Ronald B. Clary
Vice President
New Nuclear Deployment

SCE&G®
A SCANA COMPANY

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NND-09-0333

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

ATTN: Document Control Desk

Subject: V. C. Summer Nuclear Station Units 2 and 3
Docket Numbers 52-027 and 52-028
Combined License Application – Response to NRC
Environmental Report (ER) Requests for Additional Information
(RAI): GW-3 Revision 1

Reference:
1. Letter from Ronald B. Clary to Document Control Desk, Submittal of Revision 1 to Part 3 (Environmental Report) of the Combined License Application for the V. C. Summer Nuclear Station Units 2 and 3, dated February 13, 2009.
2. Letter from Patricia J. Vokoun to Ronald B. Clary, Requests for Additional Information Related to the Environmental Review for the Combined License Application for the V. C. Summer Nuclear Station, Units 2 and 3, dated June 22, 2009.

By letter dated March 27, 2008, South Carolina Electric & Gas Company (SCE&G) submitted a combined license application (COLA) for V.C. Summer Nuclear Station (VCSNS) Units 2 and 3, to be located at the existing VCSNS site in Fairfield County, South Carolina. Subsequently the Environmental Report (ER), Part 3 of the application, was revised and submitted to the NRC (reference 1).

The enclosure to this letter provides revised information for the SCE&G response to RAIs transmitted by the NRC via reference 2. Specifically a revised response to GW-3 is provided to reflect a corresponding change made for the response to FSAR RAI 02.04.13-12.

Please address any questions to Mr. Alfred M. Paglia, Manager, Nuclear Licensing, New Nuclear Deployment, P. O. Box 88, Jenkinsville, S.C. 29065; by telephone at 803-345-4191; or by email at apaglia@scana.com.

D083
NRO

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 2nd day of December 2009

Ronald B. Clary
Vice President
New Nuclear Deployment

ARR/RBC/ar

Enclosures

c (with Enclosures):
Patricia Vokoun
Carl Berkowitz
FileNet

c (without Enclosures):
Luis A. Reyes
John Zeiler
Chandu Patel
Stephen A. Byrne
Ronald B. Clary
Bill McCall
William M. Cherry
Randolph R. Mahan
Kathryn M. Sutton
Rich Louie
John J. DeBlasio
April Rice

VCSNS UNITS 2 and 3
Environmental Report Review
Response to NRC Requests for Additional Information

NRC RAI Letter Dated June 22, 2009

NRC RAI Number: GW-3 **Revision:** 1

Reference ER Information Needs Item: GW-3

Question Summary (RAI):

Evaluate eastern groundwater pathways from the proposed new units in the saprolite/shallow bedrock zone and deep bedrock zone toward possible receptors (e.g. Mayo Creek and wells). Also, evaluate possible westward pathways from the proposed new units in the deep-bedrock pathway (the western pathway in the saprolite/shallow bedrock zone is the only pathway described in the ER).

Full Text (supporting information):

None

VCSNS Response (Revised):

The original response to this RAI was provided to the NRC in SCE&G letter NND-09-0203, dated July 20, 2009. That response indicated that RAI GW-3 was addressed in the response to FSAR RAI 02.04.13-2, which had been provided to the NRC in letter NND-09-0171, dated June 24, 2009. The NRC subsequently issued FSAR RAI 02.04.13-12 regarding the need to consider potentially more conservative eastern pathways towards the Mayo Creek. SCE&G provided its response to FSAR RAI 02.04.13-12 in letter NND-09-0272, dated October 8, 2009. Revision 1 of RAI GW-3 incorporates the additional eastern and western pathway analyses provided in the response to FSAR RAI 02.04.13-12. As a result, the response provided herein replaces the original response to this RAI in its entirety.

Eastern groundwater pathways from the proposed new units in the saprolite/shallow bedrock and deep bedrock zones have been evaluated. Westward pathways from the proposed new units in the deep bedrock zone have also been evaluated. The results of these evaluations are presented in the attached proposed revisions to ER Subsection 2.3.1.2.3.

Associated COLA Revisions:

See attached proposed revisions to ER Subsection 2.3.1.2.3.

Associated Attachments:

Table 2.3-24 (To be deleted)
Table 2.3-25 (Revised)
Table 2.3-37 (New)
Figure 2.3-34 (Revised)
Figure 2.3-39 (New)
Figure 2.3-40 (New)

2.3.1.2.3.3 Hydraulic Properties

Hydraulic conductivities of the site subsurface materials were determined in the observation wells using the slug test method and in selected geotechnical borings using the packer test method. The results of the slug tests are presented in Table 2.3-21.

