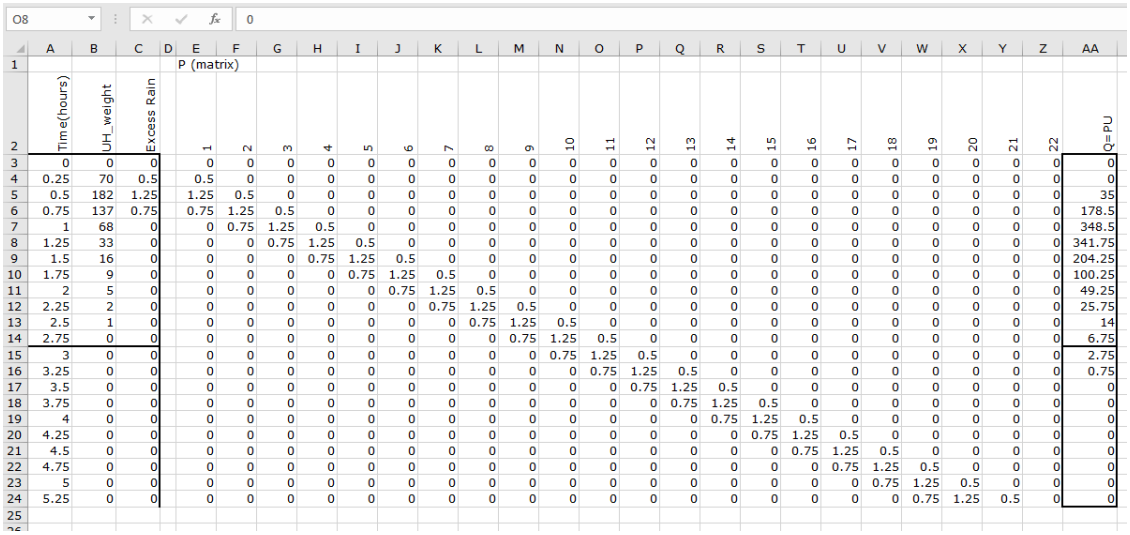
es5-ws7

August 4, 2025

Simply perform the matrix multiplication ($Q = PU$).

The screen capture below uses an Excel worksheet. Extends the data range with zero post-padding.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1					P (matrix)																						
2	Time(hours)	UH_weight	Excess Rain		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Q=PU
3	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0.25	70	0.5		0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0.5	182	1.25		1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
6	0.75	137	0.75		0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	178.5
7	1	68	0		0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	348.5
8	1.25	33	0		0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	341.75
9	1.5	16	0		0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	204.25
10	1.75	9	0		0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.25
11	2	5	0		0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49.25
12	2.25	2	0		0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	25.75
13	2.5	1	0		0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	14
14	2.75	0	0		0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	0	6.75
15	3	0	0		0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0	2.75
16	3.25	0	0		0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0	0.75
17	3.5	0	0		0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0	0
18	3.75	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0	0
19	4	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0	0
20	4.25	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0	0
21	4.5	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0	0
22	4.75	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0	0
23	5	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0	0
24	5.25	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	1.25	0.5	0	0
25																											

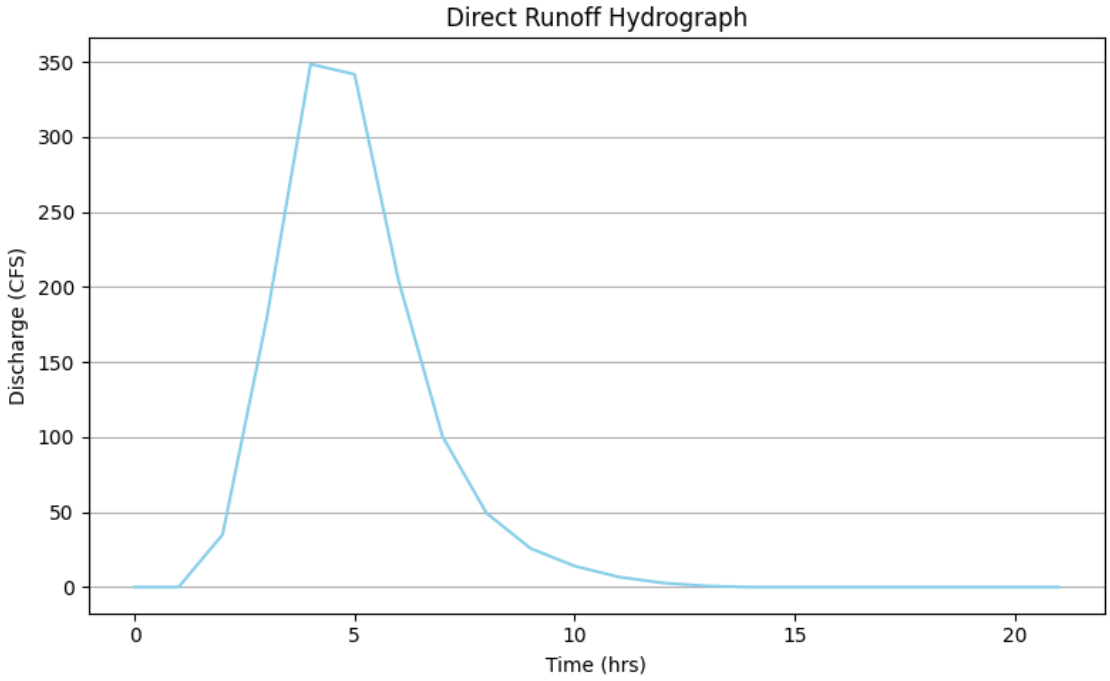
Then plot the results

[9]:
```
import matplotlib.pyplot as plt

discharge = [0,0,35,178.5,348.5,341.75,204.25,100.25,49.25,25.75,14,6.75,2.75,0.
↪75,0,0,0,0,0,0,0,0]
time = list(range(len(discharge)))

plt.figure(figsize=(8, 5))
plt.plot(time, discharge, color='skyblue')

plt.title("Direct Runoff Hydrograph")
plt.xlabel("Time (hrs)")
plt.ylabel("Discharge (CFS)")
plt.grid(True, axis='y')
plt.tight_layout()
plt.show()
```


Direct Runoff Hydrograph
Discharge (CFS)
350
300
250
200
150
100
50
0
0
5
10
15
20
Time (hrs)

[ ]: