Critical Pressure Calculations

Critical Pressure Rise Calculations Burdock Area				
Minnelusa to Unkpapa/Sundance				
Depth to base of Unkpapa/Sundance	1255	ft bgs	$Base_{US}$	
Depth to top of Unkpapa/Sundance potentiometric surface	-29	ft bgs	$PotSurf_{US}$	29 feet above ground surface p. 2-5 Class V Permit App
Depth to top of Minnelusa Fm	1950	ft bgs	Top_{IJ}	
Depth to top of Minnelusa potentiometric surface	1750	ft bgs	$PotSurf_{IJ}$	
Specific gravity USDW fluids γ_{USDW}	1.001			
Specific gravity Minnelusa injection zone fluids γ_{Minn}	1.008			
water column pressure gradient	0.433	psi/ft		
Critical pressure from Minnelusa to Unkpapa/Sundance				
Pressure at top of Minnelusa injection zone=P_O				
$P_O=0.433[\gamma_{Minn}*PotSurf_{IJ}]=$	763.8	psi		
distance between base of USDW and top of injection zone:Top_{IJ}-$Base_{USDW}$	695.0	ft		
distance between base of USDW and top of USDW pot surf:$Base_{USDW}$-$PotSurf_{USDW}$	1284.0	ft		
pressure required to move injection zone fluids from top of Minnluesa up to Unkpapa/Sundance=P_{MUS}				
$P_{MUS}=0.433[\gamma_{Minn}(Top_{IJ}-Base_{USDW})]=$	303.3	psi		
pressure that must be overcome in the Unpapa/Sundance USDW=P_{US}				
$P_{US}=0.433[\gamma_{USDW}(Base_{USDW}-PotSurf_{USDW})$	556.5	psi		
$P_C=(P_{MUS}+P_{US}) - P_O$	96.1	psi		
Critical pressure from Minnelusa to Madison				
Depth to base of Minnelusa Inj Zone	2540	ft bgs	$Base_{IJ}$	2785 ft (if lower sandstones are included in the injection zone)
Depth to top of Madison USDW	3100	ft bgs	Top_{Mad}	
distance between base of Minnelusa injection zone and top of Madison USDW = $Base_{IJ}$ - Top_{Mad}	-560.0	ft		-315.0 ft (if lower sandstones are included in the injection zone)
pressure required to move injection zone fluids from bottom of Minnluesa down to top of Madison USDW=P_{MM}				
$P_{MM}=0.433[\gamma_{Minn}(Base_{IJ} - Top_{Mad})]$	-244.4	psi	P_{MM}	-137.5 psi (if lower sandstones are included in the injection zone)
Depth to top of Madison potentiometric surface=	86.8	ft bgs	$PotSurf_{Mad}$	86.8 ft EPA's input value
Pressure at base of Minnelusa injection zone= P_O above + aquifer fluid pressure within Minnelusa				
$P_O + 0.433[\gamma_{Minn}*(Base_{IJ}-Top_{IJ})]=$	1021.3	psi	P_{Minn}	1128.3 ft (if lower sandstones are included in the injection zone)
pressure that must be overcome in the Madison USDW=P_{Mad}				
$P_{Mad}=0.433[\gamma_{USDW}(Top_{Mad}-PotSurf_{Mad})]$	1306.0	psi		1306.0
$P_C=(P_{MM}+P_{Mad}) - P_{Minn}$	40.3	psi		40.3 psi (at 40.3 psi even if lower sandstones are included in the injection zone)

Critical Pressure Rise Calculations Burdock Area
Minnelusa to Unkpapa/Sundance

Depth to base of Unkpapa/Sundance	920	ft bgs	$Base_{US}$	
Depth to top of Unkpapa/Sundance potentiometric surface	-29	ft bgs	$PotSurf_{US}$	29 feet above ground surface p. 2-3 Class V Permit App
Depth to top of Minnelusa Fm	1615	ft bgs	Top_{Ij}	
Depth to top of Minnelusa potentiometric surface	1415	ft bgs	$PotSurf_{Ij}$	
Specific gravity USDW fluids γ_{USDW}	1.001			
Specific gravity Minnelusa injection zone fluids γ_{Minn}	1.008			
water column pressure gradient	0.433	psi/ft		

Critical pressure from Minnelusa to Unkpapa/Sundance

Pressure at top of Minnelusa injection zone=P_O				
$P_O=0.433[\gamma_{Minn}*PotSurf_{Ij}]=$	617.6	psi		
distance between base of USDW and top of injection zone:$Top_{Ij}-Base_{USDW}$	695.0	ft		
distance between base of USDW and top of USDW pot surf:$Base_{USDW}-PotSurf_{USDW}$	949.0	ft		
pressure required to move injection zone fluids from top of Minnluesa up to Unkpapa/Sundance=P_{MUS}				
$P_{MUS}=0.433[\gamma_{Minn}(Top_{Ij}-Base_{USDW})]=$	303.3	psi		
pressure that must be overcome in the Unpapa/Sundance USDW=P_{US}				
$P_{US}=0.433[\gamma_{USDW}(Base_{USDW}-PotSurf_{USDW})$	411.3	psi		
$P_C=(P_{MUS}+P_{US}) - P_O$	97.1	psi		

Critical pressure from Minnelusa to Madison

Depth to base of Minnelusa Inj Zone	2205	ft bgs	$Base_{Ij}$	2450 ft (if lower sandstones are included in the injection zone)
Depth to top of Madison USDW	2765	ft bgs	Top_{Mad}	
distance between base of Minnelusa injection zone and top of Madison USDW = $Base_{Ij}$ - Top_{Mad}	-560.0	ft		-315.0 ft (if lower sandstones are included in the injection zone)
pressure required to move injection zone fluids from bottom of Minnluesa down to top of Madison USDW=P_{MM}				
$P_{MM}=0.433[\gamma_{Minn}(Base_{Ij} - Top_{Mad})]$	-244.4	psi	P_{MM}	-137.5 psi (if lower sandstones are included in the injection zone)
Depth to top of Madison potentiometric surface=	-200.0	ft bgs (PT)	$PotSurf_{Mad}$	101.8 =86.8 ft +15 ft EPA's input value
Pressure at base of Minnelusa injection zone= P_O above + aquifer fluid pressure within Minnelusa				
$P_O + 0.433[\gamma_{Minn}*(Base_{Ij}-Top_{Ij})]=$	875.1	psi	P_{Minn}	982.0 psi (if lower sandstones are included in the injection zone)
pressure that must be overcome in the Madison USDW=P_{Mad}				
$P_{Mad}=0.433[\gamma_{USDW}(Top_{Mad}-PotSurf_{Mad})]$	1285.1	psi		1154.3 psi (using EPA's input value for depth to top of Madison pot surf)
$P_C=(P_{MM}+P_{Mad}) - P_{Minn}$	165.6	psi (PT)		34.8 psi (using EPA's input value for depth to top of Madison pot surf)
				34.9 psi even if lower sandstones are included in the injection zone