Slug tests were conducted in 29 of the 31 observation wells; two wells—OW-312 and OW-501—were not tested. OW-312 was dry, and OW-501 was screened in fill and residual soil.

Of the 29 wells that were tested, 8 were assessed as providing invalid or unreliable test results because of the large ratio of theoretical head change over the submerged screen length, failure to approach asymptote, and/or erratic data.

The remaining 21 slug test results were analyzed and low, high, and geometric mean values were calculated for each of the hydrostratigraphic zones. The saprolite/shallow bedrock hydrostratigraphic zone tests were completed in saprolite, partially weathered rock, or a combination of both. Based on 16 slug tests, the range of hydraulic conductivity values for this zone is from 0.0017 feet/-day to 18 feet/day with a geometric mean for this zone of 0.62 feet/day. The deep bedrock hydrostratigraphic zone tests were completed in sound rock. Based on five slug tests, the range of hydraulic conductivity values for the deep bedrock zone is from 0.0088 feet/day to 0.38 feet/day with a geometric mean for this zone ~~is~~of 0.07 feet/day.

Table 2.3-22 gives the results of packer tests conducted in selected geotechnical borings. These tests were conducted in the deep bedrock hydrostratigraphic zone. The range of hydraulic conductivity values for the deep bedrock zone from the packer tests is 0 to 1.14 feet/day, with the non-zero packer tests having a geometric mean value ~~for this zone~~ of 0.166 feet/day. Some hydraulic conductivity values are listed as zero. This is a result of a test conducted in a zone that did not take any water. This geometric mean hydraulic conductivity value of the packer tests is higher than the 0.07 feet/day geometric mean hydraulic conductivity value indicated by the slug test results. When comparing the two sets of data, it can be seen that the difference in values measured by the two tests was a result of the depths at which the tests were taken. The packer tests were generally conducted at shallower depths than the slug tests. At shallower depths, the hydraulic conductivity of the deep bedrock zone increases. When compared with just the shallow slug test results, the packer test values and the slug test values are in much closer agreement.

Table 2.3-23 presents porosity values derived from laboratory test results for grain size, moisture content, and specific gravity on residual soil and saprolite. The range in porosity values calculated for the residual soil is from 0.465 to 0.631 with an arithmetic mean porosity value of 0.527. The range in porosity values calculated for the saprolite material is from 0.401 to 0.632 with an arithmetic mean porosity value of 0.494. This is based on seven samples of residual soil and 23 samples of saprolite. The saprolite value is considered to be representative of the porosity value for the saprolite/shallow bedrock zone. The residual soil porosity values are considered to be representative of the unsaturated zone above the aquifer. There are no direct estimates of the specific yield at the site of Units 2 and 3. Considering the composition of the overburden soils (clayey, silty, and sandy materials), it is reasonable to expect the specific yield to be of the order of 20% to 25%. Reported average specific yield values in the literature are 18% for silt, 21% for fine sand, 26% for medium sand, and 27% for coarse sand (Fetter 1988). The specific yield of the saprolite should be similar to these values. ~~of the same order of magnitude.~~

~~Geometric mean values for the porosity were calculated for the residual soil and saprolite material types. Both of these soil types are within the saprolite/shallow bedrock hydrostratigraphic zone. The geometric mean value for the porosity for the residual soil is 0.524 and for the saprolite is 0.492.~~

~~The effective porosity of the saprolite was estimated using Figure 2.17 of de Marsily (1986) (Figure 2.3-33). This figure plots total and effective porosity as a function of grain size. To estimate the effective porosity for the saprolite, the ratio of effective-to-total-porosity determined from Figure 2.3-33 was applied to the site specific total porosity value for the VCSNS site. Using the median D_{50} value of 0.13 mm as a representative grain size (Table 2.3-24), a ratio of effective-to-total porosity of about 0.8 was determined from Figure 2.3-33. Multiplying the median total porosity of 0.49 by this ratio yields an effective porosity of 0.39 for the saprolite material.~~

Soil samples were collected from geotechnical borings at the VCSNS site for grain size analyses (MACTEC 2007). The coarser materials (sands and gravels) are assumed to be representative of the subsurface material along potential contaminant transport pathways. The median (D_{50}) grain size of the samples classified as sand or gravel under the Unified Soil Classification System is 0.15 mm. This value is assumed to be the representative grain size of the saprolite/shallow bedrock zone. An effective porosity of 0.27 is estimated using a grain size of 0.15 mm and Figure 2.17 of de Marsily (1986) (Figure 2.3-33). A study by Stephens et al. (1998) suggests that effective porosities derived from grain size data tend to be biased high. Therefore, the grain size data-derived effective porosity (0.27) was reduced by 33% for added conservatism to obtain an estimated saprolite/shallow bedrock zone effective porosity of 0.18.

The total porosity of the deep bedrock is assumed to be 0.05 (Harned and Daniel, 1989). This value is the mean of four measured porosity values in the bedrock ranging from approximately 0.03 to 0.06 at an approximate depth of 70 feet elsewhere in the Piedmont, the physiographic region in which the VCSNS site is located. The effective porosity of the deep bedrock is assumed to be 0.04, approximately 80% of the total porosity.

Hydraulic properties of the unsaturated zone were not measured because accidental release of liquid effluents would be through the saturated zone.

2.3.1.2.3.4 Subsurface Pathways

The Units 2 and 3 site is ~~would be~~ located on a ridgetop. Piezometric contour maps developed from piezometric levels measured for one year from June 2006 through June 2007 indicate that groundwater flows in all directions from the ridgetop. Drainage swales are present to the northwest, southwest, and east of the site as can be seen from the topographic map in Figure 2.3-2. These swales drain to tributaries that eventually lead to the Broad River. The Broad River is located approximately 1 mile to the west of the site. The surface groundwater flow regime roughly mimics the topography and flows through the saprolite/shallow bedrock hydrostratigraphic zone. Groundwater from the saprolite/shallow bedrock zone recharges the deep bedrock hydrostratigraphic zone. Piezometric-level contour maps developed for the deep bedrock zone indicate a flow path that leads directly toward the Broad River.

The primary and most plausible groundwater pathway from the Units 2 and 3 auxiliary buildings is through the saprolite/shallow bedrock zone to the nearby unnamed creeks, one to the north-northwest of Unit 2 and the other to the south-southwest of Unit 3.

In the following discussion, the term "pathway" is used to describe travel through a specific geologic medium (e.g. saprolite/shallow bedrock or deep bedrock) and in a general direction (e.g. east or west). The term "pathline" is used to describe a specific course followed from the initial to terminal point.

~~Although groundwater flows in all directions from the ridgetop, including toward Mayo Creek to the east, the shortest subsurface pathways from the PBA circle to a release point was determined to be toward the unnamed creeks to the north and south based on the data summarized above.~~ Figure 2.3-34 shows the expected pathways in plan view. Cross sections were developed roughly along these groundwater pathways as shown in Figures 2.3-36, 2.3-37, and 2.3-38. The subsurface pathways from Unit 2 and 3 to the nearest groundwater discharge point are shown in Figures 2.3-37 and 2.3-38, respectively. ~~The groundwater travel time from the PBA circle to the unnamed creek to the north was calculated to be 1.6 years. The groundwater travel time from the PBA circle to the unnamed creek to the south was calculated to be 3.1 years.~~ The travel time in the saprolite/shallow bedrock zone, analyzed between the Units 2 and 3 auxiliary buildings and the nearest creek where groundwater discharges, has been ~~conservatively~~ determined below, and is based on site-specific data. ~~The saprolite material properties are used because they provide the shortest travel times, *i.e.*, the most conservative analysis.~~

For the unnamed creek to the north-northwest of the site, the average advective velocity (v) is calculated using the following parameters:

> hydraulic conductivity K = 1.7 feet/day (75th percentile hydraulic conductivity value from ~~all~~ the slug test data in the saprolite/shallow bedrock zone ~~material~~)
>
> effective porosity n_e = 0.~~39~~18
>
> horizontal hydraulic gradient $\frac{dh}{dx}$ = - ~~0.0307~~ 0.032 ft/ft. (Table 2.3-25)

Substituting these values in the following equation yields:

$$U=-\frac{K}{n_e}\frac{dh}{dx}=-\frac{1.7\,ft/day}{0.39}\left(-0.0307\,ft/ft\right)=0.1338\,ft/day\cong 48.89\,ft/yr$$

$$v=\frac{K}{n_e}\frac{dh}{dx}=\frac{1.7\,\text{ft/day}}{0.18}(-0.032\,\text{ft/ft})=0.30\,\text{ft/day}\cong 110\,\text{ft/yr}$$

