MEMORANDUM

TO:	Mr. Patrick Donahue – Entergy Nuclear Northeast
FROM:	Matthew Barvenik – GZA
REVIEWED BY:	Michael Powers - GZA
DATE:	January 25, 2008
RE:	Memorandum – Synopsis of Long Term Monitoring Plan Bases

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As requested, the following provides a synopsis of the bases[1] which underpin the Long Term Monitoring Plan (LTMP) currently being implemented at the Indian Point Energy center (IPEC) Site. These bases were derived from the Conceptual Site Model (CSM)[2] which was developed and refined during over two years of comprehensive hydrogeologic investigations completed at the Site, and as described in the Final Report[3]. During the progress of the investigations[4], Entergy also conducted regular and frequent meetings where GZA presented existing data and exchanged concepts with representatives of the United States Nuclear Regulatory Commission (NRC), the United States Geological Survey (USGS), and the New York State Department of Environmental Conservation (NYSDEC). This interchange of concepts, as well as information garnered during stakeholder and public meetings, was used to help set the course of the then ongoing investigations. Based on the outcome of these investigations and the resulting CSM, GZA has formulated and recommended to Entergy a LTMP design, which Entergy has adopted.

The overall LTMP design was formulated to satisfy four primary objectives:

1. Monitor groundwater to both detect and characterize current and potential future off-Site groundwater contaminant migration to the Hudson River from abnormal radionuclide releases of liquid effluents, so as to allow computation of potential radiation dose to the public;
2. Monitor groundwater along the southern property boundary to confirm that contaminated groundwater is not migrating off of the property in that direction;

[1] It is noted that the sampling installations referenced herein are a compilation of the LTMP as well as the 80-10/Effluents Programs.

[2] GZA used the Observational Method (see Section 2.0 of the Final Report) to guide our investigations, identify and fill data gaps, assess the reasonableness of findings, and develop parameters controlling contaminant transport, and ultimately to formulate the CSM. This is inherently an iterative process and, as studies progressed, the CSM was refined to better fit observed conditions. With completion of the investigations, the CSM was consistent with both the Site-specific project data and published data for the area (see Section 3.0 of the Final Report).

[3] Final Hydrogeologic Investigation Report, GZA GeoEnvironmental, Inc; January 7, 2008

[4] The investigations included approximately 60 shallow and deep, overburden and bedrock, single and multi-level instrument installations, as well as footing drain and man hole sampling points, which encompass approximately 150 individual sampling intervals. A subset of this overall monitoring installation network, as summarized on Figure LTMP 1, is used to provide the data for the LTMP. The level of redundancy designed into the LTM network anticipates and allows for the loss of a number of monitoring zones without significant impact to the adequacy of the monitoring system.

3. Monitor groundwater proximate to Systems, Structures and Components (SSCs) which exhibit a credible probability of resulting in a visually undetected release of radionuclides to the subsurface carrying an activity level of significance; and
4. Monitor the groundwater plumes identified on-Site to demonstrate overall reductions in total activity over time as is consistent with the requirements of Monitored Natural Attenuation (MNA)[5], the selected remediation for the IPEC Site.

These objectives are consistent with and fully encompass the guidance provided in the NEI Groundwater Protection Initiative.

To address objectives 1) and 2) above, groundwater monitoring installations have specifically been installed, and are currently being monitored, to both detect and characterize current and potential future off-Site groundwater contaminant migration to the river, both directly and through the Discharge Canal[6]. Additional installations have also been installed specifically for monitoring of the southern Site property boundary[7]. The IPEC Site was subdivided into six individual groundwater flow zones, with each including a separate shallow and deep flow zone. The instrument installations specifically targeted to monitor these individual zones, and the associated discharge pathways to the Hudson River, are outlined in the attached ***Dose Computation Monitoring Installation Matrix***. As shown on Figure LTMP-1 (included herewith), the multi-level sampling network is concentrated in the Unit 2 and Unit 1 areas given that this is where contaminant concentrations are by far the highest[8].

To address objective 3) above, monitoring installations have also been installed downgradient[9] of, and in close proximity to, both identified and potential critical Structures, Systems and Components (SSCs). The specific monitoring installations which target locations where identified and credible potential future sources of leakage might exist[10] are outlined on the attached ***Potential Source Monitoring Installation Matrix***. These installations, in concert with specific footing drain monitoring, provide earlier detection of potential future leaks associated with the power generating units than would be possible with boundary wells alone.

To address objective 4) above, monitoring installations have been strategically placed to monitor the behavior of the plumes identified on the Site (see Figure LTMP-1). Because of the nature and age of the releases, groundwater contaminant migration rates, and interdictions by Entergy to eliminate/control releases, the groundwater contaminant plumes have reached their maximum

[5] The selection of MNA as the remediation for the Site is more fully discussed in Section 11.0 of the Final Report.
[6] The methods used to monitor and compute the magnitude of radiological release to the river, and justification for their selection, are more fully discussed in Section 6.0 of the Final Report.
[7] Selection of appropriate installations to monitor the southern property boundary in light of groundwater elevation transients are more fully discussed in Section 6.6 of the Final Report.
[8] The monitoring installations located downgradient of Unit 3 are judged sufficient for monitoring and computations in this area given the low contaminant concentrations measured, even in the typically more contaminated shallow flow regime.
[9] Groundwater flow contours are provided on Figure LTMP-1, attached herewith, to demonstrate the groundwater flow pathway relationships between the potential source and the monitoring installation locations.
[10] The identification of contaminant sources and release mechanisms on the Site is more fully discussed in Section 8.0 of the Final Report.

spatial extent and should now decrease over time[11]. The specific instrument installations which target the monitoring of these plumes are summarized on the attached ***Plume Attenuation Monitoring Installation Matrix***. This monitoring is intended to verify that reductions are occurring in an anticipated manner.

Groundwater testing is performed quarterly on the majority of the LTMP installations, with some sampled semi-annually and the rest remaining on standby to provide added detail, if required. The sampling frequencies, targeted analysis suites, radionuclide analyses MDCs, and investigation trigger levels and associated action procedures are provided in the Radiological Ground Water Monitoring Procedures[12]. During long term monitoring, GZA anticipates that contaminant concentrations in individual monitoring wells will fluctuate over time (increasing at times as well as decreasing, as potentially related to precipitation events), and that a future short term increase in concentrations does *not*, in and of itself, indicate a new leak. In addition, it is also expected that some areas within the plumes will exhibit faster decay rates than others. Both behaviors are commonly observed throughout the industry with groundwater contamination sampling and analyses, and therefore, conclusions pursuant to plume behavior and the potential for new leaks must be evaluated in the context of all of the Site-wide monitoring data. Overall, however, GZA believes that the continuing monitoring will demonstrate decreasing long term trends in groundwater contaminant concentrations over time given the source interdictions completed by Entergy.

We appreciate the opportunity to be of service to you. Should you have any questions or comments, please feel free to contact me (781) 278-3805.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

