Census Designated Places

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##Loading Data and Packages

```
library(tidyverse)
```

```
## Warning in system("timedatectl", intern = TRUE): running command 'timedatectl'
## had status 1
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v dplyr   1.0.9
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(sf)
```

```
## Linking to GEOS 3.8.0, GDAL 3.0.4, PROJ 6.3.1; sf_use_s2() is TRUE
```

```
library(tigris)
```

```
## To enable caching of data, set `options(tigris_use_cache = TRUE)`
## in your R script or .Rprofile.
```

```
library(ggplot2)
options(tigris_use_cache="TRUE")
```

```
fixed_utilities<- st_read("~/EPIC/David Switzer's Service Area Dataset/Switzer Shapefile/FixedUtilities
```

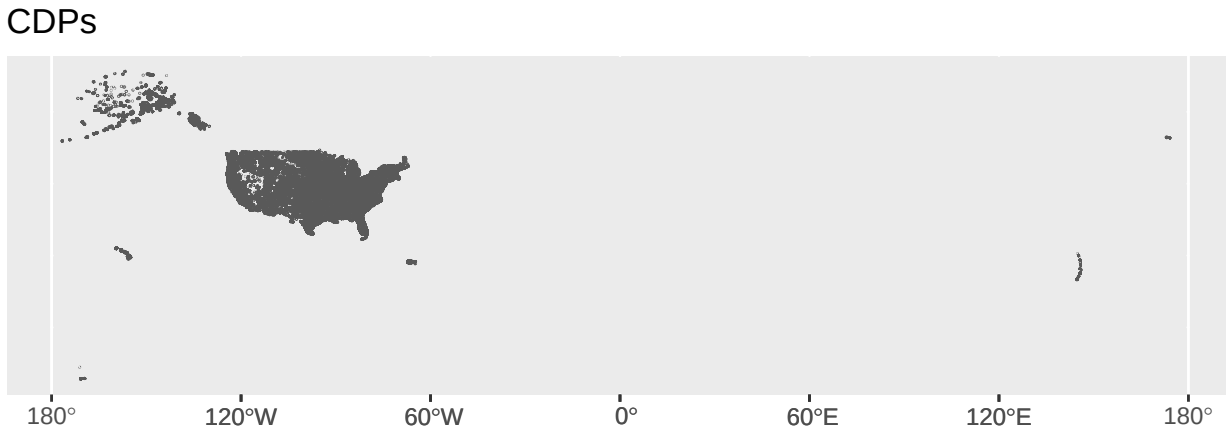
```
## Reading layer `FixedUtilities' from data source
##   `/home/guest/EPIC/David Switzer's Service Area Dataset/Switzer Shapefile/FixedUtilities.shp'
##   using driver `ESRI Shapefile'
## Simple feature collection with 1193 features and 1 field
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: -178.3347 ymin: 20.50091 xmax: -70.11755 ymax: 64.88882
## Geodetic CRS:  NAD83
```

```
census_designated_places <- places(state= NULL, cb = TRUE, year=2021) %>%
  arrange(STATE_NAME)
```

```
## Retrieving Census-designated places for the entire United States
```

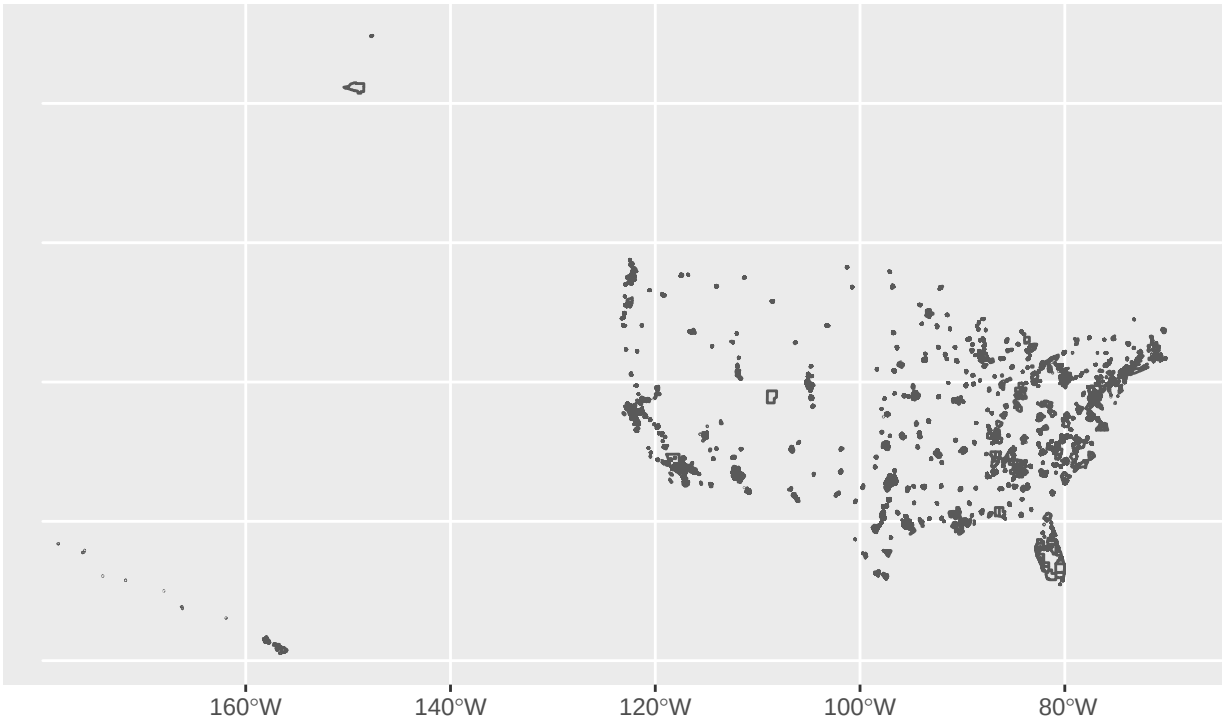
```
fixed_utilities<-fixed_utilities %>%
  arrange("PSWID")
```

```
ggplot(census_designated_places)+
  geom_sf()+
  labs(title= "CDPs")
```




```
ggplot(fixed_utilities) +
  geom_sf()+
  labs(title="Fixed Utilities")
```

Fixed Utilities



##FLORIDA##

```
census_FL <- places(state= "FL", cb = TRUE, year=2021)
```

```
fixed_FL<-fixed_utilities %>%
  filter(str_detect(PWSID,"FL")) %>%
  filter(PWSID %in% c("FL1370655", "FL2100741", "FL2161328", "FL3050442", "FL3314052", "FL3480962", "FL
```

```
fixed_FL<-fixed_FL %>%
  mutate(System_Area=st_area(fixed_FL))

census_FL<-census_FL %>%
  mutate(Census_Area=st_area(census_FL))
```

```
intersection_FL <- st_intersection(census_FL, fixed_FL)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

##{r plot-FL} ggplot()+ geom_sf(color="green", data=census_FL_6, fill="transparent")
geom_sf(color="pink", data=fixed_FL_1, fill="transparent")

##"'{r plot-intersection-FL} ggplot() + geom_sf(color="seagreen", data=intersection_FL)

```
sf::sf_use_s2(FALSE)
```

```
## Spherical geometry (s2) switched off
```

```
intersection_FL<-intersection_FL %>%
  mutate(Intersection_Area=st_area(intersection_FL))
```

```
intersection_area_FL <- intersection_FL %>%
  group_by(PWSID) %>%
  mutate(Sum_Intersection_Area=sum(Intersection_Area))

intersection_area_FL_1<- intersection_area_FL %>%
  st_set_geometry(NULL)
```

```
census_FL$geometry <- NULL
combined_data<-inner_join(intersection_area_FL, census_FL, by="PLACEFP")
```

```
combined_data <- combined_data %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area.x) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.98 & "pct_system" > 0.98, "True", "False"))
```

#FL6531014

```
combined_data_1 <- combined_data %>%
  filter(PWSID=="FL6531014")
```

Census Area Boundary.

#FL3050442

```
combined_data_2 <- combined_data %>%
   filter(PWSID=="FL3050442")
```

Unknown- Not Census Area Boundary.

#FL4560954

```
combined_data_3 <- combined_data %>%
  filter(PWSID=="FL4560954")
```

Census Area Boundary.

#FL6290327

```
combined_data_4 <- combined_data %>%
  filter(PWSID=="FL6290327")
```

Unknown-Not Census Area Boundary.

#FL4060925

```
combined_data_5 <- combined_data %>%
  filter(PWSID=="FL4060925")
```

Census Area Boundary.

#FL5360325

```
combined_data_6 <- combined_data %>%
  filter(PWSID=="FL5360325")
```

Census Area Boundary.

#FL4501559

```
combined_data_7 <- combined_data %>%
  filter(PWSID=="FL4501559")
```

Census Area Boundary.

#FL3480962

```
combined_data_8 <- combined_data %>%
  filter(PWSID=="FL3480962")
```

Census Area Boundary.

#FL6520336

```
combined_data_9 <- combined_data %>%
  filter(PWSID=="FL6520336")
```

Unknown- Not Census Area Boundary

#FL1370655

```
combined_data_10 <- combined_data %>%
  filter(PWSID=="FL1370655")
```

Census Area Boundary.

#FL6521715

```
combined_data_11 <- combined_data %>%
  filter(PWSID=="FL6521715")
```

Unknown- Not Census Area Boundary.

#FL4060486

```
combined_data_12 <- combined_data %>%
  filter(PWSID=="FL4060486")
```

Census Area Boundary

#FL4500145

```
combined_data_13 <- combined_data %>%
  filter(PWSID=="FL4500145")
```

Census Area Boundary

#FL2161328

```
combined_data_14 <- combined_data %>%
  filter(PWSID=="FL2161328")
```

Unknown - Not Census Boundary

#FL3484132

```
combined_data_15 <- combined_data %>%
  filter(PWSID=="FL3484132")
```

Unknown- Not Census Area Boundary

#FL6521405

```
combined_data_16 <- combined_data %>%
  filter(PWSID=="FL6521405")
```

Unknown- Not Census Area Boundary

#FL6581591

```
combined_data_17 <- combined_data %>%
  filter(PWSID=="FL6581591")
```

Unknown- Not Census Area Boundary

#FL5084100

```
combined_data_18 <- combined_data %>%
  filter(PWSID=="FL5084100")
```

Unknown- Not Census Area Boundary

#FL5114069

```
combined_data_19 <- combined_data %>%
  filter(PWSID=="FL5114069")
```

Unknown- Not Census Area Boundary

#FL3314052

```
combined_data_20 <- combined_data %>%
  filter(PWSID=="FL3314052")
```

Unknown- Not Census Area Boundary

#FL6411132

```
combined_data_21 <- combined_data %>%
  filter(PWSID=="FL6411132")
```

Unknown- Not Census Area Boundary

#FL4504393

```
combined_data_22 <- combined_data %>%
  filter(PWSID=="FL4504393")
```

Unknown- Not Census Area Boundary

#FL6511361

```
combined_data_23 <- combined_data %>%
  filter(PWSID=="FL6511361")
```

Unknown- Not Census Area Boundary

#FL2100741

```
combined_data_24 <- combined_data %>%
  filter(PWSID=="FL2100741")
```

Unknown- Not Census Area Boundary

##VIRGINIA##

```
census_VA <- places(state= "VA", cb = TRUE, year=2021)
```

```
system_VA<-fixed_utilities %>%
  filter(str_detect(PWSID,"VA")) %>%
  filter(PWSID %in% c("VA3550051", "VA3700500", "VA3710100", "VA3740600", "VA3810900", "VA4087125", "VA
```

```
system_VA<-system_VA %>%
  mutate(System_Area=st_area(system_VA))
```

```
census_VA<-census_VA %>%
  mutate(Census_Area=st_area(census_VA))

intersection_VA <- st_intersection(census_VA, system_VA)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_VA<-intersection_VA %>%
  mutate(Intersection_Area=st_area(intersection_VA))
```

```
intersection_VA <- intersection_VA %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#VA3740600

```
intersection_VA_1<-intersection_VA %>%
  filter(PWSID=="VA3740600")
```

Unknown- Not Census Area Boundary

#VA4760100

```
intersection_VA_2<-intersection_VA %>%
  filter(PWSID=="VA4760100")
```

Census Area Boundary

#VA3550051

```
intersection_VA_3<-intersection_VA %>%
  filter(PWSID=="VA3550051")
```

Census Area Boundary

#VA3810900

```
intersection_VA_4<-intersection_VA %>%
  filter(PWSID=="VA3810900")
```

Unknown- Not Census Boundary

#VA3700500

```
intersection_VA_5<-intersection_VA %>%
  filter(PWSID=="VA3700500")
```

Unknown- Not Census Boundary

#VA3710100

```
intersection_VA_6<-intersection_VA %>%
  filter(PWSID=="VA3710100")
```

Unknown- Not Census Boundary

#VA6179100

```
intersection_VA_7<-intersection_VA %>%
  filter(PWSID=="VA6179100")
```

Unknown- Not Census Boundary

#VA4041845

```
intersection_VA_8<-intersection_VA %>%
  filter(PWSID=="VA4041845")
```

Unknown- Not Census Boundary

#VA4087125

```
intersection_VA_9<-intersection_VA %>%
  filter(PWSID=="VA4087125")
```

Unknown- Not Census Boundary

#VA2770900

```
intersection_VA_10<-intersection_VA %>%
  filter(PWSID=="VA2770900")
```

Unknown- Not Census Boundary

##GEORGIA##

```
census_GA <- places(state= "GA", cb = TRUE, year=2021)
```

```
system_GA<-fixed_utilities %>%
  filter(str_detect(PWSID,"GA")) %>%
  filter(PWSID %in% c("GA0570002", "GA0630000", "GA0670003", "GA0890001", "GA1510001", "GA0210001", "GA
```

```
system_GA<-system_GA %>%
  mutate(System_Area=st_area(system_GA))

census_GA<-census_GA %>%
  mutate(Census_Area=st_area(census_GA))

intersection_GA <- st_intersection(census_GA, system_GA)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
sf::sf_use_s2(FALSE)
intersection_GA<-intersection_GA %>%
  mutate(Intersection_Area=st_area(intersection_GA))
```

```
intersection_GA <- intersection_GA %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#GA0590000

```
intersection_GA_1<-intersection_GA %>%
  filter(PWSID=="GA0590000")
```

Census Area Boundary

#GA1390001

```
intersection_GA_2<-intersection_GA %>%
  filter(PWSID=="GA1390001")
```

Unknown- Not Census Area Boundary

#GA1210001

```
intersection_GA_3<-intersection_GA %>%
  filter(PWSID=="GA1210001")
```

Census Area Boundary

#GA0510003

```
intersection_GA_4<-intersection_GA %>%
  filter(PWSID=="GA0510003")
```

Unknown-Not Census Area Boundary

#GA2450000

```
intersection_GA_5<-intersection_GA %>%
  filter(PWSID=="GA2450000")
```

Census Area Boundary

#GA0730000

```
intersection_GA_6<-intersection_GA %>%
  filter(PWSID=="GA0730000")
```

Unknown-Not Census Area Boundary

#GA1350004

```
intersection_GA_7<-intersection_GA %>%
  filter(PWSID=="GA1350004")
```

Unknown-Not Census Area Boundary

#GA1170050

```
intersection_GA_8<-intersection_GA %>%
  filter(PWSID=="GA1170050")
```

Unknown-Not Census Area Boundary

#GA0570002

```
intersection_GA_9<-intersection_GA %>%
  filter(PWSID=="GA0570002")
```

Unknown-Not Census Area Boundary

#GA0890001

```
intersection_GA_10<-intersection_GA %>%
  filter(PWSID=="GA0890001")
```

Unknown-Not Census Area Boundary

#GA2230002

```
intersection_GA_11<-intersection_GA %>%
  filter(PWSID=="GA2230002")
```

Unknown-Not Census Area Boundary

#GA0670003

```
intersection_GA_12<-intersection_GA %>%
  filter(PWSID=="GA0670003")
```

Unknown-Not Census Area Boundary

#GA1210005

```
intersection_GA_13<-intersection_GA %>%
  filter(PWSID=="GA1210005")
```

Unknown-Not Census Area Boundary

#GA0630000

```
intersection_GA_14<-intersection_GA %>%
  filter(PWSID=="GA0630000")
```

Unknown-Not Census Area Boundary

#GA1510001

```
intersection_GA_15<-intersection_GA %>%
  filter(PWSID=="GA1510001")
```

Unknown-Not Census Area Boundary

#GA0210001

```
intersection_GA_16<-intersection_GA %>%
  filter(PWSID=="GA0210001")
```

Unknown-Not Census Area Boundary

##NEW YORK##

```
census_NY <- places(state= "NY", cb = TRUE, year=2021)
```

```
system_NY<-fixed_utilities %>%
  filter(str_detect(PWSID,"NY")) %>%
  filter(PWSID %in% c("NY1400443", "NY2701047", "NY3202411", "NY2704518", "NY2900000", "NY3304334", "NY
```

```
system_NY<-system_NY %>%
  mutate(System_Area=st_area(system_NY))

census_NY<-census_NY %>%
  mutate(Census_Area=st_area(census_NY))

intersection_NY <- st_intersection(census_NY, system_NY)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar

## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_NY<-intersection_NY %>%
  mutate(Intersection_Area=st_area(intersection_NY))
```

```
intersection_NY <- intersection_NY %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
```

```
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#NY7003493

```
intersection_NY_1<-intersection_NY %>%
  filter(PWSID=="NY7003493")
```

Unknown- Not Census Area Boundary

#NY2704518

```
intersection_NY_2<-intersection_NY %>%
  filter(PWSID=="NY2704518")
```

Census Area Boundary

#NY5903465

```
intersection_NY_3<-intersection_NY %>%
  filter(PWSID=="NY5903465")
```

Census Area Boundary

#NY3304334

```
intersection_NY_4<-intersection_NY %>%
  filter(PWSID=="NY3304334")
```

Census Area Boundary

#NY2900000

```
intersection_NY_5<-intersection_NY %>%
  filter(PWSID=="NY2900000")
```

Unknown- Not Census Area Boundary

#NY3202411

```
intersection_NY_6<-intersection_NY %>%
  filter(PWSID=="NY3202411")
```

Unknown- Not Census Area Boundary

#NY5110526

```
intersection_NY_7<-intersection_NY %>%
  filter(PWSID=="NY5110526")
```

Unknown- Not Census Area Boundary

##COLORADO##

```
census_CO <- places(state= "CO", cb = TRUE, year=2021)
```

```
system_CO<-fixed_utilities %>%
  filter(str_detect(PWSID,"CO")) %>%
  filter(PWSID %in% c("CO0103005", "CO0107152", "CO0107155", "CO0116001", "CO0121150", "CO0130001", "CO
```

```
system_CO<-system_CO %>%
  mutate(System_Area=st_area(system_CO))

census_CO<-census_CO %>%
```

```
  mutate(Census_Area=st_area(census_CO))

intersection_CO <- st_intersection(census_CO, system_CO)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_CO<-intersection_CO %>%
  mutate(Intersection_Area=st_area(intersection_CO))
```

```
intersection_CO <- intersection_CO %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#CO0135291

```
intersection_CO_1<-intersection_CO %>%
  filter(PWSID=="CO0135291")
```

Census Area Boundary

#CO0121150

```
intersection_CO_2<-intersection_CO %>%
  filter(PWSID=="CO0121150")
```

Census Area Boundary

#CO0107152

```
intersection_CO_3<-intersection_CO %>%
  filter(PWSID=="CO0107152")
```

Census Area Boundary

#CO0162321

```
intersection_CO_4<-intersection_CO %>%
  filter(PWSID=="CO0162321")
```

Census Area Boundary

#CO0107155

```
intersection_CO_5<-intersection_CO %>%
  filter(PWSID=="CO0107155")
```

Census Area Boundary

#CO0130001

```
intersection_CO_6<-intersection_CO %>%
  filter(PWSID=="CO0130001")
```

Census Area Boundary

#CO0103005

```
intersection_CO_7<-intersection_CO %>%
  filter(PWSID=="CO0103005")
```

Unknown-Not Census Area Boundary

#CO0116001

```
intersection_CO_8<-intersection_CO %>%
  filter(PWSID=="CO0116001")
```

Census Area Boundary

#CO0151500

```
intersection_CO_9<-intersection_CO %>%
  filter(PWSID=="CO0151500")
```

Unknown-Not Census Area Boundary

##TENNESSEE##

```
census_TN <- places(state= "TN", cb = TRUE, year=2021)
```

```
system_TN<-fixed_utilities %>%
  filter(str_detect(PWSID,"TN")) %>%
  filter(PWSID %in% c("TN0000116", "TN0000349", "TN0000366", "TN0000491", "TN0000494", "TN0000791"))
```

```
system_TN<-system_TN %>%
  mutate(System_Area=st_area(system_TN))

census_TN<-census_TN %>%
  mutate(Census_Area=st_area(census_TN))

intersection_TN <- st_intersection(census_TN, system_TN)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_TN <-intersection_TN %>%
  mutate(Intersection_Area=st_area(intersection_TN))
```

```
intersection_TN <- intersection_TN %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#TN0000491

```
intersection_TN_1<-intersection_TN %>%
  filter(PWSID=="TN0000491")
```

Unknown-Not Census Area Boundary

#TN0000116

```
intersection_TN_2<-intersection_TN %>%
  filter(PWSID=="TN0000116")
```

Census Area Boundary

#TN0000349

```
intersection_TN_3<-intersection_TN %>%
  filter(PWSID=="TN0000349")
```

Census Area Boundary

#TN0000494

```
intersection_TN_4<-intersection_TN %>%
  filter(PWSID=="TN0000494")
```

Census Area Boundary

#TN0000366

```
intersection_TN_5<-intersection_TN %>%
  filter(PWSID=="TN0000366")
```

Census Area Boundary

#TN0000791

```
intersection_TN_6<-intersection_TN %>%
  filter(PWSID=="TN0000791")
```

Unknown- Not Census Area Boundary

##OHIO##

```
census_OH <- places(state= "OH", cb = TRUE, year=2021)
```

```
system_OH<-fixed_utilities %>%
  filter(str_detect(PWSID,"OH")) %>%
  filter(PWSID %in% c("OH0900303", "OH2101412", "OH2504412", "OH3102612", "OH5703512", "OH7608112", "OH
```

```
system_OH<-system_OH %>%
  mutate(System_Area=st_area(system_OH))

census_OH<-census_OH %>%
  mutate(Census_Area=st_area(census_OH))

intersection_OH <- st_intersection(census_OH, system_OH)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_OH <-intersection_OH %>%
  mutate(Intersection_Area=st_area(intersection_OH))
```

```
intersection_OH <- intersection_OH %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#OH2504412

```
intersection_OH_1<-intersection_OH %>%
  filter(PWSID=="OH2504412")
```

Census Area Boundary

#OH5703512

```
intersection_OH_2<-intersection_OH %>%
  filter(PWSID=="OH5703512")
```

Census Area Boundary

#OH7608112

```
intersection_OH_3<-intersection_OH %>%
  filter(PWSID=="OH7608112")
```

Census Area Boundary

#OH7700011

```
intersection_OH_4<-intersection_OH %>%
  filter(PWSID=="OH7700011")
```

Census Area Boundary

#OH3102612

```
intersection_OH_5<-intersection_OH %>%
  filter(PWSID=="OH3102612")
```

Census Area Boundary

#OH0900303

```
intersection_OH_6<-intersection_OH %>%
  filter(PWSID=="OH0900303")
```

Unknown-Not Census Area Boundary

#OH5701315

```
intersection_OH_7<-intersection_OH %>%
  filter(PWSID=="OH5701315")
```

Unknown-Not Census Area Boundary

#OH2101412

```
intersection_OH_8<-intersection_OH %>%
  filter(PWSID=="OH2101412")
```

Unknown-Not Census Area Boundary

##ALABAMA##

```
census_AL <- places(state= "AL", cb = TRUE, year=2021)
```

```
system_AL<-fixed_utilities %>%
  filter(str_detect(PWSID,"AL")) %>%
  filter(PWSID %in% c("AL0000882", "AL0001005", "AL0001070"))
```

```
system_AL<-system_AL %>%
  mutate(System_Area=st_area(system_AL))

census_AL<-census_AL %>%
  mutate(Census_Area=st_area(census_AL))

intersection_AL <- st_intersection(census_AL, system_AL)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar

## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
sf::sf_use_s2(FALSE)
intersection_AL <-intersection_AL %>%
  mutate(Intersection_Area=st_area(intersection_AL))
```

```
intersection_AL <- intersection_AL %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#AL0001070

```
intersection_AL_1<-intersection_AL %>%
  filter(PWSID=="AL0001070")
```

Census Area Boundary

#AL0001005

```
intersection_AL_2<-intersection_AL %>%
  filter(PWSID=="AL0001005")
```

Unknown-Not Census Area Boundary

#AL0000882

```
intersection_AL_3<-intersection_AL %>%
  filter(PWSID=="AL0000882")
```