The straight-line distance from the auxiliary building of Unit 2 to the nearest unnamed creek to the north-northwest is about L=850 feet, which results in an ~~conservatively~~ estimated groundwater travel time of:

$$\cancel{t=\frac{LR}{U}=\frac{850\,ft\times 1}{48.89\,ft/yr}\cong 17.39\,yrs}$$

$$t=\frac{L}{v}=\frac{850\,\text{ft}}{110\,\text{ft/yr}}\cong 7.7\,\text{yrs}$$

This same methodology was ~~also~~ used for calculating the groundwater travel time from Unit 3. ~~The differences are at~~ At Unit 3, the horizontal hydraulic gradient was calculated to be ~~0.0369~~ -0.038 ft/ft (Table 2.3-25) and the straight-line distance from the auxiliary building of Unit 3 to the nearest unnamed creek to the south-southwest is about L=1727 feet. The estimated travel time from Unit 3 to the unnamed creek ~~to the south-southwest was~~ is ~~29.35~~ 13.3 years. Calculated travel times are summarized in Table 2.3-25.

2.3.1.2.3.5 Alternate Subsurface Pathways

As discussed in the preceding subsection, the western pathway through the saprolite/shallow bedrock zone to the nearby unnamed creeks is the most plausible groundwater pathway from Units 2 and 3. Units 2 and 3 are close to a groundwater high point under the ridge where Units 2 and 3 are located. In the event that the groundwater high should shift laterally to the west as a result of plant construction, the groundwater pathway from Units 2 and 3 auxiliary buildings could potentially be to the east. To account for this possibility as well as the potential for groundwater pathways in the deep bedrock, several alternate, less likely groundwater pathways were also analyzed. The alternate pathways are:

1. Saprolite/shallow bedrock zone pathway to the east discharging in Mayo Creek (see Figure 2.3-39)
2. Deep bedrock pathway to the west discharging in the Broad River (see Figure 2.3-40)
3. Deep bedrock pathway to the east discharging in Mayo Creek (see Figure 2.3-39)
4. Deep bedrock pathway to the east continuing beyond Mayo Creek and intercepted by a postulated receptor well at the nearest SCE&G property boundary (see Figure 2.3-40)

2.3.1.2.3.5.1 Saprolite/shallow bedrock zone pathway to Mayo Creek

In the event that the groundwater high point under Units 2 and 3 shifts laterally to the west, the groundwater flow direction from the auxiliary building in the saprolite/shallow bedrock zone could potentially be to the east, discharging in Mayo Creek. Groundwater travel times were calculated using the same methods and hydraulic properties of the saprolite/shallow bedrock as previously described. The groundwater travel times along the pathlines from Units 2 and 3 to Mayo Creek in the saprolite/shallow bedrock are estimated as 38.4 and 37.7 years, respectively as presented in Table 2.3-25.

2.3.1.2.3.5.2 Deep Bedrock Pathway to the Broad River

Groundwater travel times from Units 2 and 3 were calculated assuming the groundwater pathway is in the deep bedrock and discharges to the Broad River. A deep bedrock pathway is assumed to be less likely than a saprolite/shallow bedrock pathway due to the higher hydraulic conductivity of the overlying saprolite/shallow bedrock. The deep bedrock is assumed to have a hydraulic conductivity of 0.4 feet/day (the highest value measured in the deep bedrock from slug tests) and an effective porosity of 0.04. The groundwater travel times along the pathlines from Units 2 and 3 to the Broad River in the deep bedrock are estimated as 56.4 and 48.6 years, respectively as presented in Table 2.3-25.

2.3.1.2.3.5.3 Deep Bedrock Pathway to Mayo Creek

As discussed in subsection 2.3.1.2.3.5.1, a shift in the groundwater high under Units 2 and 3 could result in an eastern groundwater flow path discharging in Mayo Creek. Groundwater travel times from Units 2 and 3 were calculated assuming the groundwater pathway is in the deep bedrock and discharges to Mayo Creek. Groundwater travel times were calculated using the same hydraulic properties of the deep bedrock as described in the previous section. The groundwater travel times along the pathlines from Units 2 and 3 to Mayo Creek in the deep bedrock are estimated as 42.1 and 35.1 years, respectively as presented in Table 2.3-25.

