grid.) The 1-kg samples were analyzed for ^{238}Pu and $^{239,240}Pu$. Analyses for ^{137}Cs, ^{90}Sr, total uranium, and gross gamma were done on standard-size samples.

In Table XXV the analytical results in 1983 from the six stations are compared with similar data from 1981. There is no significant difference in the concentrations of ^{137}Cs, ^{238}Pu, or ^{90}Sr. The average $^{239,240}Pu/^{238}Pu$ ratios for both sets of samples are similar at 23 (1981) and 15 (1983).

TRANSPORT OF RADIONUCLIDES IN SNOWMELT RUNOFF, 1983

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The major transport of radionuclides from canyons that have received or are now receiving treated low-level radioactive effluents is by surface runoff (solution and sediments). Radionuclides in the effluents become adsorbed or attached to sediment particles in the stream channels.

Surface runoff, the major transport mechanism, occurs in two modes. Spring snowmelt runoff occurs over a long period of time (days) at a low discharge rate and sediment load. Summer runoff from thunderstorms occurs over a short period of time (hours) at a high discharge rate and sediment load.

Samples of the runoff were collected and analyzed for radionuclides in solution and suspended sediments (Table XXVI). Radioactivity in solution is defined as the filtrate passing through a 0.45-μm-pore-size filter; radioactivity in suspended sediments is defined as the residue on the filter. The solution was analyzed for ^{137}Cs, ^{238}Pu, $^{239,240}Pu$, ^{3}H, total uranium, and gross gamma, whereas suspended sediments were analyzed for ^{238}Pu and $^{239,240}Pu$.

During 1983, snowmelt runoff was monitored at Los Alamos Canyon at State Road 4 (SR-4) and at Otowi near the Rio Grande (Fig. 25). Los Alamos Canyon and tributary Pueblo Canyon have

TABLE XXVI. Average Radiochemical and Chemical Concentrations in Snowmelt Runoff

Measured Element	Units	Los Alamos Canyon		Pajarito Canyon
		SR-4	Otowi	
Radiochemical (solution)				
^{137}Cs	10^{-9} μCi/mL	20 ± 65	16 ± 44	4 ± 60
^{238}Pu	10^{-9} μCi/mL	0.003 ± 0.018	−0.001 ± 0.008	−0.005 ± 0.019
$^{239,240}Pu$	10^{-9} μCi/mL	0.014 ± 0.021	0.008 ± 0.008	0.007 ± 0.005
^{3}H	10^{-6} μCi/mL	2.4 ± 1.1	2.4 ± 1.0	3.1 ± 1.4
Total uranium	μg/L	0.1 ± 0.7	0.6 ± 1.1	0.3 ± 0.8
Gross gamma	counts/min/L	49 ± 67	33 ± 47	41 ± 56
Radiochemical (suspended sediments)				
^{238}Pu	pCi/g	0.27 ± 0.40	0.15 ± 0.24	0.20 ± 0.59
$^{239,240}Pu$	pCi/g	4.7 ± 6.4	2.3 ± 3.0	0.18 ± 0.53
Chemical				
Cl	mg/L	11	13	31
F	mg/L	0.1	0.2	0.1
NO_3	mg/L	1.5	1.0	0.9
TDS	mg/L	118	131	192
pH	—	7.5	7.8	7.7

received low-level radioactive effluents from treatment plants, so the channel sediments contain radionuclides that are subject to transport surface runoff.

Snowmelt runoff was also monitored in Pajarito Canyon at SR–4, which forms the eastern boundary of the Laboratory. There are no industrial effluents released into Pajarito Canyon. Runoff was also monitored because it drained several of the Laboratory's technical areas, one of which is used for the disposal and storage area for low-level solid radioactive wastes.

The concentrations of ^{137}Cs, ^{238}Pu, $^{239,240}Pu$, ^{3}H, total uranium, and gross-gamma activity in solution samples from Los Alamos Canyon at SR–4 and Otowi were indistinguishable from radioactivity concentrations in solution samples from Pajarito Canyon (Table XXVI).

There was no significant difference in concentrations of ^{238}Pu in suspended sediment in Los Alamos Canyon at SR–4 and at Otowi when compared with those ^{238}Pu concentrations in Pajarito Canyon. There was, however, a significant difference in the $^{239,240}Pu$ concentrations in suspended sediments in Los Alamos Canyon when compared with those concentrations in Pajarito Canyon. The average concentrations of $^{239,240}Pu$ in suspended sediments in Los Alamos Canyon ranged from 4.7 pCi/g at SR–4 to 2.3 pCi/g at Otowi. These were about 26 and 13 times greater than the average background $^{239,240}Pu$ concentrations in Pajarito Canyon. The concentrations of $^{239,240}Pu$ in sediments declined downstream in Los Alamos Canyon as the sediments dispersed and mixed with uncontaminated sediments in the channel.

The average chemical concentrations of the runoff at each of the three stations are also shown in Table XXVI. The chloride and total-dissolved-solids concentrations in runoff in Pajarito Canyon were higher than those in Los Alamos Canyon. This was probably caused by the smaller drainage area of Pajarito Canyon. This resulted in smaller volume of runoff in Pajarito Canyon at SR–4 (about $11 \times 10^4 m^3$) compared with that in Los Alamos Canyon at SR–4 ($52 \times 10^4 m^3$).

There was little, if any, transport during 1983 of radionuclides in solution surface runoff in Los Alamos Canyon, which has received treated low-level radioactive effluents. There is little, if any, transport of ^{238}Pu in suspended sediments. The major transport of radioactivity in the suspended sediments was of $^{239,240}Pu$. This was the major isotope of plutonium released by the treatment plants into DP and Pueblo Canyons, which are tributaries to Los Alamos Canyon. The runoff in Los Alamos Canyon carries trace amounts of plutonium to the Rio Grande in silts and clays (suspended sediments).

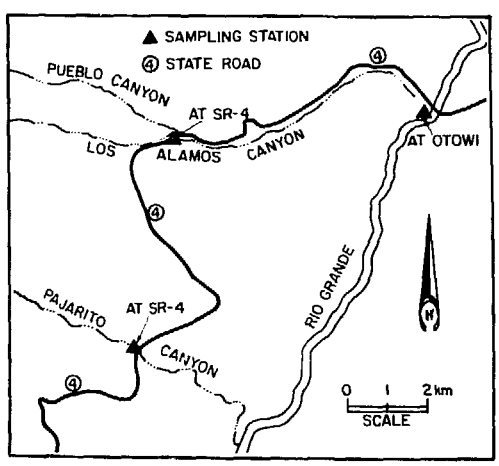

FIGURE 25.
Locations of surface runoff sampling stations.