Gy)—The SI unit of *absorbed dose*. One gray is equal to an absorbed dose of 1 Joule per kilogram (100 *rad*).

Groundshine—Gamma radiation from radioactive materials deposited on the ground.

Half-life—The time in which half the atoms of a particular *radioactive* substance disintegrate to another nuclear form.

Health Effects—See *stochastic effects* and *nonstochastic effects*.

Ion—An *atom* that has too many or too few *electrons*, causing it to be chemically active.

Ionizing radiation—Any *radiation* capable of displacing electrons from atoms or molecules, thereby producing *ions*. Includes: alpha, beta, gamma, X-rays, neutrons, and ultraviolet light.

Isotope—One of two or more atoms with the same number of protons, but different number of neutrons, in their nuclei. Isotopes have very nearly the same chemical properties, but very often different physical properties (for example, carbon-12 and -13 are *stable*, carbon-14 is *radioactive*).

Joule (J)—A unit of energy equal to 1 watt-second or .239 calories. Named after English physicist James P. Joule (1818-1889).

Linear Attenuation Coefficient—See *attenuation coefficient.*

Maritime modes—See *Waterway modes.*

Member of the Public—An individual in an unrestricted area. An individual is not a member of the public during any period in which the individual receives an *occupational dose.*

Molecule—A group of *atoms* held together by chemical bonds. A molecule is the smallest unit of a compound that can exist by itself and retain all its chemical properties.

Neutron—An uncharged elementary particle found in the nucleus of every *atom* heavier than hydrogen.

Noble Gas—A gaseous chemical element that does not readily enter into chemical combination with other elements. An inert gas. (See *fission gases*)

Nonstochastic effects—Health effects, the severity of which varies with the dose and for which a threshold is believed to exist (also called deterministic, early, or prompt effects). Usually follow exposure within a few hours or days; effects range from short-term nausea and skin-reddening up to, for supralethal doses, death within a few days.

Nuclide—A general term referring to all known isotopes, both *stable* and *unstable,* of a chemical *element.* See also *radionuclide.*

Occupational Dose—The dose received by an individual in a restricted area or in the course of employment in which the individual's assigned duties involve exposure to radiation and to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person.

Overland modes of transportation—Carriage of *packages* by *highway* or *rail* modes.

Package—A *packaging* and its *radioactive* contents.

Packaging—The assembly of components necessary to ensure compliance with packaging requirements. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The *vehicle*, tie-down system, and auxiliary equipment may be designated as part of the packaging.

Parent—A *radionuclide* that upon *radioactive decay* or disintegration yields another nuclide (the *daughter*).

Pasquill System—Also called the Pasquill-Gifford System. A widely used empirical system for assigning Gaussian diffusion parameters to atmospheric releases of pollutants, including radionuclides. Six classes of atmospheric stability may be specified in RADTRAN 5; they range from highly unstable (Class A) to moderately stable (Class F). The frequency of occurrence of each class is recorded by many weather stations.

Passenger air mode—Carriage of *packages* by passenger aircraft.

Photon—A quantum (or packet) of energy emitted in the form of *radiation*. *Gamma rays* and X-rays are examples of photons.

Point Source—Ideally, a source with infinitesimal dimensions. Practically, a source of radiation the dimensions of which are small compared with the viewing distance.

Public Dose—The population *dose* received by *members of the public* from exposure to *radiation* and to radioactive material. It does not include *occupational dose*.

Pressurized Water Reactor (PWR)—A power reactor in which heat is transferred from the core to a heat exchanger by high-temperature water kept under high pressure.

Quality Factor—The modifying factor that is used to derive *dose equivalent* from *absorbed dose*.

Rad— A unit of *absorbed dose*. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 J per kg (0.01 gray).

Radiation (ionizing radiation)—*Alpha* particles, *beta* particles, *gamma* rays, X-rays, *neutrons* and other particles capable of producing *ions*.

Radioactive—Exhibiting *radioactivity*.

Radioactive Decay—See *Decay, radioactive*.

Radioactive Isotope—A *radioisotope*.

Radioactivity—The spontaneous emission of *radiation*, from the nucleus of an unstable *isotope*.

Radioisotope—An unstable *isotope* of an *element* that *decays* or disintegrates spontaneously, emitting *radiation*.

Radionuclide—A general term referring to all known *unstable* or *radioactive* isotopes of a chemical *element*. A *radioisotope*.

Rail mode—Carriage of one or more *packages* by one or more railcars in a train traveling on a railroad.

Reference Man—A hypothetical aggregation of human physical and physiological characteristics arrived at by international consensus. These standards are used to relate biological insult from radiation to a common base.

Rem—A unit of *dose equivalent*. The *dose equivalent* in rem is equal to the *absorbed dose* in *rad* multiplied by the *quality factor* (1 rem = 0.01 sievert). Rem was originally an abbreviation for "Roentgen equivalent man (or mammal). See also *sievert*.

Shielding—Any material or obstruction that absorbs *radiation* and thus tends to protect persons or materials from the effects of *ionizing radiation*.

Short-lived daughters—*Radioactive* progeny of *radioactive isotopes* that have *half-lives* on the order of a few hours or less.

Sievert (Sv)—The SI unit of *dose equivalent*. The dose equivalent in sieverts is equal to the *absorbed dose* in *gray* multiplied by a *quality factor* (1 Sv = 100 *rem*).

Spent Fuel (spent nuclear fuel)—Nuclear reactor fuel that has been used to the extent that it can no longer effectively sustain a chain reaction; also applied less accurately to fuel that has been used to any extent in a reactor and permanently removed from the reactor.

Stable Isotope—An *isotope* that does not undergo *radioactive decay*.

Stochastic Effects—Health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Genetic effects and cancer incidence are examples of stochastic effects of exposure to radiation.

Survey—An evaluation of the radiological conditions and potential hazards incident to the release or presence of *radioactive material*. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation or concentrations or quantities of radioactive material present.

Transport Index (TI)—A dimensionless number, rounded up to the first decimal place, placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The TI is derived from the maximum radiation level in millirem per hour at 1 meter from the external surface of the package.

Truck—Any of several types of *vehicles* used in the carriage of *packages* by *highway mode*

Unstable Isotope—A *radionuclide* or *radioisotope*.

Unit-Risk Factor—A risk (e.g., dose-risk, fatality-risk) associated with transportation of a given radioactive material shipment for a unit distance of travel, usually 1 km.

Van—Any of a class of medium-sized *vehicles* often used for the carriage of small *packages* such as radiopharmaceuticals by *highway mode*.

Vehicle—Motorized *conveyance* used for transportation of *packages* by *highway* mode. *Trucks* and *vans* are vehicles.

Vessel—Any conveyance used for the transportation of *packages* by *waterway modes*. *Ships* and *barges* are vessels.

Waterway Modes—Carriage of *packages* by *barge* or *ship* (also called *maritime modes*).

APPENDIX B Intermediate Data and Plots

Ordered pairs of probability and consequence values are written to output files R5PLOT0.DAT, R5PLOT1.DAT and R5PLOT2.DAT. These files contain, respectively, dose or latent-cancer-fatality (LCF) estimates, genetic-effects estimates, and maximum-individual-dose estimates. Associated summed probabilities are also included in these files. R5INTERM.DAT contains all of the data necessary to produce each of these files. These data can be used for probability-consequence plotting and sensitivity analysis. R5INTERM.DAT is intended to preserve the numerous intermediate probability and consequence calculations that are performed in RADTRAN 5 prior to the generation of the ordered-pair files and the final products and summations which are the actual risk values. Additional features of the ordered-pairs files are implemented by the subroutine PAIRS, which reads consequence and probability data from R5INTERM.DAT by using keywords within the file to locate the data. The probabilities are link-specific, and the consequence types are dispersion-cloud-specific. This means that for each link analyzed, up to six separate dispersion clouds and associated sets of consequence values, corresponding to up to six Pasquill atmospheric stability categories, may be given for each consequence type. Corresponding probability arrays also are constructed. If the pre-calculated Pasquill dispersion clouds are used, then each probability value is multiplied by the appropriate Pasquill probability. If the Pasquill dispersion data are not used, then a single set of dispersion data is used.

For each link in a given analysis, the accident rates are written to R5INTERM.DAT. The total number of expected accidents for all shipments is written for each link. A record is written for each radionuclide in each material for each mode in the link. The record gives estimates of either dose or latent cancer fatalities, genetic effects, and maximum individual consequences. The expected numbers of accidents and Pasquill categories are given at the link level, whereas dose and health-effects estimates are calculated at the radionuclide-level.