2.3.1.2.3.5.4 Deep Bedrock Pathway to Hypothetical Private Well at Property Boundary

A deep bedrock pathway to the east continuing beyond Mayo Creek to a hypothetical well at the SCE&G property boundary is considered implausible. Groundwater levels in water table aquifer systems generally mimic the topography, but with subdued relief. As shown in Figure 2.3-40, the ground surface elevation increases substantially to the east of Mayo Creek. Therefore, it is expected that the water table and piezometric levels in the deep bedrock also increase to the east of Mayo Creek. This would result in a reversal of the hydraulic gradient with the flow of groundwater east of Mayo Creek being toward the creek. There is no evidence of any geologic feature (e.g. confining unit) precluding groundwater discharge from the deep bedrock aquifer to Mayo Creek.

Although it is considered implausible, groundwater travel times were calculated using the previously described hydraulic properties of the deep bedrock and the hydraulic gradients used for the deep bedrock to Mayo Creek calculations. The groundwater travel times along the pathlines from Units 2 and 3 to a hypothetical well at the SCE&G property boundary in the deep bedrock are estimated as 69.2 and 56.4 years, respectively as presented in Table 2.3-25.

New Section 2.3 References:

Stephens et al. 1998. Stephens, D.B., K. Hsu, M.A. Prieksat, M.D. Ankeny, N. Blandford, T.L. Roth, J.A. Kelsey, and J.R. Whitworth, *A comparison of estimated and calculated effective porosity*, Hydrogeology Journal, Volume 6, pages 156-165. (Copyright), 1998.

Harned, D.A., and C.C. Daniel III, 1989. "The Transition Zone between Bedrock and Regolith: Conduit for Contamination?" in *Ground Water in the Piedmont*, edited by C.C. Daniel III, R.K. White, and P.A. Stone, published by Clemson University, Clemson, SC, Oct. 1989.

Table 2.3-24
Calculation of Median D50 Size of Saprolite

Source of Sample	Sample No.	Depth (feet)	USCS Note	Gravel[a] (%)	Sand [a] (%)	Fines [a] (%)	Silt [a] (%)	0.005 mm Clay[a]	D50 (mm)
B-215	UD-3	28.5	SM	0	70	30			0.15
B-216	UD-1	6.5	ML	0	5	95	70	25	0.02
B-216	UD-2	13.5	ML	0.5	17	83	66	17	0.04
B-216[a]	UD-3	23.5	ML	0	15	84	63	21	0.03
B-217	UD-1	8.5	SM	0	65	35	25	10	0.14
B-222	UD-3	28.5	SM	0	64	36			0.12
B-309	UD-1	8.5	SM	0	65	36	26	10	0.13
B-309	UD-3	28.5	ML	0	30	70	48	22	0.03
B-309	UD-4	[illegible]	SM	0	51	49			0.08
B-319	UD-2	18.5	[illegible]	[illegible]	71	28			0.17
B-321	UD-2	18.5	[illegible]	[illegible]	[illegible]	34	25	9	0.16
B-322	UD-2	[illegible]	[illegible]	[illegible]	71	29	20	9	0.16
							Median		0.13

Deleted

(a) For this sample detailed data was not in Mactec (2007) Appendix F. Data interpreted from the curve.

Table 2.3-25 Groundwater Travel Time Summary

Primary Pathlines	K (ft/day)	n_e	h_o (ft) (NAVD88)	h_1 (ft) (NAVD88)	L (ft)	dh/dx	v (ft/day)	t (yrs)
Unit 2 saprolite/shallow bedrock to unnamed creek	1.7	0.18	367.15	340	850	-0.032	0.30	7.7
Unit 3 saprolite/shallow bedrock to unnamed creek	1.7	0.18	368.35	303.55	1727	-0.038	0.35	13.3
Alternate Pathlines	-	-	-	-	-	-	-	-
Unit 2 saprolite/shallow bedrock to Mayo Creek	1.7	0.18	367.15	308	2800	-0.021	0.20	38.4
Unit 3 saprolite/shallow bedrock to Mayo Creek	1.7	0.18	368.35	308	2800	-0.022	0.20	37.7
Unit 2 deep bedrock to Broad River	0.4	0.04	358.97	265	4400	-0.021	0.21	56.4
Unit 3 deep bedrock to Broad River	0.4	0.04	369.18	265	4300	-0.024	0.24	48.6
Unit 2 deep bedrock to Mayo Creek	0.4	0.04	358.97	308	2800	-0.018	0.18	42.1
Unit 3 deep bedrock to Mayo Creek	0.4	0.04	369.18	308	2800	-0.022	0.22	35.1
Unit 2 deep bedrock to hypothetical private well	0.4	0.04	NA	NA	4600	-0.018	0.18	69.2
Unit 3 deep bedrock to hypothetical private well	0.4	0.04	NA	NA	4500	-0.022	0.22	56.4

NA - not applicable, the gradient used for the hypothetical private well pathlines is assumed to equal the gradient used for the the Mayo Creek pathlines.

