GIS 5003 Spring 2022 Term Project:

State Parks in South Dakota Along Interstate I- 90

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Abstract

Planning is one of the most essential first steps of taking a vacation or going on a road trip. This planning stage can involve choosing a route, choosing which destinations to visit, determining duration of stops along the way, locating accommodations, et cetera. When planning road trips, many people think of the Upper Great Plains as a vast expanse of nothingness, punctuated only by small towns lacking any notoriety isolated from the outside world by cropland and pastures, and thus will often stay on the interstates not giving their surroundings a second thought.

This project aims to prove to the reader that there are many places worth visiting in South Dakota within a short driving distance from interstate I- 90. Custer State Park is perhaps the most well-known state park that falls within the short driving distance established in this project, containing steep switchbacks and drive-through tunnels, rolling prairies, and world-class wildlife conservation. This project provides thirty-six potential destinations available to road trippers traveling through South Dakota looking to experience parks often overlooked.

The goals of the project are lofty, but easily achieved by efficiently utilizing the correct software. This includes the PostGIS Shapefile Import/Export Manager, pgAdmin 4, ArcGIS Pro, and Microsoft Excel. Progress assurance was done with Google Maps and Google Earth Pro. Datasets used are of the United States states and territories and United States interstate system, both from the United States Census' Tigerline/Line shapefiles collection, as well as a dataset of South Dakota state parks, from South Dakota Game, Fish, & Parks. The length of I- 90 in South Dakota was found to be 664.2 kilometers. A fifty-kilometer buffer was created around I- 90 which was found to contain thirty-six state parks. The acreage of these parks was calculated and grouped by county, then the acreage of smallest and largest parks, Fort George State Park and Custer State Park, respectively, were compared. These same parks were selected in ArcGIS Pro, and the pgAdmin 4 acreage calculation result and the ArcGIS Pro acreage

attribute were compared using a subtraction function in a Microsoft Excel spreadsheet to determine the accuracy, but not equivalence, of this project's results.

Introduction

This project was inspired by the planning stages of a road trip I went on in the summer of 2019 across the Upper Great Plains. At the time, I utilized ArcMap 9.x, as well as shapefiles gathered from state and federal databases, such as Departments of Natural Resources and the United States Census. For that road trip, I set a goal to travel not just along the interstates, but also to lesser-known destinations and places known only to locals. When producing the proposal for this project, I wanted to challenge myself to conduct those steps needed to identify parks but using new-to-me software.

The questions most pertinent to a reader planning their own road trip along I- 90 in South Dakota would be: What is the distance from the western state line to the eastern state line on I-90? How many parks are within a fifty-kilometer drive off of I- 90? How many acres of parks are in each county along the way? What are the largest, and smallest, parks within that fifty-kilometer buffer? How accurate are the calculations made in this new program, as compared to the raw data directly from the parks' shapefile attribute table?

The parks in the area of South Dakota where I- 90 passes through contain natural beauty and biodiversity the likes of which have not been seen since Europeans colonized America. Many of the state parks are host to ecosystems that have been completely destroyed by agricultural practices of the last two centuries, such as tall- and short-grass prairies, boreal and eastern deciduous forests, and Rocky Mountain Foothills (*Black Hills National Forest - Nature & Science*. (n.d.).), (Gevik, 2019).

Research Context and Background

In Walker (2019), it is discussed how utilizing objective measures to establish proximity to parks can "increase park use, … create contact with nature and restorative environments, … and support local economies," among many other ways. Though this webpage discusses parks in more urbanized areas, the benefits of parks are not constrained to their geographic locations - they are beneficial in a myriad of ways to all who choose to experience them.

In Stemberk, et. al. (2018), national parks of Europe are discussed, and a conclusion is drawn after statistical analysis that larger parks have higher budget and number of staff, more diverse environments, and more overall attractiveness to the general public. Interestingly, it also mentions accessibility to Sumava National Park, the largest wild-nature area in Central Europe, and how it is in close proximity to large cities.

In Keiter (2010), it is implied that because of increased visitation to national parks over the last one hundred years, the federal policies governing those public lands have "shifted toward greater protectionism, as reflected in the expanded national park system, the advent of formal wilderness areas, and other protective designations." Keiter goes on to say that the nation's national parks, once fledgling, overlooked, isolated natural areas, are now more connected to larger cities, and thus potential visitors, than ever, thanks to the advent of the interstate system, and more recently, the Information Age (Keiter, 2010).