The order in which the values are written to the file R5INTERM.DAT is as follows:

The first number in the file R5INTERM.DAT is the number of severity categories (NSEV) used in the analysis to describe the spectrum of accidents. The descriptor line PASQUILL CATEGORY AND PROBABILITY is followed by the Pasquill category number and the fraction; if the run is not a Pasquill run then the category number will be 1 and be assigned a fraction of 1.0. Descriptor line LINK is followed by the link number, the vehicle identifier, and the vehicle number, then the descriptor ACCIDENT RATE followed by the accident rate multiplied by the severity fraction. There will be NSEV values. Next is the descriptor EXPECTED NUMBER OF ACCIDENTS (PROBABILITY) which is then followed by the accident rate multiplied by the product of the distance traveled and the number of shipments. Again, there will be NSEV values. Descriptor lines ISOTOPES are listed after the LINK descriptor. Each ISOTOPES descriptor is followed by the isotope number, the curie value times the number of packages, and the half-life of the isotope. The next line lists the nuclide name, the physical-chemical group to which it was assigned, and the material in which it is contained. For each radionuclide there are three associated descriptors. The first is LCF (NON-UNIT) OR PERSON-REM (UNIT) CONSEQUENCE DATA. The values for this descriptor are, as indicated, either latent cancer fatality data or person-rem dose vales for each severity category. The next descriptor is GE CONSEQUENCE DATA. The values following this will be zero if health effects output was not chosen. Otherwise; the genetic effects data will be listed for each severity category. Finally, the descriptor MAXIMUM INDIVIDUAL DOSE is listed followed by maximum individual dose consequences for each severity category.

The above order is repeated for each Pasquill category if the run uses the Pasquill atmospheric dispersion option. Each link is listed and within each link all radionuclides are listed with their associated descriptors and values. Below is an example of the subroutine PAIRS which is used to produce the probability-consequence pairs in files R5PLOT0.DAT, R5PLOT1.DAT and R5PLOT2.DAT. PAIRS is written so that it can be used as a stand-alone program.

```
      SUBROUTINE PAIRS
C       PROGRAM PAIRS
C
C      THIS SUBROUTINE (PROGRAM) READS IN DATA FROM R5INTERM.DAT
C      PRODUCED BY
C      RADTRAN AND PRODUCES 3 FILES OF ORDERED PAIRS OF NUMBERS.
C      THE FIRST NUMBER IS A CONSEQUENCE AND THE SECOND IS A SUMMED
C      PROBABILITY. THE SUMMED PROBABILITIES INDICATE THE PROBABILITY
C      OF A PARTICULAR CONSEQUENCE OR WORSE. CONSEQUENCES WITH
C      ZERO PROBABILITIES ARE IGNORED AND NOT PRINTED.
C      1. R5PLOT0.DAT CONTAINS SORTED LCF OR PERSON-REM CONSEQUENCES
C         WITH SUMMED PROBABILITIES.
C      2. R5PLOT1.DAT CONTAINS SORTED GENETIC EFFECTS CONSEQUENCES
C         WITH SUMMED PROBABILITIES.
C      4. R5PLOT2.DAT CONTAINS SORTED MAXIMUM INDIVIDUAL DOSE
C       CONSEQUENCES WITH SUMMED PROBABILITIES.
C
C .... 20*60*6=7200    SEVERITIES*LINKS*PASQUILL CATEGORIES

      PARAMETER (LENGTH=7200)

      REAL CONLCF(LENGTH), CONGE(LENGTH), CONMAX(LENGTH)

C .... CONLCF > CONSEQUENCE OF LCF (OR PERSON-REM)
C .... CONGE  > CONSEQUENCE OF GENETIC EFFECTS
C .... CONMAX > CONSEQUENCE OF MAXIMUM INDIVIDUAL DOSE

      REAL CLCF(20), CGE(20)

C .... TEMPORARY VARS TO HOLD EACH ISOTOPE'S NSEV VALUES FOR LCF AND C
     GE
```

```
      REAL PRLCF(LENGTH), PRGE(LENGTH), PRMAX(LENGTH)

C .... PRLCF  > PROBABILITY OF LCFs (OR PERSON-REM)
C .... PRGE   > PROBABILITY OF GENETIC EFFECTS
C .... PRMAX  > PROBABILITY OF MAXIMUM INDIVIDUAL DOSE

      CHARACTER TEST*10

      REAL DUMMY(20), PROB(20), PASQPR
C .... PROB HOLDS THE PROBABILITY FOR A LINK
C .... PASQPR HOLDS THE PASQUILL PROBABILITY (WILL BE 1.0 IF
C .... PASQUILL NOT USED IN RADTRAN)

      LOGICAL EOF
      DATA EOF / .FALSE. /

C .... COMMENT OUT NEXT LINE IF USED AS A SUBROUTINE INSIDE RADTRAN
C      OPEN (UNIT=8, STATUS='OLD', FILE='R5INTERM.DAT')
      REWIND (8)
      OPEN (UNIT=10, STATUS='UNKNOWN', FILE='R5PLOT0.DAT')
      OPEN (UNIT=11, STATUS='UNKNOWN', FILE='R5PLOT1.DAT')
      OPEN (UNIT=12, STATUS='UNKNOWN', FILE='R5PLOT2.DAT')

   10 CONTINUE
C ... CONTINUE READING R5INTERM.DAT - FOR SEPARATE RUNS

      READ (8,'(I5)',END=1000) NSEV
      LOOP = -1
C .... LOOP KEEPS TRACK OF THE NUMBER OF DIFFERENT OUTPUT GROUPS
C      DIFFERENT VEHICLES AND/OR DIFFERENT PASQUILL CATEGORIES)
C      STARTS AT ZERO
      DO 15 I = 1, LENGTH
       CONLCF(I) = 0.0
       CONGE(I) = 0.0
   15 CONTINUE

      IF (EOF) THEN
C ...... WRITE EOF TO THE OUTPUT FILES --- VARIABLE EOF WILL NOT BE TRUE
C ...... UNLESS A DATA SET HAS BEEN READ -- IF THERE IS ONLY ONE DATA SET
C ......OR IT IS THE LAST DATA SET THEN THE ABOVE READ WILL HAVE FOUND
C       THE END OF FILE. MARKER AND WOULD SKIP THIS AND GO TO THE END C
    IN THIS WAY THERE WILL BE NO ENDING EOF AND NO EOF AT ALL FOR
C       JUST ONE DATA SET
       WRITE (10,'("      EOF")')
       WRITE (11,'("      EOF")')
```

```
      WRITE (12,'("     EOF")')
      EOF = .FALSE.
     ENDIF

   20 CONTINUE
C .... CONTINUE READING DATA FROM R5INTERM.DAT WHILE NOT EOF

      READ (8,'(A10)',END=1000) TEST

      IF (TEST.EQ.'      EOF') THEN
       EOF = .TRUE.

      ELSEIF (TEST.EQ.'     LINK') THEN
       READ (8,'()')
       READ (8,'()')
C . . . . SKIP THE ACCRAT ARRAY -- NOT USED FOR THIS APPLICATION
       READ (8, 100) (DUMMY(I),I = 1, NSEV)
       READ (8,'()')
       READ (8, 100) (PROB(I),I = 1, NSEV)
       LOOP = LOOP + 1

      ELSEIF (TEST.EQ.' PASQUILL') THEN
       READ (8,'(I6,1PE10.2)') IDUM, PASQPR

      ELSEIF (TEST.EQ.'  ISOTOPE') THEN
       READ (8,'()')
       READ (8,'()')
       READ (8,'()')
       READ (8, 100) (CLCF(I), I = 1, NSEV)
       READ (8,'()')
       READ (8, 100) (CGE(I), I = 1, NSEV)

       DO 30 I = 1, NSEV
        PP = PROB(I)*PASQPR
        INDEX = LOOP*NSEV+I
        PRLCF(INDEX) = PP
        PRGE(INDEX) = PP
C . . . . . SUM THE COSEQUENCES OVER ISOTOPES
        CONLCF(INDEX) = CONLCF(INDEX) + CLCF(I)
        CONGE(INDEX) = CONGE(INDEX) + CGE(I)
   30   CONTINUE

      ELSEIF (TEST.EQ.'  MAXIMUM') THEN
       READ (8, 100) (CONMAX(LOOP*NSEV+I),I = 1, NSEV)
```

```
      DO 45 I = 1, NSEV
        PRMAX(LOOP*NSEV+I) = PROB(I)*PASQPR
 45     CONTINUE

     ELSE
       WRITE (10,'(A)') ' ERROR IN R5INTERM.DAT'
       WRITE (11,'(A)') ' ERROR IN R5INTERM.DAT'
       WRITE (12,'(A)') ' ERROR IN R5INTERM.DAT'
       STOP 'ERROR IN R5INTERM.DAT'
     ENDIF

     IF (.NOT.EOF) GOTO 20

C .... FOUND END OF A DATA SET IN R5INTERM.DAT

C
     LEN = (LOOP+1)*NSEV
C .... SORT BY CONSEQUENCE IN DECREASING ORDER CARRYING THE
C      PROBABILITY ALONG
     CALL SSORT (CONLCF, PRLCF, LEN, -2)
     CALL SSORT (CONGE, PRGE, LEN, -2)
     CALL SSORT (CONMAX, PRMAX, LEN, -2)

C .... SUM1 AND SUM2 HOLD PROBABILITY SUMS
     SUM1 = 0.0
     SUM2 = 0.0
     DO 50 I = 1, LEN
       IF (PRLCF(I).NE.0.0) THEN
C . . . . .SKIP IT IF THE PROBABILITY IS ZERO
         SUM1 = SUM1 + PRLCF(I)
         WRITE (10,200) CONLCF(I), SUM1
       ENDIF
       IF (PRGE(I).NE.0.0) THEN
C . . . . .SKIP IT IF THE PROBABILITY IS ZERO
         SUM2 = SUM2 + PRGE(I)
         WRITE (11,200) CONGE(I), SUM2
       ENDIF
 50  CONTINUE

     SUM1 = 0.0
     DO 70 I = 1, LEN
       IF (PRMAX(I).NE.0.0) THEN
C . . . . .SKIP IT IF THE PROBABILITY IS ZERO
         SUM1 = SUM1 + PRMAX(I)
         WRITE (12,200) CONMAX(I), SUM1
```

```
      ENDIF
 70  CONTINUE

      GOTO 10

 1000 CONTINUE
C .... END OF FILE MARKER WAS READ ....

 100 FORMAT (8(E10.3))
 200 FORMAT (2(1PE10.2))
C     STOP
      RETURN
      END
```