Unknown-Not Census Area Boundary

##ILLINOIS##

```
census_IL <- places(state= "IL", cb = TRUE, year=2021)
```

```
system_IL<-fixed_utilities %>%
  filter(str_detect(PWSID,"IL")) %>%
  filter(PWSID %in% c("IL0195300", "IL0316000", "IL0434670", "IL0894070", "IL0894380", "IL1635040", "IL
```

```
system_IL<-system_IL %>%
  mutate(System_Area=st_area(system_IL))

census_IL<-census_IL %>%
  mutate(Census_Area=st_area(census_IL))

intersection_IL <- st_intersection(census_IL, system_IL)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar

## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_IL <-intersection_IL %>%
  mutate(Intersection_Area=st_area(intersection_IL))
```

```
intersection_IL <- intersection_IL %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#IL0434670

```
intersection_IL_1<-intersection_IL %>%
  filter(PWSID=="IL0434670")
```

Census Area Boundary

#IL0894380

```
intersection_IL_2<-intersection_IL %>%
  filter(PWSID=="IL0894380")
```

Unknown-Not Census Area Boundary

#IL0316000

```
intersection_IL_3<-intersection_IL %>%
  filter(PWSID=="IL0316000")
```

Census Area Boundary

#IL0894070

```
intersection_IL_4<-intersection_IL %>%
  filter(PWSID=="IL0894070")
```

Census Area Boundary

#IL1970450

```
intersection_IL_5<-intersection_IL %>%
  filter(PWSID=="IL1970450")
```

Unknown-Not Census Area Boundary

#IL2010300

```
intersection_IL_6<-intersection_IL %>%
  filter(PWSID=="IL2010300")
```

Census Area Boundary

#IL1671200

```
intersection_IL_7<-intersection_IL %>%
  filter(PWSID=="IL1671200")
```

Unknown-Not Census Area Boundary

#IL0195300

```
intersection_IL_8<-intersection_IL %>%
  filter(PWSID=="IL0195300")
```

Census Area Boundary

#IL1635040

```
intersection_IL_9<-intersection_IL %>%
  filter(PWSID=="IL1635040")
```

Census Area Boundary

##LOUISIANA##

```
census_LA <- places(state= "LA", cb = TRUE, year=2021)
```

```
system_LA<-fixed_utilities %>%
  filter(str_detect(PWSID,"LA")) %>%
  filter(PWSID %in% c("LA1051004", "LA1017031", "LA1055017", "LA1071009", "LA1109002"))
```

```
system_LA<-system_LA %>%
  mutate(System_Area=st_area(system_LA))

census_LA<-census_LA %>%
  mutate(Census_Area=st_area(census_LA))

intersection_LA <- st_intersection(census_LA, system_LA)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_LA <-intersection_LA %>%
  mutate(Intersection_Area=st_area(intersection_LA))
```

```
intersection_LA <- intersection_LA %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#LA1017031

```
intersection_LA_1<-intersection_LA %>%
  filter(PWSID=="LA1017031")
```

Census Area Boundary

#LA1055017

```
intersection_LA_2<-intersection_LA %>%
  filter(PWSID=="LA1055017")
```

Census Area Boundary

#LA1071009

```
intersection_LA_3<-intersection_LA %>%
  filter(PWSID=="LA1071009")
```

Census Area Boundary

#LA1109002

```
intersection_LA_4<-intersection_LA %>%
  filter(PWSID=="LA1109002")
```

Unknown-Not Census Area Boundary

##SOUTH CAROLINA##

```
census_SC <- places(state= "SC", cb = TRUE, year=2021)
```

```
system_SC<-fixed_utilities %>%
  filter(str_detect(PWSID,"SC")) %>%
  filter(PWSID %in% c("SC2310001", "SC2620004", "SC4010001", "SC4210001", "SC0720003"))
```

```
system_SC<-system_SC %>%
  mutate(System_Area=st_area(system_SC))

census_SC<-census_SC %>%
  mutate(Census_Area=st_area(census_SC))

intersection_SC <- st_intersection(census_SC, system_SC)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_SC <-intersection_SC %>%
  mutate(Intersection_Area=st_area(intersection_SC))
```

```
intersection_SC <- intersection_SC %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#SC4210001

```
intersection_SC_1<-intersection_SC %>%
  filter(PWSID=="SC4210001")
```

Unknown-Not Census Area Boundary

#SC4010001

```
intersection_SC_2<-intersection_SC %>%
  filter(PWSID=="SC4010001")
```

Census Area Boundary

#SC2310001

```
intersection_SC_3<-intersection_SC %>%
  filter(PWSID=="SC2310001")
```

Census Area Boundary

#SC2620004

```
intersection_SC_4<-intersection_SC %>%
  filter(PWSID=="SC2620004")
```

Unknown-Not Census Area Boundary

##WISCONSIN##

```
census_WI <- places(state= "WI", cb = TRUE, year=2021)
```

```
system_WI<-fixed_utilities %>%
  filter(str_detect(PWSID,"WI")) %>%
  filter(PWSID %in% c("WI1130224", "WI2410100", "WI2520062", "WI4050356"))
```

```
system_WI<-system_WI %>%
  mutate(System_Area=st_area(system_WI))

census_WI<-census_WI %>%
```

```
  mutate(Census_Area=st_area(census_WI))

intersection_WI <- st_intersection(census_WI, system_WI)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_WI <-intersection_WI %>%
  mutate(Intersection_Area=st_area(intersection_WI))
```

```
intersection_WI <- intersection_WI %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#WI2410100

```
intersection_WI_1<-intersection_WI %>%
  filter(PWSID=="WI2410100")
```

Census Area Boundary

#WI1130224

```
intersection_WI_2<-intersection_WI %>%
  filter(PWSID=="WI1130224")
```

Census Area Boundary

#WI4050356

```
intersection_WI_3<-intersection_WI %>%
  filter(PWSID=="WI4050356")
```

Unknown-Not Census Area Boundary

#WI2520062

```
intersection_WI_4<-intersection_WI %>%
  filter(PWSID=="WI2520062")
```

Census Area Boundary

##INDIANA##

```
census_IN <- places(state= "IN", cb = TRUE, year=2021)
```

```
system_IN<-fixed_utilities %>%
  filter(str_detect(PWSID,"IN")) %>%
  filter(PWSID %in% c("IN5202020", "IN5249004", "IN5271014", "IN5282002"))
```

```
system_IN<-system_IN %>%
  mutate(System_Area=st_area(system_IN))

census_IN<-census_IN %>%
  mutate(Census_Area=st_area(census_IN))

intersection_IN <- st_intersection(census_IN, system_IN)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_IN <-intersection_IN %>%
  mutate(Intersection_Area=st_area(intersection_IN))
```

```
intersection_IN <- intersection_IN %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#IN5271014

```
intersection_IN_1<-intersection_IN %>%
  filter(PWSID=="IN5271014")
```

Census Area Boundary

#IN5202020

```
intersection_IN_2<-intersection_IN %>%
  filter(PWSID=="IN5202020")
```

Census Area Boundary

#IN5282002

```
intersection_IN_3<-intersection_IN %>%
  filter(PWSID=="IN5282002")
```

Census Area Boundary

#IN5249004

```
intersection_IN_4<-intersection_IN %>%
  filter(PWSID=="IN5249004")
```

Census Area Boundary

##IOWA##

```
census_IA <- places(state= "IA", cb = TRUE, year=2021)
```

```
system_IA<-fixed_utilities %>%
  filter(str_detect(PWSID,"IA")) %>%
  filter(PWSID %in% c("IA5715093", "IA7727031", "IA8222001"))
```

```
system_IA<-system_IA %>%
  mutate(System_Area=st_area(system_IA))

census_IA<-census_IA %>%
  mutate(Census_Area=st_area(census_IA))

intersection_IA <- st_intersection(census_IA, system_IA)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_IA <-intersection_IA %>%
  mutate(Intersection_Area=st_area(intersection_IA))
```

```
intersection_IA <- intersection_IA %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#IA5715093

```
intersection_IA_1<-intersection_IA %>%
  filter(PWSID=="IA5715093")
```

Census Area Boundary

#IA7727031

```
intersection_IA_2<-intersection_IA %>%
  filter(PWSID=="IA7727031")
```

Census Area Boundary

#IA8222001

```
intersection_IA_3<-intersection_IA %>%
  filter(PWSID=="IA8222001")
```

Census Area Boundary

##IDAHO##

```
census_ID <- places(state= "ID", cb = TRUE, year=2021)
```

```
system_ID<-fixed_utilities %>%
  filter(str_detect(PWSID,"ID")) %>%
  filter(PWSID %in% c("ID4010016", "ID3140080", "ID4010097"))
```

```
system_ID<-system_ID %>%
  mutate(System_Area=st_area(system_ID))

census_ID<-census_ID %>%
  mutate(Census_Area=st_area(census_ID))

intersection_ID <- st_intersection(census_ID, system_ID)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar

## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_ID <-intersection_ID %>%
  mutate(Intersection_Area=st_area(intersection_ID))
```

```
intersection_ID <- intersection_ID %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#ID4010097

```
intersection_ID_1<-intersection_ID %>%
  filter(PWSID=="ID4010097")
```

Unknown-Not Census Area Boundary

#ID3140080

```
intersection_ID_2<-intersection_ID %>%
  filter(PWSID=="ID3140080")
```

Unknown-Not Census Area Boundary

#ID4010016

```
intersection_ID_3<-intersection_ID %>%
  filter(PWSID=="ID4010016")
```

Unknown-Not Census Area Boundary

##MICHIGAN##

```
census_MI <- places(state= "MI", cb = TRUE, year=2021)
```

```
system_MI<-fixed_utilities %>%
  filter(str_detect(PWSID,"MI")) %>%
  filter(PWSID %in% c("MI0000220", "MI0001800", "MI0002790"))
```

```
system_MI<-system_MI %>%
  mutate(System_Area=st_area(system_MI))

census_MI<-census_MI %>%
  mutate(Census_Area=st_area(census_MI))

intersection_MI <- st_intersection(census_MI, system_MI)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar

## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_MI <-intersection_MI %>%
  mutate(Intersection_Area=st_area(intersection_MI))
```

```
intersection_MI<- intersection_MI %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#MI0002790

```
intersection_MI_1<-intersection_MI %>%
  filter(PWSID=="MI0002790")
```

Census Area Boundary

#MI0001800

```
intersection_MI_2<-intersection_MI %>%
  filter(PWSID=="MI0001800")
```

Census Area Boundary

#MI0000220

```
intersection_MI_3<-intersection_MI %>%
  filter(PWSID=="MI0000220")
```

Census Area Boundary

##OREGON##

```
census_OR <- places(state= "OR", cb = TRUE, year=2021)
```

```
system_OR<-fixed_utilities %>%
  filter(str_detect(PWSID,"OR")) %>%
  filter(PWSID %in% c("OR4100657", "OR4100665", "OR4100731"))
```

```
system_OR<-system_OR %>%
  mutate(System_Area=st_area(system_OR))

census_OR<-census_OR %>%
  mutate(Census_Area=st_area(census_OR))

intersection_OR <- st_intersection(census_OR, system_OR)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_OR <-intersection_OR %>%
  mutate(Intersection_Area=st_area(intersection_OR))
```

```
intersection_OR<- intersection_OR %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#OR4100657

```
intersection_OR_1<-intersection_OR %>%
  filter(PWSID=="OR4100657")
```

Census Area Boundary

#OR4100731

```
intersection_OR_2<-intersection_OR %>%
  filter(PWSID=="OR4100731")
```

Census Area Boundary

#OR4100665

```
intersection_OR_3<-intersection_OR %>%
  filter(PWSID=="OR4100665")
```

Unknown-Not Census Area Boundary

##MISSOURI##

```
census_MO <- places(state= "MO", cb = TRUE, year=2021)
```

```
system_MO<-fixed_utilities %>%
  filter(str_detect(PWSID,"MO")) %>%
  filter(PWSID %in% c("MO1010415", "MO3010181", "MO5010754"))
```

```
system_MO<-system_MO %>%
  mutate(System_Area=st_area(system_MO))

census_MO<-census_MO %>%
```

```
  mutate(Census_Area=st_area(census_MO))

intersection_MO <- st_intersection(census_MO, system_MO)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_MO <-intersection_MO %>%
  mutate(Intersection_Area=st_area(intersection_MO))
```

```
intersection_MO<- intersection_MO %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#MO5010754

```
intersection_MO_1<-intersection_MO %>%
  filter(PWSID=="MO5010754")
```

Census Area Boundary

#MO1010415

```
intersection_MO_2<-intersection_MO %>%
  filter(PWSID=="MO1010415")
```

Census Area Boundary

#MO3010181

```
intersection_MO_3<-intersection_MO %>%
  filter(PWSID=="MO3010181")
```

Census Area Boundary

##NEBRASKA##

```
census_NE <- places(state= "NE", cb = TRUE, year=2021)
```

```
system_NE<-fixed_utilities %>%
  filter(str_detect(PWSID,"NE")) %>%
  filter(PWSID %in% c("NE3105507", "NE3110926"))
```

```
system_NE<-system_NE %>%
  mutate(System_Area=st_area(system_NE))

census_NE<-census_NE %>%
  mutate(Census_Area=st_area(census_NE))

intersection_NE <- st_intersection(census_NE, system_NE)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_NE <-intersection_NE %>%
  mutate(Intersection_Area=st_area(intersection_NE))
```

```
intersection_NE<- intersection_NE %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#NE3110926

```
intersection_NE_1<-intersection_NE %>%
  filter(PWSID=="NE3110926")
```

Census Area Boundary

#NE3105507

```
intersection_NE_2<-intersection_NE %>%
  filter(PWSID=="NE3105507")
```

Unknown- Not Census Area Boundary

##NEVADA##

```
census_NV <- places(state= "NV", cb = TRUE, year=2021)
```

```
system_NV<-fixed_utilities %>%
  filter(str_detect(PWSID,"NV")) %>%
  filter(PWSID %in% c("NV0000076", "NV0000190"))
```

```
system_NV<-system_NV %>%
  mutate(System_Area=st_area(system_NV))

census_NV<-census_NV %>%
  mutate(Census_Area=st_area(census_NV))

intersection_NV <- st_intersection(census_NV, system_NV)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar

## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_NV <-intersection_NV %>%
  mutate(Intersection_Area=st_area(intersection_NV))
```

```
intersection_NV<- intersection_NV %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#NV0000076

```
intersection_NV_1<-intersection_NV %>%
  filter(PWSID=="NV0000076")
```

Census Area Boundary

#NV0000190

```
intersection_NV_2<-intersection_NV %>%
  filter(PWSID=="NV0000190")
```

Unknown-Not Census Area Boundary

##MASSACHUSETTS##

```
census_MA <- places(state= "MA", cb = TRUE, year=2021)
```

```
system_MA<-fixed_utilities %>%
  filter(str_detect(PWSID,"MA")) %>%
  filter(PWSID %in% c("MA1281000", "MA3035000"))
```

```
system_MA<-system_MA %>%
  mutate(System_Area=st_area(system_MA))

census_MA<-census_MA %>%
  mutate(Census_Area=st_area(census_MA))

intersection_MA <- st_intersection(census_MA, system_MA)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_MA <-intersection_MA %>%
  mutate(Intersection_Area=st_area(intersection_MA))
```

```
intersection_MA<- intersection_MA %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#MA3035000

```
intersection_MA_1<-intersection_MA %>%
  filter(PWSID=="MA3035000")
```

Unknown-Not Census Area Boundary

#MA1281000

```
intersection_MA_2<-intersection_MA %>%
  filter(PWSID=="MA1281000")
```

Census Area Boundary

##KENTUCKY##

```
census_KY <- places(state= "KY", cb = TRUE, year=2021)
```

```
system_KY<-fixed_utilities %>%
  filter(str_detect(PWSID,"KY")) %>%
  filter(PWSID %in% c("KY0590220", "KY0340250"))
```

```
system_KY<-system_KY %>%
  mutate(System_Area=st_area(system_KY))

census_KY<-census_KY %>%
  mutate(Census_Area=st_area(census_KY))

intersection_KY <- st_intersection(census_KY, system_KY)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_KY <-intersection_KY %>%
  mutate(Intersection_Area=st_area(intersection_KY))
```

```
intersection_KY<- intersection_KY %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#KY0340250

```
intersection_KY_1<-intersection_KY %>%
  filter(PWSID=="KY0340250")
```

Unknown-Not Census Area Boundary

#KY0590220

```
intersection_KY_2<-intersection_KY %>%
  filter(PWSID=="KY0590220")
```

Unknown-Not Census Area Boundary

##DISTRICT OF COLUMBIA##

```
census_DC <- places(state= "DC", cb = TRUE, year=2021)
```

```
system_DC<-fixed_utilities %>%
  filter(str_detect(PWSID,"DC")) %>%
  filter(PWSID %in% c("DC0000002"))
```

```
system_DC<-system_DC %>%
  mutate(System_Area=st_area(system_DC))

census_DC<-census_DC %>%
  mutate(Census_Area=st_area(census_DC))

intersection_DC <- st_intersection(census_DC, system_DC)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_DC <-intersection_DC %>%
  mutate(Intersection_Area=st_area(intersection_DC))
```

```
intersection_DC<- intersection_DC %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#DC0000002

```
intersection_DC_1<-intersection_DC %>%
  filter(PWSID=="DC0000002")
```

Census Area Boundary

##MISSISSIPPI##

```
census_MS <- places(state= "MS", cb = TRUE, year=2021)
```

```
system_MS<-fixed_utilities %>%
  filter(str_detect(PWSID,"MS")) %>%
  filter(PWSID %in% c("MS0250008"))
```

```
system_MS<-system_MS %>%
  mutate(System_Area=st_area(system_MS))

census_MS<-census_MS %>%
  mutate(Census_Area=st_area(census_MS))

intersection_MS <- st_intersection(census_MS, system_MS)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_MS <-intersection_MS %>%
  mutate(Intersection_Area=st_area(intersection_MS))
```

```
intersection_MS<- intersection_MS %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#MS0250008

```
intersection_MS_1<-intersection_MS %>%
  filter(PWSID=="MS0250008")
```

Census Area Boundary

##MONTANA##

```
census_MT <- places(state= "MT", cb = TRUE, year=2021)
```

```
system_MT<-fixed_utilities %>%
  filter(str_detect(PWSID,"MT")) %>%
  filter(PWSID %in% c("MT0000153"))
```

```
system_MT<-system_MT %>%
  mutate(System_Area=st_area(system_MT))

census_MT<-census_MT %>%
  mutate(Census_Area=st_area(census_MT))

intersection_MT <- st_intersection(census_MT, system_MT)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_MT <-intersection_MT %>%
  mutate(Intersection_Area=st_area(intersection_MT))
```

```
intersection_MT<- intersection_MT %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
```

```
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#MT0000153

```
intersection_MT_1<-intersection_MT %>%
  filter(PWSID=="MT0000153")
```

Census Area Boundary

##HAWAII##

```
census_HI <- places(state= "HI", cb = TRUE, year=2021)
```

```
system_HI<-fixed_utilities %>%
  filter(str_detect(PWSID,"HI")) %>%
  filter(PWSID %in% c("HI0000331"))
```