Materials and Methods

The Data Life Cycle to select all South Dakota state parks in a buffer around I- 90 is as follows:

- Plan: Description of the data that will be compiled, how it will be managed, and made accessible in its lifetime. In this project, that means identify data tables needed to perform spatial functions. State, interstate, and park tables with identifying attributes will be needed, and will be kept in a database together, called Dakotas.
- Collect: Observations are made either by hand or with sensors and the data placed into digital form. The data in the tables has already been collected by South Dakota Game, Fish, & Parks, and the U.S. Census Bureau.
- Assure: The quality of the data is assured through checks and inspections. Throughout the project, ArcGIS Pro, Google Maps, and Google Earth Pro to conduct on-the-fly measurements to compare and verify results from pgAdmin. Additionally, Geometry Viewer is extensively used within pgAdmin itself, as well as verifying changes to tables using a SELECT * query. No NULL values or empty table cells were encountered in the course of this project.
- Describe: Data are accurately and thoroughly described using the appropriate metadata standards. Metadata Wizard was unable to open the XML files of the data tables. This is possibly because of strange file extensions, such as FILENAME.shp.ea.iso.xml. However, opening the XML file in ArcGIS Pro's Catalog Viewer worked and was able to provide the necessary information. That said, the state parks shapefile contained no metadata, per the ArcGIS Pro Catalog viewer.
- Preserve: The tables are submitted to an appropriate long-term archive. In the instance of this project, the data is stored both locally on a physical computer, and in a cloud-based file hosting service, Dropbox, managed by Dropbox, Inc.
- Discover: Potentially useful data, and relevant information about it, are located and obtained. For this project, that is achieved through opening the tables in pgAdmin and observing the

column headers and rows, ultimately deciding what will be useful and what can be eliminated to preserve storage space, functionality, and faster processing. Were this a paid endeavor, potential financial savings (and deficits) would also be considered when choosing what and how much data to retain.

- Integrate: Data from disparate sources are combined to form one homogenous set of data that can be readily analyzed. In this project, that is achieved through the use of multiple nested spatial functions to select and manipulate data, and, for sake of faster processing speeds, occasionally exported into new data tables to be accessed and analyzed by future queries.
- Analyze: Data are analyzed. In this project is the analysis of areas of the smallest and largest parks within the buffer; compared to the original data tables, this means determining what the calculated results indicate about park acreage.

In order to achieve the goals set forth in this project, one must utilize a series of queries and filters, used in within pgAdmin 4 and in conjunction with PostGIS and ArcGIS Pro. In this project, the shapefiles of state parks within South Dakota, the United States Interstate System, and the states and territories of the United States, as well as their associated attributes, are needed:

- South Dakota state parks:
    - File name given by source: Parks_And_Recreation_Areas
    - Simplified name: parks
    - Source URL: https://opendata2017-09-18t192802468z-sdbit.opendata.arcgis.com/datasets/cfcb6562b1cd4e1287e836b2df60426f_0/explore?location=44.080360%2C-102.201590%2C7.45
    - Data type: MultiPolygon
    - File size: 5.81 MB

  - Access date: April 15, 2022

- United States Interstate System:
  - File name given by source: tl_2021_us_primaryroads
  - Simplified name: interstate
  - Source URL: https://www.census.gov/cgi-bin/geo/shapefiles/index.php
  - Data type: MultiLineString
  - File size: 57.6 MB
  - Access date: April 15, 2022

- United States states and territories:
  - File name given by source: tl_2021_us_state
  - Simplified name: state
  - Source URL: https://www.census.gov/cgi-bin/geo/shapefiles/index.php
  - Data type: MultiPolygon
  - File size: 14.8 MB
  - Access date: April 13, 2022

The spatial functions used in this project are defined as follows, including a brief project-specific purpose:

- **Find_SRID**('schema name', 'table name', 'geom name'): Returns the integer SRID of the specified geometry column by searching through the GEOMETRY_COLUMNS table - Verifies the shapefile was imported with no SRID.