In the subroutine PAIRS, the consequence types are sorted and printed in decreasing order (highest first) and the corresponding probability array is re-ordered accordingly. When the consequences are printed, zero-probability consequences are omitted. The probabilities associated with each non-zero consequence are summed and printed at the same time that the consequences are printed. The resulting ordered pairs can be used for producing consequence vs. probability plots such as Cumulative Complementary Density Functions (CCDFs) in which the probability associated with each consequence represents the probability of the corresponding consequence being equal to or greater than the given value.

If the original output was requested in terms of dose rather than health effects, then doses will be written in R5PLOT0.DAT as indicated, but all consequence values in R5PLOT1.DAT will be zero and should be neglected. If R5INTERM.DAT contains more than one data set (indicated by the key word EOF after each data set), then each data set in R5PLOT0.DAT, R5PLOT1.DAT, and R5PLOT2.DAT will be separated by the word EOF. If there is only one data set, then no EOF is printed and all values in these files will be numeric.

To plot the values contained in the file R5PLOT0.DAT, R5PLOT1.DAT and R5PLOT2.DAT simply:

1. download the file (it is an ASCII text file),

2. open a spreadsheet program,

3. import the ASCII text file, and

4. create a plot using the program's capabilities.

Figure B-1 shows an example is given below of a plot created from the R5PLOT0.DAT data loaded into the spreadsheet program, Microsoft Excel.™ The accompanying data table, Table B-1, also was created by the spreadsheet program from the downloaded R5PLOT0.DAT file.

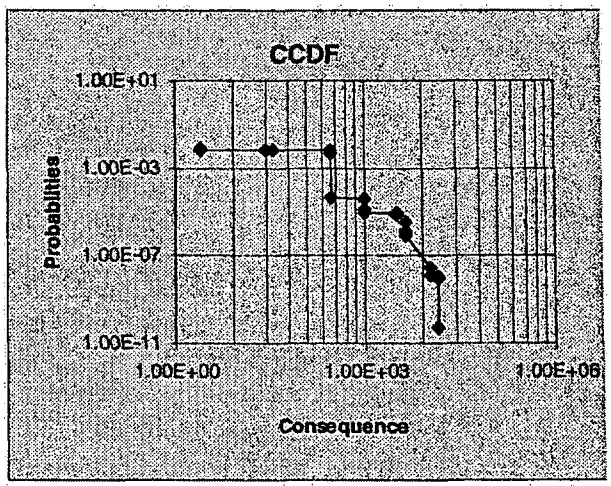


Figure B.1. Sample Probability-Consequence Plot

Table B-1. Probability-Consequence Pairs Used in Sample Plot

CONSEQUENCE	PROBABILITY
1.41E+05	5.08E-10
1.41E+05	8.74E-08
1.41E+05	9.71E-08
1.41E+05	1.02E-07
1.06E+05	1.20E-07
1.06E+05	1.29E-07
1.06E+05	1.30E-07
1.06E+05	2.97E-07
4.34E+04	8.72E-06
4.34E+04	1.15E-05
4.34E+04	1.25E-05
4.34E+04	3.78E-05
3.27E+04	7.57E-05
3.27E+04	7.71E-05
3.27E+04	8.13E-05
3.27E+04	9.39E-05
9.85E+03	9.39E-05
9.85E+03	9.39E-05
9.85E+03	9.39E-05
9.85E+03	9.42E-05
9.85E+03	1.22E-04
9.85E+03	1.24E-04
9.85E+03	3.78E-04
9.85E+03	3.91E-04
3.03E+03	4.42E-04
3.03E+03	4.47E-04
3.03E+03	4.49E-04
3.03E+03	4.66E-04
3.03E+03	5.10E-02
3.03E+03	5.28E-02
3.03E+03	6.96E-02
3.03E+03	7.53E-02
3.63E+02	7.53E-02
3.63E+02	7.53E-02
2.73E+02	7.53E-02
2.73E+02	7.53E-02
2.53E+01	7.53E-02
2.53E+01	7.53E-02
2.53E+01	8.34E-02
2.53E+01	8.61E-02
0.00E+01	8.85E-02
0.00E+01	1.33E-01
0.00E+01	1.63E-01

Table B-1. Probability-Consequence Pairs Used in Sample Plot (continued)

CONSEQUENCE	PROBABILITY
0.00E+01	1.64E-01
0.00E+01	1.78E-01
0.00E+01	5.16E-00
0.00E+01	7.70E-00
0.00E+01	1.53E+01
0.00E+01	1.57E+01
0.00E+01	1.67E+01
0.00E+01	1.73E+01
0.00E+01	1.89E+01
0.00E+01	2.06E+01
0.00E+01	2.08E+01
0.00E+01	2.08E+01
0.00E+01	2.12E+01
0.00E+01	2.14E+01
0.00E+01	2.20E+01
0.00E+01	2.23E+01
0.00E+01	2.31E+01

APPENDIX C Error Messages

The following is a listing of error messages for RADTRAN. This listing does not include device error messages that the user may receive from the system on which RADTRAN is installed. Device error messages are system-specific, and RADTRAN may be installed on a variety of systems. Many of the RADTRAN error messages are self-explanatory, but explanations are provided below to assist the user. Error messages appear in the main output file. In general, when an error occurs, the remainder of the output file will not be printed because calculation was terminated. With a few exceptions, which are noted below, recovery from RADTRAN errors consists of correcting value(s) in the input file and re-running RADTRAN.

ERROR MESSAGE LISTING IN ALPHABETICAL ORDER

AVINT INTEGRATION RETURNED ERROR = n

This message will only appear if there is an error within the SLATEC math routine AVINT. If this message appears, the copy of the code being used may have been corrupted. In this event, please contact the code developer, Sandia National Laboratories.

CAN ONLY DEFINE A MAXIMUM OF n VEHICLES.

where

n = maximum number of vehicles allowed

User entered more than the maximum allowed number of vehicles under the keyword VEHICLE.