Sources of the h_0 and h_1 data are presented in Table 2.3-37

Table 2.3-37 Sources Used for Head Data

Pathline	**h_o data source**	**h_1 data source**
Unit 3 saprolite/shallow bedrock to unnamed creek	OW-305b	OW-618
Unit 3 deep bedrock to Broad River	OW-305a	Parr Reservoir full pool
Unit 2 saprolite/shallow bedrock to unnamed creek	OW-205b	topo map
Unit 2 deep bedrock to Broad River	OW-205a	Parr Reservoir full pool
Unit 3 saprolite/shallow bedrock to Mayo Creek	OW-305b	topo map
Unit 3 deep bedrock to Mayo Creek	OW-305a	topo map
Unit 2 saprolite/shallow bedrock to Mayo Creek	OW-205b	topo map
Unit 2 deep bedrock to Mayo Creek	OW-205a	topo map

Water level data from the observation wells were taken on 6-27-07
The values used for each h_o and h_1 are presented in Table 2.3-25

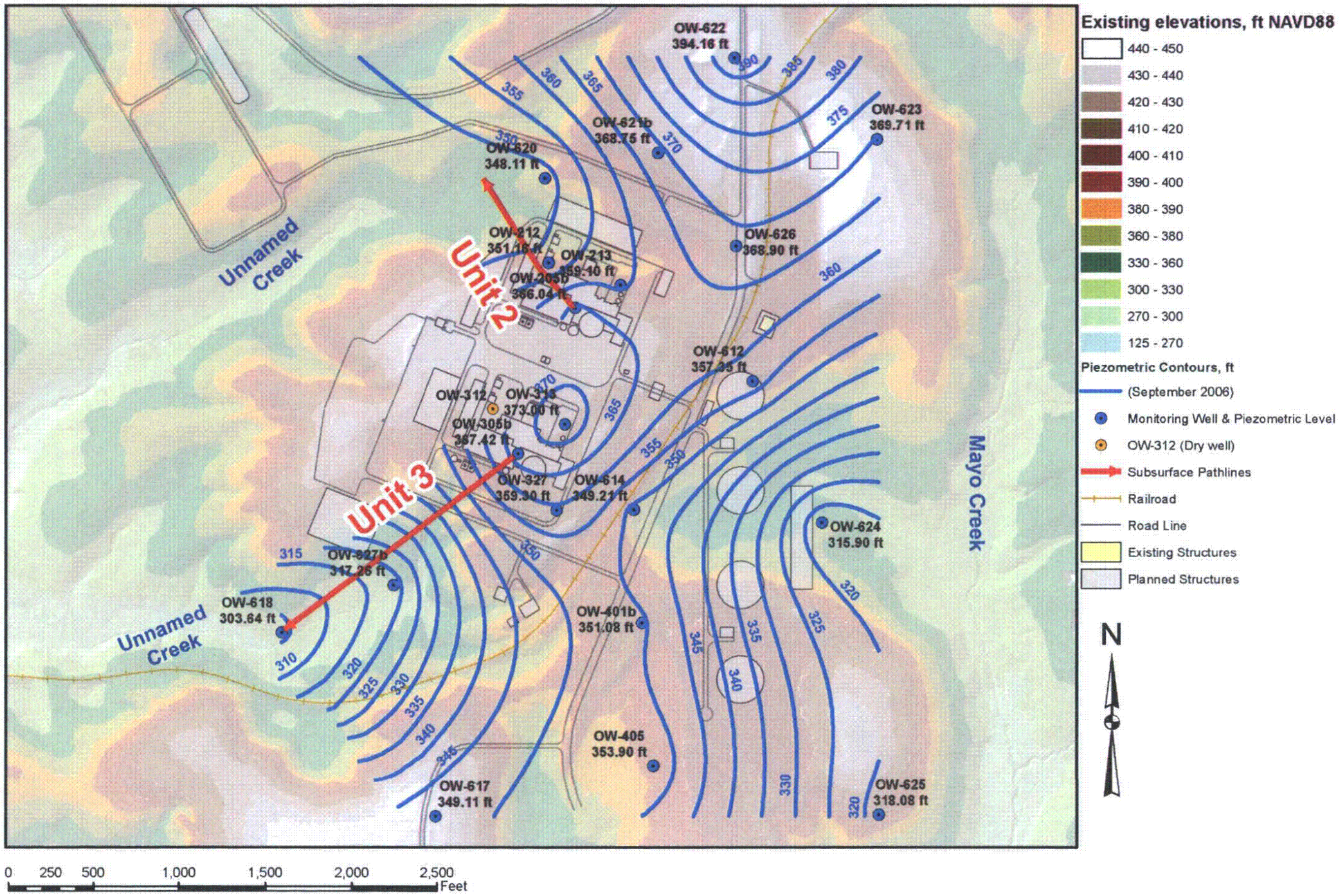

Figure 2.3-34 Plan View of Subsurface Groundwater ~~Contaminant~~ Pathways for Units 2 and 3 ~~(All elevations are with reference to the NAVD88 datum)~~ to the Unnamed Creeks (saprolite/shallow bedrock zone)

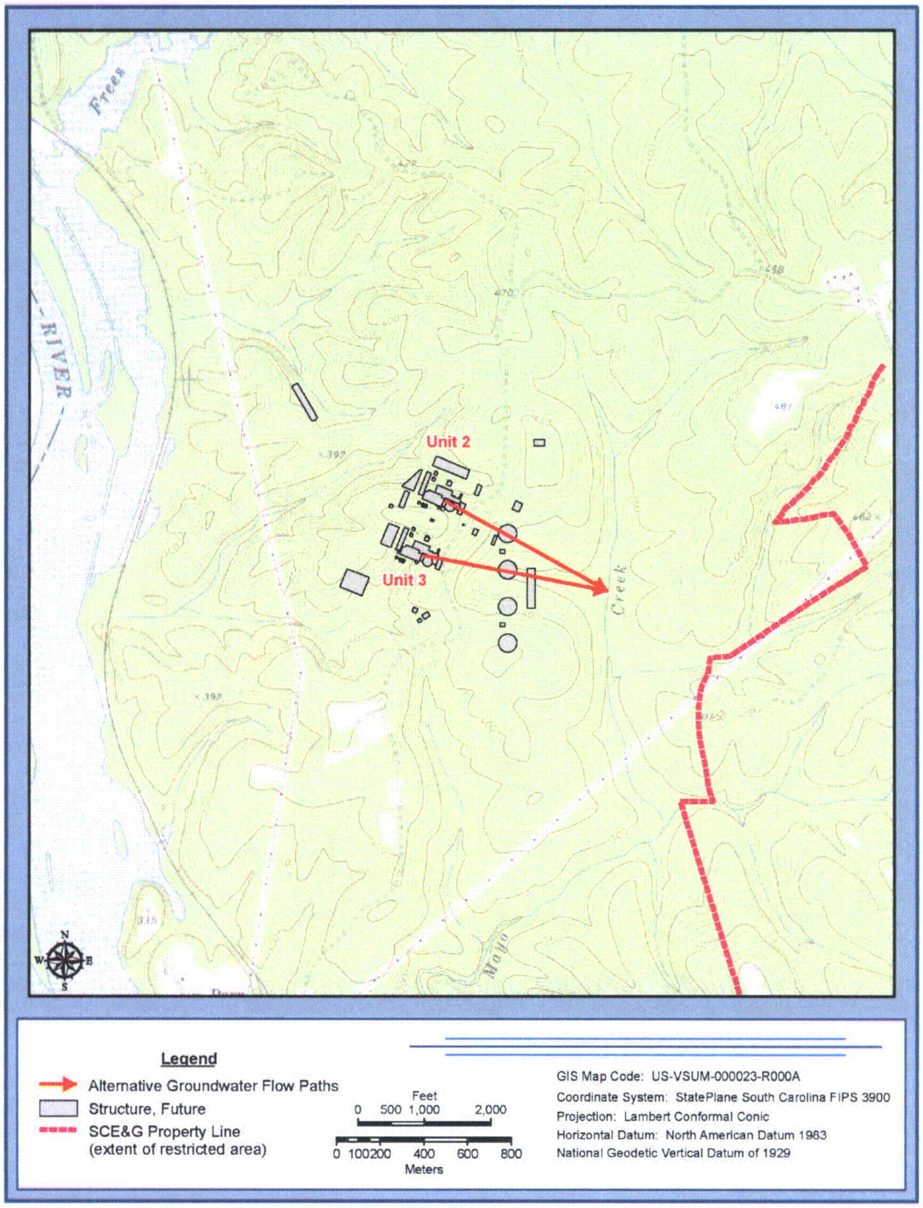

Figure 2.3-39 Alternative Groundwater Pathways to Mayo Creek (saprolite/shallow bedrock and deep bedrock zones)