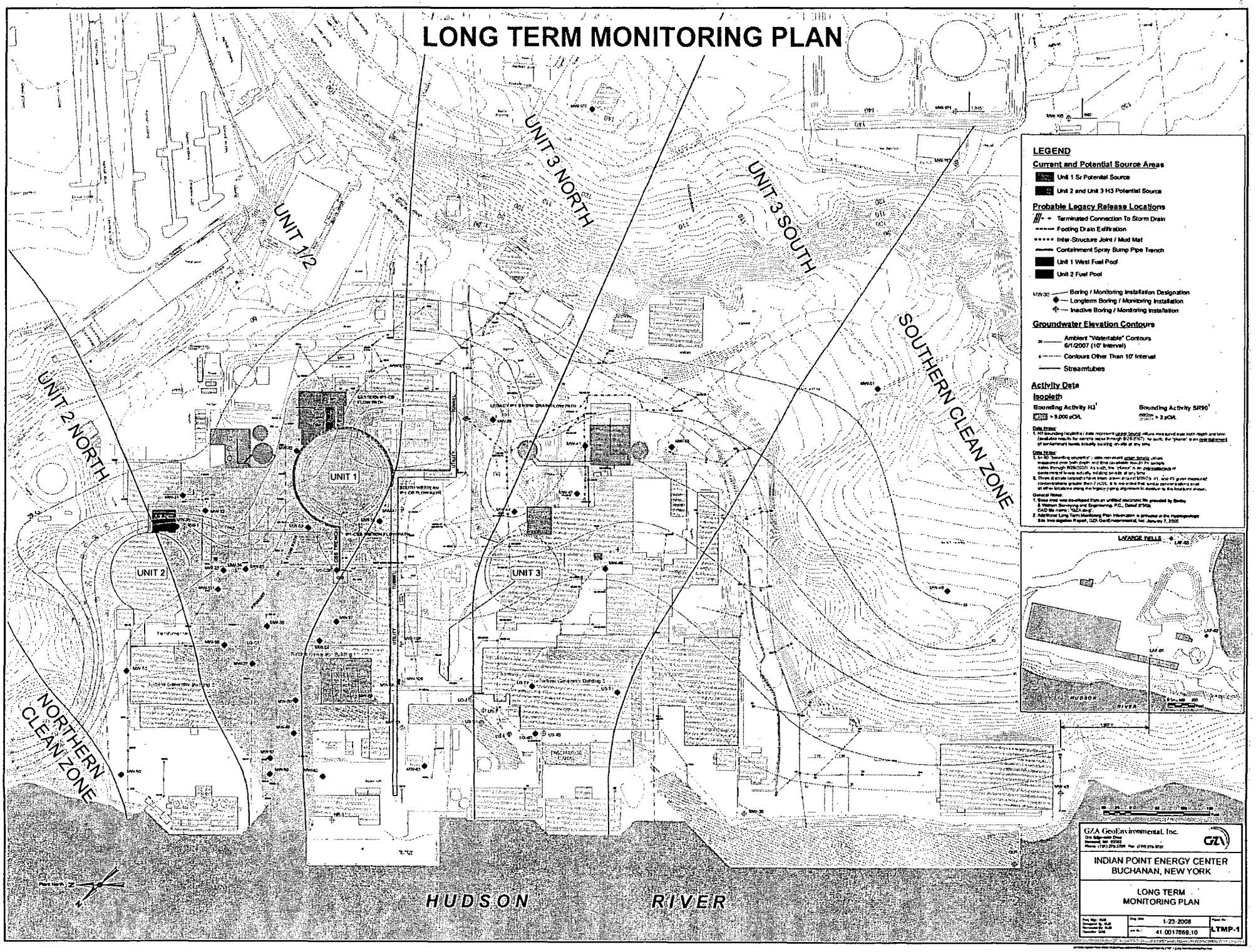
Matthew J. Barvenik, LSP
Senior Principal

Michael Powers, PE
Consultant/Reviewer

Attachments: Figure LTMP -1
Potential Dose Computation Monitoring Installation Matrix
Potential Source Monitoring Installation Matrix
Plume Attenuation Monitoring Installation Matrix.

[11] The temporal and spatial behavior of the plumes identified on the IPEC site are more fully discussed in Section 9.0 of the Final Report.
[12] Radiological Ground Water Monitoring Program; IPEC Site Management Manual; IP-SMM CY-110; January 11, 2008.

LONG TERM MONITORING PLAN



Dose Computation Monitoring Installation Matrix

Groundwater Flow Zone[1]	Activity to Discharge Canal[2]	Activity to Hudson River[2]
Northern Clean Zone	NA	NA
Unit 2 North	MW-52	MW-60
		MH-1
		MH-12
Unit 1/2	MW-36	MW-37
	MW-55	MW-49
	MW-50	MW-66
	MW-32	MW-67
	MW-53	
	MH-4A	MH-14
Unit 3 North	MW-54	MW-62
	MW-58	MW-63
	CB-14	CB-15
	CB-34	
Unit 3 South	U3-T2	CB-3
	U3-T1	
	U3-4D	
	MW-44	
	MW-41	
	U3-CB-B8	
Southern Clean Zone	MW-51	CB-E13
	MW-40	CB-C2
	CB-xx	
	CB-D1	
	CB-E6	
	CB-E8	

NOTE:

[1] Additional Long Term Monitoring Plan information is provided in the Hydrogeologic Site Investigation Report; GZA GeoEnvironmental, Inc.; January 7, 2008.

[2] It is noted that the sampling installations referenced herein are a compilation of the LTMP as well as the 80-10/Effluents Programs.

Potential Source Monitoring Installation Matrix

Potential Source [1,2]	Primary [3,5] Monitoring Installation	Secondary [4,5] Monitoring Installation
Unit 2		
Unit 2 Spent Fuel Pool	MW-30	MW-33
	MW-31	MW-35
	MW-32	MW-111
	MH-5	MW-36
		MW-37
		MW-55
		MW-52
Unit 2 Transfer Canal	MW-30	MW-33
	MW-31	MW-35
	MW-32	MW-111
	MH-5	MW-36
		MW-37
		MW-55
		MW-52
Unit 2 Transfer Tube	MW-30	MW-33
	MW-31	MW-35
	MW-32	MW-111
	MH-5	MW-36
		MW-37
		MW-55
		MW-52
Unit 2 Rad Waste Transfer Line to Unit 1	MW-33	MW-55
	MW-35	MW-36
	MW-111	MW-37
	U1-CSS	MW-50
Unit 2 Drain Line under MOB	MW-31	MW-33
	MW-30	MW-35
	MW-32	MW-111
	MH-5	MW-36
		MW-37
		MW-55
		MW-52
Unit 2 Drain Line under Fan House	MW-30	MW-35
	MH-5	MW-111
	MW-33	MW-36
		MW-37
		MW-55
		MW-52
Unit 2 Primary Auxilary Building Sump	MW-33	MW-36
	MW-35	MW-37
	MW-111	MW-55
		MW-52
Unit 2 Refueling Water Storage Tank & piping	MW-42	MW-32
	NCD	MW-55
	MW-53	MW-54
	MW-33	MW-36
	MW-35	MW-37
	MW-111	
Unit 2 Primary Water Tank	MW-42	MW-32
	NCD	MW-55
	MW-53	MW-54
	MW-33	MW-36
	MW-35	MW-37
	MW-111	
Unit 2 Waste Holdup Tanks and floor drain	MW-31	MW-30
	MW-32	MH-5
	MW-42	MW-33
	NCD	MW-35
	MW-53	MW-111
		MW-55
		MW-54
Unit 2 VC footing drain	MH-5	MW-52
		MW-36
		MW-37

Potential Source Monitoring Installation Matrix

Unit 1		
Unit 1 Spent Fuel Pools - Primary (NCD) Flow Path	NCD	MW-55
	MW-42	MW-36
	MW-53	MW-37
		MW-54
		SFD Sump
Unit 1 Spent Fuel Pools - Eastern CB Flow Path	CSB Drain	MW-53
	NCD	
	MW-42	
	SFD Sump	
Unit 1 Spent Fuel Pools - Southwestern CB Flow Path	MW-56	MW-57
		MW-54
		MW-50
		CSB Drain
		SFD Sump
Unit 1 Spent Fuel Pools - CSS Trench Flow Path	U1-CSS	MW-55
	MW-57	MW-50
	MW-54	
Unit 1 CSS	U1-CSS	MW-55
	MW-57	MW-50
	MW-54	
Unit 1 Legacy Storm Drain Piping	MW-39	MW-44
	MW-41	MW-45
	MW-43	MW-46
		MH-B6a
		MH-B1
		U3-T1
		U3-T2
Unit 3		
Unit 3 Spent Fuel Pool & Transfer Canal	MW-44	U3-T1
	MW-45	U3-T2
	MW-46	
	MH-B6a	
	MH-B1	
Unit 3 Transfer Tube Sleeve Drain	MW-44	U3-T1
	MH-B6a	U3-T2
	MH-B1	
Unit 3 VC and FSB Anular Space	MW-44	U3-T1
	MH-B6a	U3-T2
	MH-B1	
Unit 3 2" Liquid Waste & 3" Containment Blowdown Piping	MW-44	U3-T1
	MH-B6a	U3-T2
	MH-B1	
Unit 3 Primary Auxilary Building Sump & Floor Drain Piping	MW-46	MH-B1
	MH-B6a	U3-T1
		U3-T2
Unit 3 Fan House Floor Drain Piping	MH-B1	MW-46
	MH-B6a	U3-T1
		U3-T2
Unit 3 Refueling Water Storage Tank & Piping	MW-39	MH-B6a
	MW-41	MH-B1
	MW-44	MW-46
	MW-45	U3-T1
		U3-T2
Unit 3 Primary Water Tank	MW-41	MW-45
	MW-43	MH-B6a
	MW-46	MH-B1
		U3-T1
		U3-T2
Unit 3 Waste Holdup Tank & Floor Drain Piping	MW-41	MW-45
	MW-43	MH-B6a
	MW-46	MH-B1
		U3-T1
		U3-T2

Potential Source Monitoring Installation Matrix

NOTES:

[1] **Potential Sources** are Systems, Structures or Components which exhibit a credible probability of resulting in a visually undetected release of radionuclides to the subsurface with an activity of significance.

[2] Additional Long Term Monitoring Plan information is provided in the Hydrogeologic Site Investigation Report; GZA GeoEnvironmental, Inc.; January 7, 2008.

[3] **Primary Monitoring Installations** are those generally closest to a potential source and most likely to initially detect a release. **Secondary Monitoring Installations** are those that are located futher down or cross gradient from a potential source.

[4]

[5] It is noted that the sampling installations referenced herein are a compilation of the LTMP as well as the 80-10/Effluents Programs.

Plume Attenuation Monitoring Installation Matrix

Plume Source	Source Area Monitoring Installation[4]	Down Gradient Monitoring Installation[4]
Unit 2 Tritium Plume		
Unit 2 Spent Fuel Pool (*direct GW flow*)[1,3]	MW-30	MW-36
	MW-33	MW-37
	MW-111	MW-67
		MW-66
Unit 2 Spent Fuel Pool (*eastern unsaturated zone flow*)[2,3]	MW-31	MW-30
		MW-33
		MW-111
		MW-36
		MW-37
		MW-67
		MW-66
Unit 2 Spent Fuel Pool (*southern unsaturated zone flow*)[2,3]	MW-32	MW-33
	MW-42	MW-35
	MW-53	MW-111
		MW-36
		MW-55
		MW-37
		MW-50
		MW-49
		MW-67
		MW-66
		MW-62
Unit 1 Strontium Plume		
Unit 1 Spent Fuel Pools - Primary (NCD) Flow Path[3]	MW-42	MW-55
	MW-53	MW-36
		MW-37
		MW-54
		MW-50
		MW-49
		MW-67
		MW-66
Unit 1 Spent Fuel Pools - Eastern CB Flow Path[3]	MW-42	MW-55
		MW-36
		MW-37
		MW-54
		MW-50
		MW-49
		MW-67
		MW-66
Unit 1 Spent Fuel Pools - Southwestern CB Flow Path[3]	MW-56	U1-CSS
		MW-57
		MW-54
		MW-50
		MW-49
		MW-67
		MW-66
		MW-62
Unit 1 Spent Fuel Pools - CSS Trench Flow Path[3]	U1-CSS	MW-55
		MW-54
		MW-37
		MW-50
		MW-49
		MW-67
		MW-66
Unit 1 Legacy Storm Drain Piping Flow Path[3]	MW-39	MW-44
	MW-41	MW-45
	MW-43	MW-46
		U3-T1
		U3-T2

NOTES:

[1] **Direct Groundwater Flow** designates that portion of the Unit 2 Tritium release that enters the groundwater below the IP2-SFP and then moves downgradient to the West.

[2] **Unsaturated zone flow** designates those portions of the Tritium release that first migrate above the water table along fracture orientations in directions other than that of the groundwater flow prior to entering the groundwater, with migration along groundwater flow paths, thereafter.

[3] Additional Long Term Monitoring Plan information is provided in the Hydrogeologic Site Investigation Report; GZA GeoEnvironmental, Inc.; January 7, 2008.

[4] It is noted that the sampling installations referenced herein are a compilation of the LTMP as well as the 80-10/Effluents Programs.