CONVERGENCE FAILED IN SUBROUTINE BESSL

The user should never receive this message during proper use of RADTRAN because the input parameters for the BESSL routine are not user-definable. If this message appears, the copy of the code being used may have been corrupted. In this event, please contact the code developer, Sandia National Laboratories.

DIMEN REQUIRES ONLY THREE VALUES

The three values are: number of severity categories, number of radial distances, and number of isopleth areas. The previous release of RADTRAN required 4 values after the keyword DIMEN, but RADTRAN 5 requires only the three values listed.

ERROR IN OPENING INGESTION FILE s

where

s = ingestion file name

The ingestion file name entered in the input file is incorrect. Either the file does not exist or the name is typed incorrectly. One should be aware that on a UNIX system filenames are *case sensitive*. If this message occurs with the file name given in the standard values data file, then the problem may be code-related. In this event, please contact the code developer, Sandia National Laboratories.

ERROR IN R5INTERM.DAT

If an error is encountered reading R5INTERM.DAT, then this error message is printed in R5PLOT0.DAT, R5PLOT1.DAT, and R5PLOT2.DAT.

ERROR IN PROBABILITIES FOR PASQUILL CATEGORIES x SUM = y

where

x = set of six values representing the frequencies of occurrence of the six Pasquill stability categories $[x_1\ x_2\ x_3\ x_4\ x_5\ x_6]$*; and*
y = sum of the Pasquill probabilities.

This error message indicates that the sum of the probabilities of occurrence of the six Pasquill atmospheric stability categories is not equal to one. The sum of the probabilities of these categories must be adjusted to equal 1.0 before the code can run.

ERROR TOLERANCE NOT MET IN QUAD1

This message only appears if the limits of integration exceed the abilities of the QUAD1 subroutine. Since the user does not control these values, this message should not appear during proper use. If it does, then the copy of the code being used may have been corrupted. In this event, please contact the code developer, Sandia National Laboratories.

EXCEEDED NUMBER OF SEGMENTS ALLOWED

MAXIMUM NUMBER OF STOPS ALLOWED IS m_s

NUMBER OF STOPS ENTERED IS n_s

MAXIMUM NUMBER OF HANDLINGS ALLOWED IS m_h
NUMBER OF HANDLINGS ENTERED IS n_h

MAXIMUM NUMBER OF LINKS ALLOWED IS m_l
NUMBER OF LINKS ENTERED IS n_l

where

m = maximum number of stops (m_s), handlings (m_h), or links (m_l)
n = number of stops (n_s), handlings (n_h), or links (n_l)

Too many stops, handlings, or links were entered in the input file. The user must reduce the number of stops, handlings or links.

EXPECTED A NUMERIC VALUE, FOUND: s

where

s = character string read in from input.

This message appears if the user enters a character string instead of a numeric value where the latter is required.

FINDI FAILED ON BSKIN CALL

This message indicates that the user has input a value for μ (linear absorption coefficient), which is used in the gamma and neutron dose calculations, of less than zero. The coefficient must have a positive value.

FIRST KEYWORD MUST BE 'TITLE'. THE NEXT KEYWORD MUST THEN BE 'INPUT' WITH SECOND LEVEL KEYWORD 'STANDARD' FOR STANDARD DATA INPUT FILE, OR 'ZERO' FOR ZEROED OUT DATA INPUT FILE.

The user did not follow the required order for the first three lines of input in the input file.

FRACTIONS OF GAMMA AND NEUTRON MUST SUM TO 1.0
THE FRACTION OF GAMMA IS n AND THE FRACTION OF NEUTRON IS m

The sum of the fractions of the dose rate at 1 meter that are gamma and neutron radiations, respectively, must be 1.0. The user must adjust the values so that n + m = 1.0 before the code will run.

GOTO ERROR AT s

where

s = name of subroutine which had an error in a GOTO statement.

This message should not appear during proper use of RADTRAN. It indicates a programming error with a computed GOTO statement. If it does appear, then the copy of the code being used may have been corrupted. In this event, please contact the code developer, Sandia National Laboratories.

GROUP s DOES NOT HAVE RELEASE FRACTIONS ASSIGNED ABOVE.

where

s = physical-chemical group name

User entered a physical-chemical group designator that had not been defined. The user must define a physical-chemical group under the keyword RELEASE before assigning release fractions, aerosol fractions, or respirable fractions to the group.

INVALID IACC VALUE IN EARLY

The IACC value is a flag used to indicate that a material contains dispersible (IACC = 2) or non-dispersable (IACC = 1) isotopes. The user should never receive this message during proper use of RADTRAN because IACC is only set to 1 or 2. If this message should appear, contact the code developer (Sandia National Laboratories).

ISOTOPE NAMED s NOT DEFINED

where

s = isotope name

User entered an isotope name s that has not previously been defined. The user must define it under keyword DEFINE.

MATERIAL s NOT PREVIOUSLY DEFINED

where

s = material name

User entered a material name that had not previously been defined. The user must define it under keyword PACKAGE.

MATERIAL s PREVIOUSLY DEFINED

where

s = material name

User attempted to define a material under keyword PACKAGE with the same name as a material that has previously been defined.

MODE TYPE CANNOT BE ZERO

A mode type of 0 was entered. Allowable mode types are 1 through 10.

s IS INCLUDED IN PHOTON ENERGY OF PARENT ISOTOPE. TO INCLUDE THIS ISOTOPE SEPARATELY, PLEASE DEFINE USING ANOTHER SYMBOL COMBINATION.

where

s = isotope name

The user has attempted to define an isotope with a name that is a reserved word indicating that the isotope in question is a daughter product of one of the library isotopes. This is a precaution to prevent the user from unknowingly adding daughter products that have already been taken into account elsewhere. The user is not prevented from defining any isotope; however, the designator must differ from those in the daughter isotopes list.

THE DISTANCE FROM SOURCE TO CREW MEMBERS IS x METERS.
THE EFFECTIVE CHARACTERISTIC VEHICLE DIMENSION IS y METERS.
THE CREW DISTANCE MUST BE GREATER THAN 1/2 OF VEHICLE DIMENSION.

The distance from source to crew members is not large enough. Too small value for x will cause crew members to be effectively *inside* of the package; x must be > 1/2 y.

TOO MANY MATERIALS, MAX IS n

where

n = maximum number of materials allowed.

This message indicates that a new material name was entered that increased the number of materials to more than the maximum allowed. The user must delete at least one material from the input file.

TOO MANY ISOTOPES IN THE MATERIAL

This message appears when the user has included more isotopes in a material description than is allowed. All materials must be modeled as consisting of no more than 200 isotopes.

TOO MANY PHYSICAL-CHEMICAL GROUP TYPES, THE MAXIMUM IS n

where

n = maximum number of physical-chemical groups allowed.

This message indicates that a new physical-chemical group was entered that increased the number of groups to more than the maximum allowed. The user must delete at least one from the input file.

UNKNOWN IDENTIFIER DETECTED ON INPUT s

where

s = character string read in from input.

This message appears when a character string that is not a keyword has been used in a keyword location. This message can result from either a spelling error or improper location of the character string.

VALUE ENTERED IS x,
VALUE MUST BE GREATER THAN OR EQUAL TO y

where

x = input value entered by the user
y = maximum value allowed

The message appears when the input file contains a value that is not within the prescribed allowable range for a particular variable. In the output file the line that is echoed just before this message will contain the erroneous value.

VALUE ENTERED IS x,
VALUE MUST BE LESS THAN OR EQUAL TO y

where

x = input value entered by the user
y = maximum value allowed

The message appears when the input file contains a value that is not within the prescribed allowable range for a particular variable. In the output file the line that is echoed just before this message will contain the erroneous value.

VEHICLE s NOT PREVIOUSLY DEFINED

where

s = vehicle name

An attempt was made to enter a vehicle name that had not previously been defined under keyword VEHICLE.

APPENDIX D STANDARD Parameter Values

Urban characteristics

1	Building dose factor;	(BDF)	5.000E-02
2	Urban building fraction;	(UBF)	9.000E-01
3	Urban sidewalk fraction;	(USWF)	1.000E-01

Incident-Free characteristics

1	Small package size for handling;	(SMALLPKG)	5.000E-01
2	Number of flight attendants for PASNGR_AIR mode	(FNOATT)	4.000E+00
3	Dedicated trains? (1=not dedicated, 2=dedicated);	(ITRAIN)	1
4	Minimum rail classifications (inspections);	(FMINCL)	2.000E+00
5	Distance-depend rail worker exposure factor (class./km)	(DDRWEF)	1.800E-03
6	Maximum In-Transit Dose: distance(m);	(MITDDIST)	3.000E+01
7	Maximum In-Transit Dose: velocity(km/hr);	(MITDVEL)	2.400E+01
8	Regulatory checks: (1= do checks, 0= don't);	(REGCHECK)	1

HIGHWAY values under second-level keyword DISTOFF

1	FREEWAY	distance to curb	3.000E+01
2		distance to outer sidewalk edge	3.000E+01
3		maximum distance of exposure	8.000E+02
4	SECONDARY	distance to curb	2.700E+01
5		distance to outer sidewalk edge	3.000E+01
6		maximum distance of exposure	8.000E+02
7	STREET	distance to curb	5.000E+00
8		distance to outer sidewalk edge	8.000E+00
9		maximum distance of exposure	8.000E+02

RAILWAY and WATERWAY values under second-level keyword DISTOFF

1	RAILWAY	distance to pedestrians	3.000E+01
2		distance to outer edge of pedestrian concentration	3.000E+01
3		maximum distance of exposure	8.000E+02
4	WATERWAY	distance to pedestrians	2.000E+02
5		distance to outer edge of pedestrian concentration	2.000E+02
6		maximum distance of exposure	1.000E+03

Values under second-level keyword DISTON

1	FREEWAY perpendicular distance of vehicle in opposite direction	1.500E+01
2	SECONDARY perpendicular distance vehicle in opposite direction	3.000E+00
3	STREET perpendicular distance of vehicle in opposite direction	3.000E+00
4	RAIL perpendicular distance of vehicle in opposite direction	3.000E+00
5	ADJACENT distance of adjacent vehicle	4.000E+00

Standard Variables that describe shielding

1	IUOPT; (1, 2 or 3)	2
2	Rural shielding factor; (RR)	1.000E+00
3	Suburban shielding factor; (RS)	8.700E-01
4	Urban shielding factor; (RU)	1.800E-02

NOTE: Building shielding option flag (IUOPT)
= 1, Buildings provide %100 shielding. RR,RS and RU do not apply.
= 2, Buildings provide partial shielding. RR,RS and RU are used.
= 3, Buildings provide no shielding. RR,RS and RU do not apply.

Standard variables that describe evacuation times and set the dispersal/non-dispersal flag.

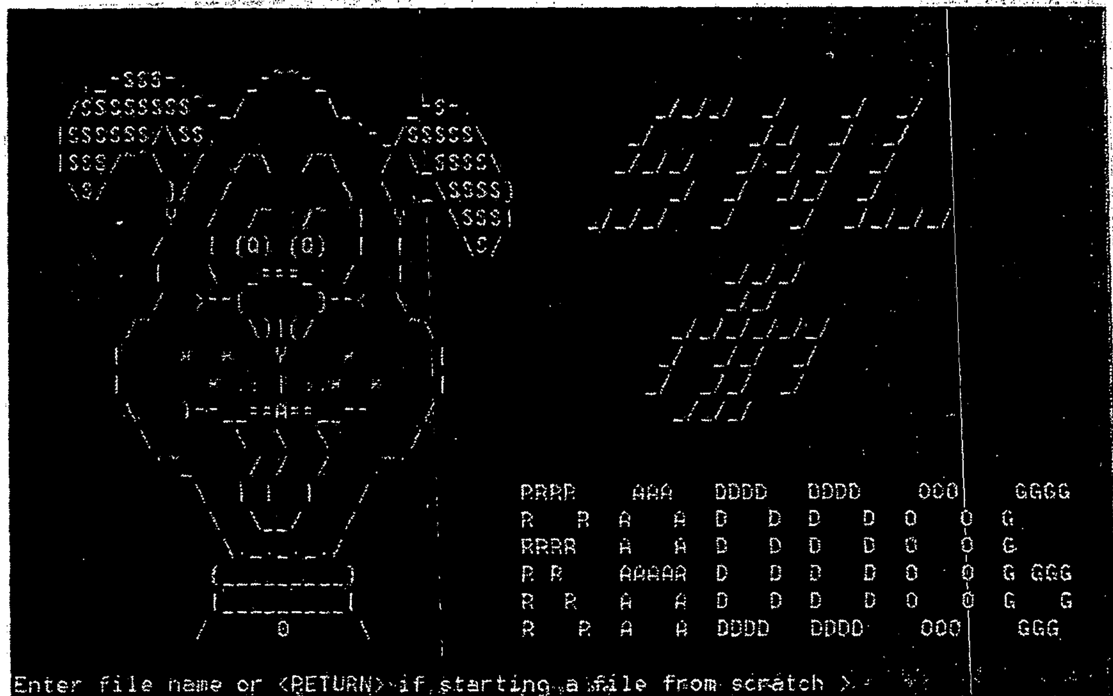
1 Evacuation time for groundshine in days;	(EVACUATION)	1.000E+00
2 Survey interval time for groundshine in days;	(SURVEY)	1.000E+01
3 Accident flag: 1= non-dispersal, 2= dispersal;	(IACC)	2
4 Rural evac time in hours for non-dispersal accidents.	(TIMENDE)	6.700E-01
5 Suburban evac time in hours for non-dispersal accidents.	(TIMENDE)	6.700E-01
6 Urban evac time in hours for non-dispersal accidents.	(TIMENDE)	4.200E-01
7 Neutron Emission values		

Miscellaneous Standard Variables

1 Ratio of sidewalk and/or pedestrians density	(RPD)	6.000E+00
2 Breathing rate; (cubic meters/sec);	(BRATE)	3.300E-04
3 Clean-up level; (micro Ci/meter sq);	(CULVL)	2.000E-01
4 Interdiction threshold;	(INTERDICT)	4.000E+01
5 Campaign time for total exposed population (years);	(CAMPAIGN)	1.000E+00

Non-radiological Fatalities per Kilometer Traveled

	Emissions	Accident		
	Occupational	Non-Occ	Occupational	Non-Occ
1 Highway – Rural	0.000E+00	0.000E+00	1.500E-08	5.300E-08
2 Highway - Suburban	0.000E+00	.000E+00	3.700E-09	1.300E-08
3 Highway – Urban	0.000E+00	1.000E-07	2.100E-09	7.500E-09
4 General Freight- R	0.000E+00	0.000E+00	1.810E-09	2.640E-08
5 General Freight- S	0.000E+00	0.000E+00	1.810E-09	2.640E-08
6 General Freight- U	0.000E+00	1.300E-07	1.810E-09	2.640E-08
7 Dedicated Rail- R	0.000E+00	0.000E+00	1.270E-07	1.850E-06
8 Dedicated Rail- S	0.000E+00	0.000E+00	1.270E-07	1.850E-06
9 Dedicated Rail- U	0.000E+00	6.500E-07	1.270E-07	1.850E-06



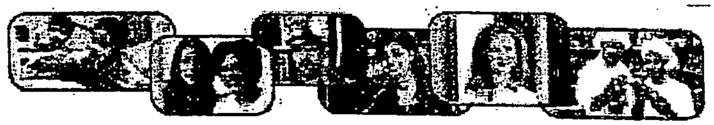
1. RADDOG Opening Screen

Section 5.12 References

1. BLS (Bureau of Labor Statistics) 2006a. *Table 1. Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2005,* Available at http://www.bls.gov/iif, accessed April 26, 2007.

2. BLS 2006b. *Table 6. Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2005, South Carolina,* Available at http://www.bls.gov/iif, accessed April 26, 2007.

U.S. Department of Labor
Bureau of Labor Statistics
Injuries, Illnesses, and Fatalities



The **Injuries, Illnesses, and Fatalities (IIF)** program provides data on illnesses and injuries on the job and data on worker fatalities.

- **Current Injury, Illness, and Fatality Data**
- **Economic News Releases and Announcements**
- **Special Notices**
- **Get Detailed IIF Statistics**
- **Publications**
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SCEG-147

CURRENT INJURY, ILLNESS, AND FATALITY DATA:

Select a subject area

- OSHA recordable case rates (TXT) (PDF 95K) - latest incidence rates, by industry, for nonfatal work-related injuries and illnesses.
- REVISED **Fatal injuries - 2004 revised data now available**
- Nonfatal (OSHA recordable) injuries and illnesses
  - **Industry incidence rates and counts**
  - NEW **Case and demographic characteristics**

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ECONOMIC NEWS RELEASES AND ANNOUNCEMENTS:

- Census of Fatal Occupational Injuries (HTML) (PDF 75K)
- Nonfatal occupational injuries and illnesses from the Survey of Occupational Injuries and Illnesses
  - Industry counts and frequency rates (HTML) (PDF 62K)
  - NEW Lost-Worktime Injuries and Illnesses: Characteristics and resulting days away from work (HTML) (PDF)
- Survey of Respirator Use and Practices (TXT) (PDF)
- Time of Lost-Workday Injuries and Illnesses, 2002 - First Results Announced By BLS (PDF)
- **Schedule of upcoming releases and access to archived news releases**

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SPECIAL NOTICES:

- **Survey of Occupational Injuries and Illnesses 2003 - Revised Published Employment Data**
- **Census of Fatal Occupational Injuries Revised Data**
- **State data included in nonfatal injury and illness data series II and CH.**
- **Recordkeeping changes affect the Occupational Injury and Illness data**
- **Occupational Safety and Health Statistics Changes to NAICS**

Latest Numbers

Nonfatal injuries and illnesses, private industry

Total recordable cases:
4,257,300 in 2004

Cases involving days away from work:
1,259,300 in 2004

Cases involving sprains, strains, tears:
525,390 in 2004

Cases involving injuries to the back:
282,240 in 2004

Cases involving falls:
255,600 in 2004

Fatal work-related injuries

Total fatalities (all sectors):
5,764 in 2004

Total fatalities (private industry):
5,229 in 2004

Highway incidents (private industry):
1,229 in 2004

Falls (private industry):
783 in 2004

Homicides (private industry):
489 in 2004

» p- preliminary
» Click on the icon for 10 years of historical data.

People Are Asking...

1. How many Hispanic workers have been fatally injured on the job?
2. Which occupations have the highest fatality rates?
3. How can I evaluate our safety record?
4. How widespread is violence in the workplace? Homicides?
5. Where can I find another company's injury rates?
6. What information do the survey data provide about injury and illness severity?
7. What kind of ergonomics numbers exist?

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004**

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction			Other recordable cases
				Total	Cases with days away from work[5]	Cases with job transfer or restriction	
Private industry[6]		107,551.8	4.8	2.5	1.4	1.1	2.3
Goods producing[6]		22,655.5	6.5	3.5	1.9	1.7	2.9
Natural resources and mining[6,7]		1,481.7	5.3	3.1	2.0	1.1	2.2
Agriculture, forestry, fishing and hunting[6]	11	961.8	6.4	3.7	2.3	1.4	2.7
Crop production[6]	111	429.8	5.6	3.3	1.7	1.5	2.3
Oilseed and grain farming[6]	1111	11.7	5.7	1.8	.5	1.3	3.9
Greenhouse, nursery, and floriculture production[6]	1114	150.8	6.0	3.7	1.6	2.1	2.4
Animal production[6]	112	141.1	8.5	4.7	2.9	1.9	3.8
Cattle ranching and farming[6]	1121	72.0	6.9	3.5	2.6	.9	3.4
Beef cattle ranching and farming, including feedlots[6]	11211	22.4	7.4	3.7	2.5	1.2	3.7
Dairy cattle and milk production[6]	11212	49.6	6.7	3.4	2.7	.7	3.3
Hog and pig farming[6]	1122	16.0	16.9	10.6	4.4	6.1	6.3
Poultry and egg production[6]	1123	38.5	8.4	4.7	2.4	2.3	3.7
Other animal production[6]	1129	10.6	9.4	6.3	4.2	2.1	3.1
Support activities for agriculture and forestry	115	309.2	5.9	3.3	2.2	1.2	2.6
Support activities for crop production	1151	268.1	5.7	3.2	2.1	1.2	2.5
Support activities for crop production	11511	268.1	5.7	3.2	2.1	1.2	2.5
Soil preparation, planting, and cultivating	115112	22.5	3.0	.9	.7	.1	2.1
Crop harvesting, primarily by machine	115113	10.5	8.7	4.6	2.7	1.9	4.1
Postharvest crop activities (except cotton ginning)	115114	69.9	8.5	5.4	2.8	2.7	3.1
Farm labor contractors and crew leaders	115115	140.1	4.1	2.0	1.4	.6	2.1
Farm management services	115116	15.5	6.6	4.8	4.1	.8	1.8
Support activities for animal production	1152	25.6	6.5	3.8	2.5	1.4	2.7
Support activities for forestry	1153	15.5	7.6	3.8	2.9	.8	3.8
Mining[7]	21	519.9	3.8	2.3	1.6	.6	1.5
Oil and gas extraction	211	121.3	2.6	1.2	.9	.3	1.4
Oil and gas extraction	2111	121.3	2.6	1.2	.9	.3	1.4
Oil and gas extraction	21111	121.3	2.6	1.2	.9	.3	1.4
Crude petroleum and natural gas extraction	211111	117.1	2.6	1.2	.9	.3	1.4
Mining (except oil and gas)[8]	212	204.2	4.3	2.9	2.2	.7	1.4
Coal mining[8]	2121	70.0	5.6	3.9	3.6	.3	1.7
Coal mining[8]	21211	70.0	5.6	3.9	3.6	.3	1.7
Bituminous coal and lignite surface mining[8]	212111	32.7	2.7	1.8	1.6	.2	.9
Bituminous coal underground mining[8]	212112	36.7	8.3	5.9	5.4	.4	2.5
Anthracite mining[8]	212113	.6	5.6	3.9	3.8	([9])	1.7

See footnotes at end of table.

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004** — Continued

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction: Total	Cases with days away from work[5]	Cases with job transfer or restriction	Other recordable cases
Utility system construction	2371	373.4	6.0	3.2	2.2	1.0	2.8
Land subdivision	2372	86.7	3.6	1.6	.9	.7	2.0
Highway, street, and bridge construction	2373	336.1	6.4	3.4	2.1	1.2	3.1
Other heavy and civil engineering construction	2379	98.8	5.8	3.8	–	1.0	2.1
Specialty trade contractors	238	4,402.9	6.8	3.6	2.6	1.0	3.2
Foundation, structure, and building exterior contractors	2381	1,004.6	8.0	4.6	3.3	1.3	3.4
Poured concrete foundation and structure contractors	23811	214.9	6.9	4.1	3.0	1.1	2.8
Structural steel and precast concrete contractors	23812	83.1	10.5	–	–	1.3	4.6
Framing contractors	23813	157.1	11.2	6.3	4.5	1.8	5.0
Masonry contractors	23814	230.9	6.6	3.8	3.0	.9	2.7
Glass and glazing contractors	23815	53.3	6.7	3.5	2.2	1.3	3.2
Roofing contractors	23816	182.8	8.1	4.9	3.3	1.6	3.2
Siding contractors	23817	43.3	–	5.0	3.7	1.3	3.2
Other foundation, structure, and building exterior contractors	23819	39.1	5.5	2.8	1.6	1.2	2.7
Building equipment contractors	2382	1,848.2	6.8	3.3	2.4	.9	3.5
Electrical contractors	23821	850.9	5.8	2.8	2.1	.6	3.0
Plumbing, heating, and air-conditioning contractors	23822	891.2	8.1	3.9	2.7	1.2	4.2
Other building equipment contractors	23829	106.0	4.5	2.5	1.7	.8	2.0
Building finishing contractors	2383	928.1	6.4	3.5	2.5	1.0	2.9
Drywall and insulation contractors	23831	339.5	7.5	3.8	2.5	1.3	3.7
Painting and wall covering contractors	23832	221.5	3.6	2.2	1.7	.5	1.4
Flooring contractors	23833	82.5	6.7	3.9	3.0	.9	2.8
Tile and terrazzo contractors	23834	64.5	7.4	3.4	2.5	.9	–
Finish carpentry contractors	23835	155.5	6.9	4.3	3.2	1.1	2.6
Other building finishing contractors	23839	64.6	7.4	4.0	3.3	.7	3.4
Other specialty trade contractors	2389	622.0	5.3	3.0	2.1	.9	2.4
Site preparation contractors	23891	326.0	5.6	2.8	2.1	.7	2.8
All other special trade contractors	23899	296.1	5.1	3.2	2.1	1.1	1.9
Manufacturing		14,257.4	6.6	3.6	1.6	2.1	3.0
Manufacturing	31-33	14,257.4	6.6	3.6	1.6	2.1	3.0
Food manufacturing	311	1,490.4	8.2	5.3	1.9	3.4	3.0
Animal food manufacturing	3111	49.1	7.1	4.5	1.5	3.0	2.6
Animal food manufacturing	31111	49.1	7.1	4.5	1.5	3.0	2.6
Dog and cat food manufacturing	311111	17.6	7.1	4.1	1.6	2.5	3.0
Other animal food manufacturing	311119	31.5	7.1	4.7	1.5	3.2	2.4
Grain and oilseed milling	3112	60.9	5.6	2.8	1.5	1.3	2.9
Flour milling and malt manufacturing	31121	19.7	6.1	3.5	2.0	1.5	2.6
Flour milling	311211	14.4	5.1	3.0	1.5	1.5	2.1

See footnotes at end of table.