```
system_HI<-system_HI %>%
  mutate(System_Area=st_area(system_HI))

census_HI<-census_HI %>%
  mutate(Census_Area=st_area(census_HI))

intersection_HI <- st_intersection(census_HI, system_HI)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_HI <-intersection_HI %>%
  mutate(Intersection_Area=st_area(intersection_HI))
```

```
intersection_HI<- intersection_HI %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#HI0000331

```
intersection_HI_1<-intersection_HI %>%
  filter(PWSID=="HI0000331")
```

Unknown-Not Census Area Boundary

##MAINE##

```
census_ME <- places(state= "ME", cb = TRUE, year=2021)
```

```
system_ME<-fixed_utilities %>%
  filter(str_detect(PWSID,"ME")) %>%
  filter(PWSID %in% c("ME0091300"))
```

```
system_ME<-system_ME %>%
  mutate(System_Area=st_area(system_ME))

census_ME<-census_ME %>%
  mutate(Census_Area=st_area(census_ME))
```

```
intersection_ME <- st_intersection(census_ME, system_ME)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_ME <-intersection_ME %>%
  mutate(Intersection_Area=st_area(intersection_ME))
```

```
intersection_ME<- intersection_ME %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#ME0091300

```
intersection_ME_1<-intersection_ME %>%
  filter(PWSID=="ME0091300")
```

Unknown-Not Census Area Boundary

##ALASKA##

```
census_AK <- places(state= "AK", cb = TRUE, year=2021)
```

```
system_AK<-fixed_utilities %>%
  filter(str_detect(PWSID,"AK")) %>%
  filter(PWSID %in% c("AK2210906"))
```

```
system_AK<-system_AK %>%
  mutate(System_Area=st_area(system_AK))

census_AK<-census_AK %>%
  mutate(Census_Area=st_area(census_AK))

intersection_AK <- st_intersection(census_AK, system_AK)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
sf::sf_use_s2(FALSE)
intersection_AK <-intersection_AK %>%
  mutate(Intersection_Area=st_area(intersection_AK))
```

```
intersection_AK<- intersection_AK %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#AK2210906

```
intersection_AK_1<-intersection_AK %>%
  filter(PWSID=="AK2210906")
```

Unknown-Not Census Area Boundary

##ARKANSAS##

```
census_AR <- places(state= "AR", cb = TRUE, year=2021)
```

```
system_AR<-fixed_utilities %>%
  filter(str_detect(PWSID,"AR")) %>%
  filter(PWSID %in% c("AR0000465"))
```

```
system_AR<-system_AR %>%
  mutate(System_Area=st_area(system_AR))

census_AR<-census_AR %>%
  mutate(Census_Area=st_area(census_AR))

intersection_AR <- st_intersection(census_AR, system_AR)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_AR <-intersection_AR %>%
  mutate(Intersection_Area=st_area(intersection_AR))
```

```
intersection_AR<- intersection_AR %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#AR0000465

```
intersection_AR_1<-intersection_AR %>%
  filter(PWSID=="AR0000465")
```

Unknown-Not Census Area Boundary

##CONNECTICUT##

```
census_CT <- places(state= "CT", cb = TRUE, year=2021)
```

```
system_CT<-fixed_utilities %>%
  filter(str_detect(PWSID,"CT")) %>%
  filter(PWSID %in% c("CT1350011"))
```

```
system_CT<-system_CT %>%
  mutate(System_Area=st_area(system_CT))

census_CT<-census_CT %>%
  mutate(Census_Area=st_area(census_CT))

intersection_CT <- st_intersection(census_CT, system_CT)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_CT <-intersection_CT %>%
  mutate(Intersection_Area=st_area(intersection_CT))
```

```
intersection_CT<- intersection_CT %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
```

```
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#CT1350011

```
intersection_CT_1<-intersection_CT %>%
  filter(PWSID=="CT1350011")
```

Unknown-Not Census Area Boundary

##MARYLAND##

```
census_MD <- places(state= "MD", cb = TRUE, year=2021)
```

```
system_MD<-fixed_utilities %>%
  filter(str_detect(PWSID,"MD")) %>%
  filter(PWSID %in% c("MD0130002"))
```

```
system_MD<-system_MD %>%
  mutate(System_Area=st_area(system_MD))

census_MD<-census_MD %>%
  mutate(Census_Area=st_area(census_MD))

intersection_MD <- st_intersection(census_MD, system_MD)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_MD <-intersection_MD %>%
  mutate(Intersection_Area=st_area(intersection_MD))
```

```
intersection_MD<- intersection_MD %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#MD0130002

```
intersection_MD_1<-intersection_MD %>%
  filter(PWSID=="MD0130002")
```

Unknown-Not Census Area Boundary

##NEW HAMPSHIRE##

```
census_NH <- places(state= "NH", cb = TRUE, year=2021)
```

```
system_NH<-fixed_utilities %>%
  filter(str_detect(PWSID,"NH")) %>%
  filter(PWSID %in% c("NH1471010"))
```

```
system_NH<-system_NH %>%
  mutate(System_Area=st_area(system_NH))

census_NH<-census_NH %>%
  mutate(Census_Area=st_area(census_NH))
```

```
intersection_NH <- st_intersection(census_NH, system_NH)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_NH <-intersection_NH %>%
  mutate(Intersection_Area=st_area(intersection_NH))
```

```
intersection_NH<- intersection_NH %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#NH1471010

```
intersection_NH_1<-intersection_NH %>%
  filter(PWSID=="NH1471010")
```

Census Area Boundary

##SOUTH DAKOTA##

```
census_SD <- places(state= "SD", cb = TRUE, year=2021)
```

```
system_SD<-fixed_utilities %>%
  filter(str_detect(PWSID,"SD")) %>%
  filter(PWSID %in% c("SD4600294"))
```

```
system_SD<-system_SD %>%
  mutate(System_Area=st_area(system_SD))

census_SD<-census_SD %>%
  mutate(Census_Area=st_area(census_SD))

intersection_SD <- st_intersection(census_SD, system_SD)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant throughout all
## geometries
```

```
intersection_SD <-intersection_SD %>%
  mutate(Intersection_Area=st_area(intersection_SD))
```

```
intersection_SD<- intersection_SD %>%
  mutate(pct_system=Intersection_Area/System_Area) %>%
mutate(pct_census=Intersection_Area/Census_Area) %>%
mutate("Census Area Boundary"=if_else("pct_census" > 0.980 & "pct_system" > 0.980, "True", "False"))
```

#SD4600294

```
intersection_SD_1<-intersection_SD %>%
  filter(PWSID=="SD4600294")
```

Census Area Boundary