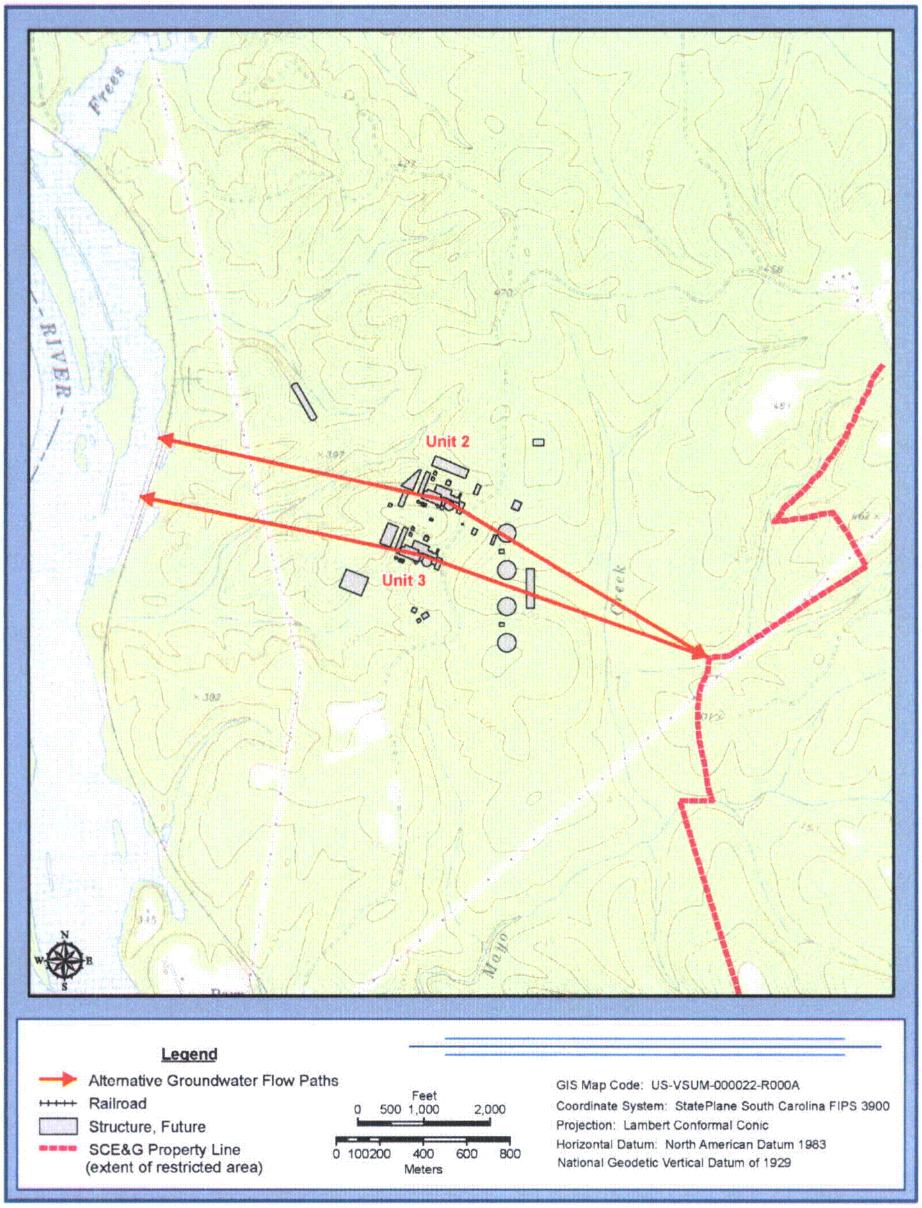

Figure 2.3-40 Alternative Groundwater Pathways to the Broad River and SCE&G Property Boundary (deep bedrock zone)