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004** — Continued

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction: Total	Cases with days away from work, job transfer, or restriction: Cases with days away from work[5]	Cases with days away from work, job transfer, or restriction: Cases with job transfer or restriction	Other recordable cases
Taxi and limousine service	4853	65.7	5.7	4.0	3.4	0.6	1.7
Taxi service	48531	29.8	6.7	4.9	4.6	.3	1.8
Limousine service	48532	35.9	4.7	3.1	2.3	.8	1.6
School and employee bus transportation	4854	166.5	5.6	2.6	2.0	.6	2.9
Charter bus industry	4855	32.5	5.2	2.8	1.8	1.0	2.4
Other transit and ground passenger transportation	4859	58.0	5.7	3.1	2.2	.9	2.6
Pipeline transportation	486	37.6	2.5	1.4	1.0	.4	1.1
Pipeline transportation of natural gas	4862	25.5	2.6	1.6	1.1	.5	1.0
Scenic and sightseeing transportation	487	27.0	4.7	2.8	2.4	.5	1.9
Support activities for transportation	488	530.6	5.3	3.5	2.2	1.3	1.9
Support activities for rail transportation	4882	20.9	7.2	4.5	3.3	1.2	2.7
Support activities for water transportation	4883	93.4	7.1	4.6	3.8	.7	2.6
Support activities for road transportation	4884	77.1	4.7	3.2	2.4	.8	1.4
Motor vehicle towing	48841	45.8	3.9	3.1	2.6	.5	.7
Freight transportation arrangement	4885	169.5	3.0	1.8	.9	.8	1.2
Other support activities for transportation	4889	29.5	6.6	4.3	1.8	2.5	2.3
Couriers and messengers	492	557.5	12.4	8.8	4.1	4.7	3.7
Couriers	4921	510.0	13.1	9.2	4.2	5.0	3.9
Local messengers and local delivery	4922	47.5	5.6	4.0	2.8	1.2	1.6
Warehousing and storage	493	555.8	9.3	5.8	2.8	3.0	3.4
Warehousing and storage	4931	555.8	9.3	5.8	2.8	3.0	3.4
General warehousing and storage	49311	463.0	9.3	5.6	2.6	3.1	3.7
Other warehousing and storage	49319	41.2	6.2	4.6	1.9	2.7	1.6
Utilities	22	563.9	5.2	2.5	1.4	1.1	2.7
Utilities	221	563.9	5.2	2.5	1.4	1.1	2.7
Electric power generation, transmission and distribution	2211	408.2	4.5	2.1	1.1	1.0	2.5
Electric power generation	22111	247.5	3.5	1.9	.9	1.0	1.6
Electric power transmission, control, and distribution	22112	160.7	6.2	2.3	1.4	.9	3.9
Natural gas distribution	2212	109.5	7.3	4.2	2.4	1.7	3.2
Water, sewage and other systems	2213	46.2	6.0	2.8	1.6	1.2	3.2
Water supply and irrigation systems	22131	35.8	6.1	3.0	1.8	1.2	3.1
Information		3,099.6	2.0	1.1	.8	.4	.9
Information	51	3,099.6	2.0	1.1	.8	.4	.9
Publishing industries (except Internet)	511	907.5	2.1	1.1	.7	.4	1.0
Newspaper, periodical, book, and directory publishers	5111	672.2	2.8	1.5	.9	.6	1.4
Newspaper publishers	51111	375.1	3.5	1.7	1.1	.6	1.9
Periodical publishers	51112	141.2	1.7	1.0	.8	.3	.6

See footnotes at end of table.

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004** — Continued

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction: Total	Cases with days away from work[5]	Cases with job transfer or restriction	Other recordable cases
Special food services	7223	531.3	6.2	2.8	1.6	–	3.4
Other services		3,785.2	3.2	1.6	1.1	0.5	1.6
Other services, except public administration	81	3,785.2	3.2	1.6	1.1	.5	1.6
Repair and maintenance	811	1,222.0	3.9	1.9	1.4	.5	2.0
Automotive repair and maintenance	8111	884.7	3.8	1.8	1.3	.5	2.0
Electronic and precision equipment repair and maintenance	8112	101.2	2.6	1.3	.8	.5	1.3
Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	8113	157.7	5.4	3.0	2.2	.7	2.5
Personal and household goods repair and maintenance	8114	78.4	–	1.2	.8	.5	–
Personal and laundry services	812	1,266.1	2.8	1.6	1.0	.7	1.2
Personal care services	8121	560.0	1.0	.5	.4	.1	.6
Death care services	8122	137.0	2.6	1.7	1.2	.6	.8
Drycleaning and laundry services	8123	349.7	5.3	3.0	1.4	1.6	2.3
Other personal services	8129	219.3	2.8	1.8	1.3	.4	1.0
Religious, grantmaking, civic, professional, and similar organizations	813	1,297.2	2.7	1.2	.8	.4	1.6

[1] The incidence rates represent the number of injuries and illnesses per 100 full-time workers and were calculated as: (N/EH) x 200,000, where

N = number of injuries and illnesses
EH = total hours worked by all employees during the calendar year
200,000 = base for 100 equivalent full-time workers (working 40 hours per week, 50 weeks per year)

[2] Totals include data for industries not shown separately.
[3] *North American Industry Classification System* — United States, 2002
[4] Employment is expressed as an annual average and is derived primarily from the BLS-Quarterly Census of Employment and Wages (QCEW) program.
[5] Days-away-from-work cases include those that result in days away from work with or without job transfer or restriction.
[6] Excludes farms with fewer than 11 employees.
[7] Data for Mining (Sector 21 in the *North American Industry Classification System*– United States, 2002) include establishments not governed by the Mine Safety and Health Administration rules and reporting, such as those in Oil and Gas Extraction and related support activities. Data for mining operators in coal, metal, and nonmetal mining are provided to BLS by the Mine Safety and Health Administration, U.S. Department of Labor. Independent mining contractors are excluded from the coal, metal, and nonmetal mining industries. These data do not reflect the changes the Occupational Safety and Health Administration made to its recordkeeping requirements effective January 1, 2002; therefore, estimates for these industries are not comparable to estimates in other industries.
[8] Data for mining operators in this industry are provided to BLS by the Mine Safety and Health Administration, U.S. Department of Labor. Independent mining contractors are excluded. These data do not reflect the changes the Occupational Safety and Health Administration made to its recordkeeping requirements effective January 1, 2002; therefore, estimates for these industries are not comparable to estimates in other industries.
[9] Fewer than 15 cases.
[10] Data for employers in railroad transportation are provided to BLS by the Federal Railroad Administration, U.S. Department of Transportation.
[11] Incidence rate less than 0.05.

NOTE: Because of rounding, components may not add to totals. Dash indicates data not available.
SOURCE: Bureau of Labor Statistics, U.S. Department of Labor
November 2005

Section 5.12 Ref 2

 BLS 2004 b

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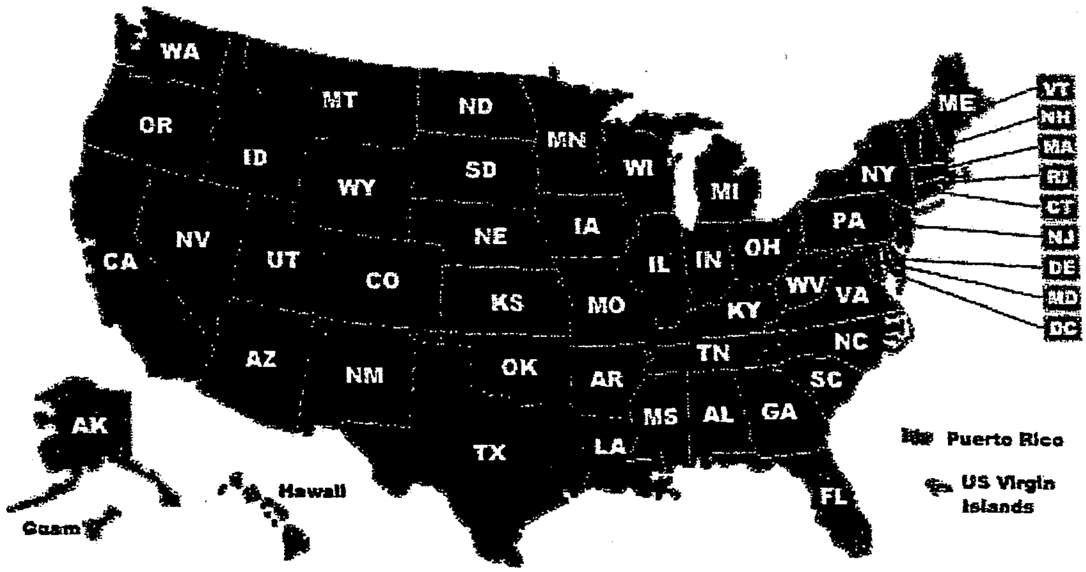

SOEG-148

Overview of State data available
State data presenting the number and frequency of work-related injuries, illnesses, and fatalities are available fi two BLS programs: nonfatal cases of work-related injuries and illnesses that are recorded by employers under Occupational safety and Health Administration's (OSHA's) recordkeeping guidelines are available for 44 States a Territories from the BLS Survey of Occupational Injuires and Illnesses (SOII); fatal cases of work-related injurie are available for all States, Territories, and New York City under a separate program, the BLS Census of Fatal Occupational Injuries (CFOI).

Note: The number of States for which SOII data are available varies from year to year because not all States I survey sample sizes sufficient to generate State specific estimates of workplace injuries and illnesses. Among tl States that do generate State estimates, the sample sizes often are not sufficient to generate estimates at the same level of detail as are available from the national estimates. The industries for which data are available al: vary among States, primarily due to the differences in industry concentration and sample size from one State t next. An asterisk (*) indicates that State estimates are available for both public and private industry.

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tate	Program	Contact	State da
ALABAMA	**SOII/CFOI**	Peggie Fryer Phone: 334-242-3460	**SOII** data (Please con

SOUTH CAROLINA	**SOII/CFOI**	Felecia Busby Phone: 803-896-7673 FAX: 803-896-7670 Mailing address: South Carolina Department of Labor, Licensing and Regulation P.O. Box 11329 Columbia, SC 29211-1329 Internet: **http://www.llr.state.sc.us/osha.asp**	**SOII** data (Please contact the State for additional data.) - *2004 Incidence rates (**PDF**) Case counts (**PDF**) - *2003 Incidence rates (**PDF**) Case counts (**PDF**) - *2002 Incidence rates (**PDF**) Case counts (**PDF**) - *2001 Incidence rates (**PDF**) Case counts (**PDF**) - *2000 Incidence rates (**PDF**) Case counts (**PDF**) - *1999 Incidence rates (**PDF**) Case counts (**PDF**) - *1998 Incidence rates (**PDF**) Case counts (**PDF**) - *1997 Incidence rates (**PDF**) Case counts (**PDF**) - *1996 Incidence rates (**PDF**) Case counts (**PDF**) **CFOI** data (Please contact the State for additional data.) - **2004 Profile of occupational fatalities** - **2003 Profile of occupational fatalities**

Table 6. Incidence rates [1] of nonfatal occupational injuries and illnesses by industry and case types, 2004

South Carolina

Industry[2]	NAICS code[3]	2004 Average annual employment[4] (000's)	Total recordable cases	Cases with days away from work, job transfer, or restriction: Total	Cases with days away from work[5]	Cases with job transfer or restriction	Other recordable cases
All industries including State and local government[6]		1,749.7	4.3	2.1	1.2	0.9	2.2
Private industry[6]		1,465.0	4.1	2.0	1.2	0.9	2.0
Goods producing[6]		395.4	4.5	2.3	1.2	1.1	2.2
Natural resources and mining[6,7]		13.0	3.2	1.3	0.8	0.5	1.9
Agriculture, forestry, fishing and hunting[6]	11	11.5	3.3	1.1	0.7	0.4	2.2
Forestry and logging	113	3.8	3.4	0.6	0.6	(")	2.8
Logging	1133	3.6	3.6	0.6	0.6	(")	3.0
Mining[7]	21	1.6	2.7	2.1	(")	1.2	(")
Construction		114.9	4.3	2.3	1.6	0.8	2.0
Construction	23	114.9	4.3	2.3	1.6	0.8	2.0
Construction of buildings	236	30.0	3.1	1.9	1.4	0.6	1.2
Residential building construction	2361	13.6	3.3	3.2	2.5	0.7	–
Nonresidential building construction	2362	16.3	3.0	0.9	0.4	0.5	2.1
Heavy and civil engineering construction	237	17.2	6.0	3.7	2.4	1.3	2.2
Utility system construction	2371	5.8	3.7	3.1	2.1	1.0	0.6
Land subdivision	2372	2.8	3.6	1.5	0.8	(")	2.2
Highway, street, and bridge construction	2373	6.4	7.6	3.5	1.4	2.1	4.1
Specialty trade contractors	238	67.7	4.4	2.1	1.4	0.7	2.3
Foundation, structure, and building exterior contractors	2381	16.1	2.1	1.1	0.9	0.2	1.0
Poured concrete foundation and structure contractors	23811	2.7	3.2	2.2	2.1	(")	1.1
Masonry contractors	23814	4.7	2.0	0.9	0.9	(")	1.2
Roofing contractors	23816	2.8	3.0	1.2	(")	1.0	1.8
Building equipment contractors	2382	30.1	6.2	2.8	2.1	0.7	3.4
Electrical contractors	23821	14.6	5.6	2.4	1.2	1.1	3.3

See footnotes at end of table.

Table 6. Incidence rates [1] of nonfatal occupational injuries and illnesses by industry and case types, 2004 – Continued

South Carolina

Industry[2]	NAICS code[3]	2004 Average annual employment[4] (000's)	Total recordable cases	Cases with days away from work, job transfer, or restriction: Total	Cases with days away from work, job transfer, or restriction: Cases with days away from work[5]	Cases with days away from work, job transfer, or restriction: Cases with job transfer or restriction	Other recordable cases
Transportation and warehousing[9]	48-49	47.8	9.1	5.8	3.2	2.6	3.3
Support activities for transportation	488	10.2	7.2	4.0	2.0	2.0	3.2
Couriers and messengers	492	5.5	13.1	10.1	3.7	6.5	3.0
Warehousing and storage	493	7.9	9.6	6.7	1.0	5.7	2.9
Utilities	22	11.7	2.6	1.2	1.0	0.2	1.4
Utilities	221	11.7	2.6	1.2	1.0	0.2	1.4
Electric power generation, transmission and distribution	2211	10.5	2.5	1.2	1.0	0.2	1.2
Information		–	–	–	–	–	–
Information	51	–	–	–	–	–	–
Publishing industries (except Internet)	511	6.8	3.0	1.5	0.8	0.7	1.5
Newspaper, periodical, book, and directory publishers	5111	5.9	3.4	1.6	0.9	0.8	1.7
Newspaper publishers	51111	4.8	4.3	2.1	1.1	1.0	2.2
Financial activities		90.5	1.1	0.4	0.4	(10)	0.7
Finance and insurance	52	64.8	0.9	0.1	0.1	(11)	0.8
Real estate and rental and leasing	53	25.7	1.9	1.2	1.1	0.2	–
Professional and business services		195.9	1.6	1.0	0.6	0.3	0.7
Professional, scientific, and technical services	54	63.6	1.1	0.3	0.2	0.2	0.7
Professional, scientific, and technical services	541	63.6	1.1	0.3	0.2	0.2	0.7
Architectural, engineering, and related services	5413	15.2	1.7	0.9	0.4	0.5	0.8
Management, scientific, and technical consulting services	5416	7.5	0.9	0.7	0.3	0.3	0.2
Other professional, scientific, and technical services	5419	4.8	4.0	(11)	(11)	(11)	3.9
Management of companies and enterprises	55	9.4	7.4	6.0	3.5	2.5	1.4

See footnotes at end of table.