

- park boundary
- roads
- cell towers
- campgrounds

Import all the layers

Hide

Linking to GEOS 3.11.2, GDAL 3.6.2, PROJ 9.2.0; sf_use_s2() is TRUE

Hide

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

  filter, lag

The following objects are masked from 'package:base':

  intersect, setdiff, setequal, union
```

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```
epsg_utm11n_wgs84 <- 32611

## Park boundary
yose_bnd_utm <- st_read(dsn="./data", layer="yose_boundary") |>
  st_transform(epsg_utm11n_wgs84)
```

```

Reading layer `yose_boundary` from data source
  "D:\Workshops\R-Spatial\rsatial_mod\outputs\rsatial_scgis23\exercises\data" using driver `ESRI Shapefile'
Simple feature collection with 1 feature and 11 fields
Geometry type: POLYGON
Dimension: XY
Bounding box: xmin: -119.8864 ymin: 37.4947 xmax: -119.1964 ymax: 38.18515
Geodetic CRS: North_American_Datum_1983

```

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```
## Roads
yose_roads_utm <- st_read("./data/yose_roads.gdb", "Yosemite_Roads") |>
  st_transform(epsg_utm11n wgs84)
```

```
Reading layer 'Yosemite_Roads' from data source
'D:\Workshops\R-Spatial\rspatial_mod\outputs\rspatial_scgis23\exercises\data\yose_roads.gdb' using driver 'Open
FileGDB'
Simple feature collection with 823 features and 40 fields
Geometry type: MULTILINESTRING
Dimension: XY
Bounding box: xmin: 234658.1 ymin: 4139484 xmax: 324852.6 ymax: 4250252
Projected CRS: NAD83 / UTM zone 11N
```

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```
## Cell towers
gdb_fn <- "./data/yose_communications.gdb"; file.exists(gdb_fn) ## two commands separated by ;
```

```
[1] TRUE
```

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```
yose_celltwrs_utm <- st_read(gdb_fn, "Cell_Towers") |>
  st_transform(epsg_utm11n_wgs84)
```

```
Reading layer 'Cell_Towers' from data source
'D:\Workshops\R-Spatial\rspatial_mod\outputs\rspatial_scgis23\exercises\data\yose_communications.gdb'
using driver 'OpenFileGDB'
Simple feature collection with 5 features and 6 fields
Geometry type: POINT
Dimension: XY
Bounding box: xmin: 251532.4 ymin: 4158756 xmax: 293307.2 ymax: 4194328
Projected CRS: NAD83 / UTM zone 11N
```

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Campsites

```
yose_campgrounds_utm <- st_read(dsn="./data", layer="yose_poi") |>
  st_transform(epsg_utm11n_wgs84) |>
  filter(POI_TYPE == "Campground")
```

```
Reading layer `yose_poi' from data source
  `D:\Workshops\R-Spatial\rspatial_mod\outputs\rspatial_scgis23\exercises\data' using driver `ESRI Shapefile'
Simple feature collection with 2720 features and 30 fields
Geometry type: POINT
Dimension: XY
Bounding box: xmin: 246416.2 ymin: 4153717 xmax: 301510.7 ymax: 4208419
Projected CRS: NAD83 / UTM zone 11N
```

CHALLENGE: How many cell towers & campgrounds

How many cell towers are there? How many campgrounds are there? [Answer](#)

Hide

```
nrow(yose_celltwrs_utm)
```

```
[1] 5
```

Hide

```
nrow(yose_campgrounds_utm)
```

```
[1] 15
```

Map the Park Boundary

Let's start with a simple map of just the park boundary:

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```
library(tmap)
```

```
Registered S3 method overwritten by 'htmlwidgets':
  method      from
  print.htmlwidget tools:rstudio
The legacy packages maptools, rgdal, and rgeos, underpinning the sp package,
which was just loaded, will retire in October 2023.
Please refer to R-spatial evolution reports for details, especially
https://r-spatial.org/r/2023/05/15/evolution4.html.
It may be desirable to make the sf package available;
package maintainers should consider adding sf to Suggests:.
The sp package is now running under evolution status 2
(status 2 uses the sf package in place of rgdal)
```

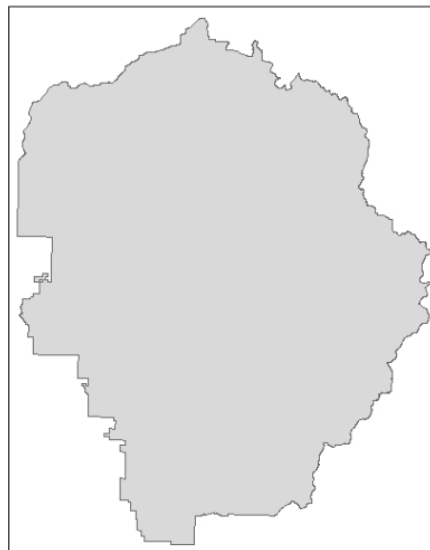
Hide

```
tmap_mode("plot")
```

```
tmap mode set to plotting
```

Hide

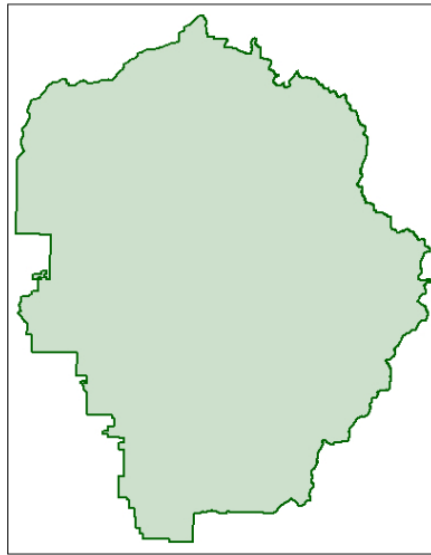
```
tm_shape(yose_bnd_utm) + tm_polygons()
```



Now make the fill and outline dark green, the fill 20% transparent (alpha = 0.2), the border line a little thicker (lwd = 2):

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```
tm_shape(yose_bnd_utm) +
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2)
```

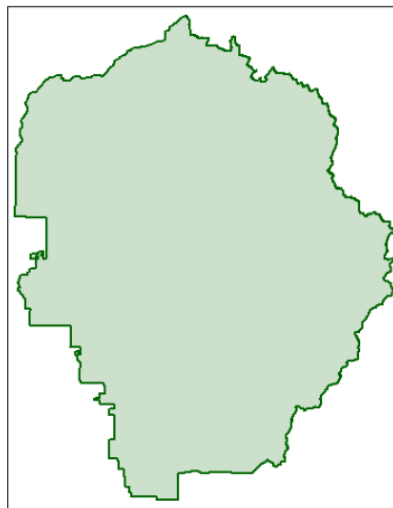


Next, we'll add a title by adding `tm_layout()` to our tmap object:

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```
tm_shape(yose_bnd_utm) +  
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2) +  
  tm_layout(main.title = "Yosemite NP Cell Towers")
```

Yosemite NP Cell Towers



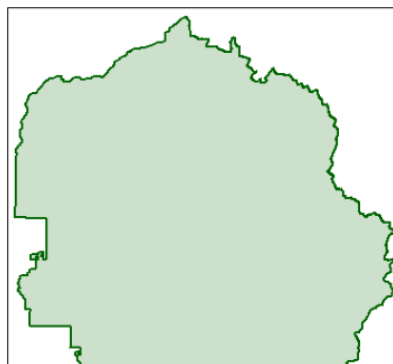
CHALLENGE: Add a scale bar

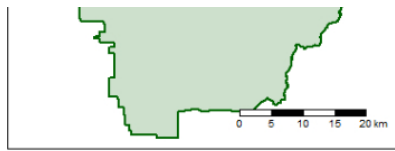
Add a scale bar to the map. Hint: add `tm_scale_bar()` to the map. [Answer](#)

Hide

```
tm_shape(yose_bnd_utm) +  
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2) +  
  tm_layout(main.title = "Yosemite NP Cell Towers") +  
  tm_scale_bar()
```

Yosemite NP Cell Towers





Add the Roads and the Cell Towers

Next we'll add the roads. This requires tacking on another `tm_shape()`, followed by a function that draws lines.

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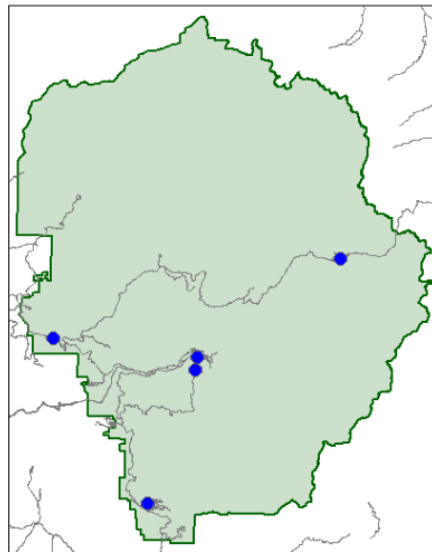
```
tm_shape(yose_bnd_utm) +
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2) +
  tm_shape(yose_roads_utm) +
  tm_lines(col = "gray50")
```



In a similar fashion, we'll add the cell towers as little blue dots:

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```
tm_shape(yose_bnd_utm) +
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2) +
  tm_shape(yose_roads_utm) +
  tm_lines(col = "gray50") +
  tm_shape(yose_celltwrs_utm) +
  tm_symbols(col = "blue", size = 0.5)
```



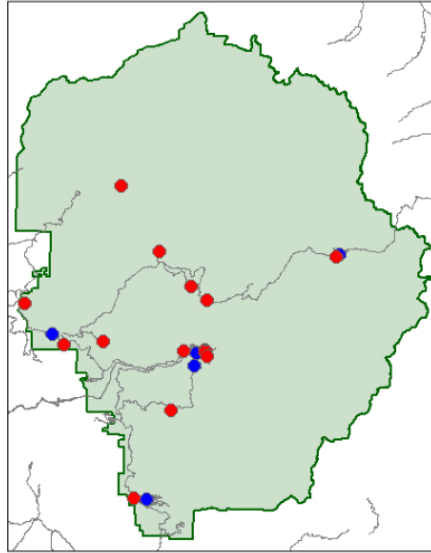
CHALLENGE: Add the campgrounds

Add the campgrounds to the map as little red dots. Hint: you can render point layers with `tm_symbols()` or `tm_dots()`. [Answer](#)

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```
tm_shape(yose_bnd_utm) +
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2) +
  tm_shape(yose_roads_utm) +
  tm_lines(col = "gray50") +
```

```
tm_shape(yose_celltwrs_utm) +
  tm_symbols(col = "blue", size = 0.5) +
tm_shape(yose_campgrounds_utm) +
  tm_symbols(col = "red", size = 0.5)
```



Make an interactive map

Note: interactive maps created by *tmap* can cause problems when you save a R Notebook to HTML. It is recommended that you run the following code in an R script rather than a Notebook.

We can switch to 'interactive map mode' by running `tmap_mode()`:

```
## tmap_mode("view")

## tmap_mode("plot") # go back to plot mode
```

Now that we're in 'view' mode, *tmap* objects be rendered as little interactive maps. We can 'redraw' the last *tmap* object using `tmap_last()`:

```
tmap_last()
```

Switch-out the basemap:

```
tm_shape(yose_bnd_utm |> st_geometry()) +
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2) +
tm_shape(yose_roads_utm |> st_geometry()) +
  tm_lines(col = "gray50") +
tm_shape(yose_celltwrs_utm |> st_geometry()) +
  tm_symbols(col = "blue", size = 0.5) +
tm_shape(yose_campgrounds_utm |> st_geometry()) +
  tm_symbols(col = "red", size = 0.5) +
  tm_baseemap("Esri.WorldTopoMap")
```

Configure Pop-ups

Lastly we'll disable interactivity (i.e., hover-over text and popup windows) on all layers except for the campgrounds:

```
tm_shape(yose_bnd_utm |> st_geometry()) +
  tm_polygons(col = "darkgreen", alpha = 0.2, border.col = "darkgreen", lwd = 2, interactive = FALSE) +
tm_shape(yose_roads_utm |> st_geometry()) +
  tm_lines(col = "gray50", interactive = FALSE) +
tm_shape(yose_celltwrs_utm |> st_geometry()) +
  tm_symbols(col = "blue", size = 0.5, interactive = FALSE) +
tm_shape(yose_campgrounds_utm |> select(POINAME)) +
  tm_symbols(col = "red", size = 0.5, id = "POINAME") +
  tm_baseemap("Esri.WorldTopoMap")
```

Tip: for more control over pop-ups, use *leaflet*.

End

Congratulations, you have completed the Notebook!

To view your Notebook at HTML, save it (again), then click the 'Preview' button in the RStudio toolbar.