- **ST_SetSRID**(geometry type, SRID): Sets the SRID on a geometry to a particular integer value - Sets the SRID of the table's geometry to that of 3857, the WGS84 Mercator Auxiliary Sphere, used as a projected coordinate system by the South Dakota Parks shapefile.
- **ST_Transform**(geometry, SRID): Returns a new geometry with its coordinates transformed to a different spatial reference system - Transforms the old geometry into a new geometry temporarily within the query.
- **ST_Within**(geometry A, geometry B): Returns true if the geometry A is completely inside geometry B - Determines which segments of I- 90 are entirely within South Dakota.
- **ST_Length**(geography): Returns the length of the line - Returns the length of I- 90
- **ST_Buffer**(geometry, radius of buffer): Computes a POLYGON or MULTIPOLYGON that represents all points whose distance from a geometry/geography is less than or equal to a given distance **-** Creates a buffer around I- 90 of 0.45 degrees, or approximately fifty kilometers.
- **ST_Union**(geometry 1, geometry 2): Unions the input geometries, merging geometry to produce a result geometry with no overlaps - As interstates is a multilinestring shapefile, buffering it creates multiple polygons; ST_Union combines them into one.
- **ST_Intersects**(geometry 1, geometry 2), alternatively (geography 1, geography 2): If a geometry or geography shares any portion of space then they intersect- Select all parks within or touching the buffer
- **ST_Area**(geography, true or false): Returns the area of a polygonal geometry. For geometry types a 2D Cartesian (planar) area is computed, with units specified by the SRID. For geography types by default area is determined on a spheroid with units in square meters. To compute the area using the faster but less accurate spherical model use ST_Area(geog, false) - Three areas are calculated; one in which geometry is used, and two in which geography are used with and without the spheroid.

Firstly, a database, Dakotas, must be established, as well as installing the PostGIS extension. Next, using the PostGIS Shapefile Import/Export Manager, a shapefile representing the polygons of parks within South Dakota, a shapefile representing states and territories of the United States, and a shapefile representing the United States interstate system are imported into the database.

The imported shapefiles are then simplified, altering the names to "parks," "interstate," and "state" using ALTER TABLE [original_table] RENAME TO [simplified_table]. Then, using DELETE FROM [table] command, fields not matching the names 'South Dakota' or 'I- 90' are deleted from the state and interstate tables, respectively. Using ALTER TABLE again, unnecessary columns are dropped using DROP COLUMN from all three shapefile tables.

Next, Find_SRID is used to determine the SRID that was imported with the table. Using the query, SELECT Find_SRID('public','table_name','geom'), it is determined that all tables currently have an SRID value of 0. To determine the SRID value, the shapefiles must be opened in ArcGIS Pro. Once imported, each of the table properties are inspected, looking specifically at the Spatial Reference data within the Source tab of the Properties window. It is shown that the parks table has a projected coordinate system WKID value of 3857, which is analogous to the same value in SRID. Thus, SRID:3857 is assigned to each table, using ALTER TABLE [table] ALTER COLUMN geom TYPE Geometry ([Geometry type], 3857);.

Now that the SRID has been properly set, the portion of I- 90 that passes through South Dakota must now be selected using SELECT (ST_Transform(ST_SetSRID(i.geom,4269),4326)) FROM interstate AS i, state AS s WHERE ST_Within(i.geom,s.geom);. This query sets the geometry of the interstates table in 4269, which is the Geographic Coordinate System for the interstate and state tables, then transforms it using ST_Transform into 4326, which is the Geographic Coordinate System for the parks table, and selects, using aliases i and s, the portions of the interstate geometry that are within, using ST_Within, the state geometry.

The length of the segment generated can be determined with the query: SELECT SUM(ST_Length(ST_Transform(ST_SetSRID(i.geom,4269),4326),true))/2000 AS "Total Length, km" FROM interstate AS i, state AS s WHERE ST_Within(i.geom,s.geom);. Using the same transformation as above, the geography is used this time (true means it is calculated using a spheroid), and divided by 2000. It is divided by 2000 because the answer of the query is returned in meters without it, and because it is an interstate it is technically recorded as two separate segments side-by-side (eastbound and westbound). Dividing by 2000 converts to kilometers and allows the function to only measure one segment. The query returns with an answer of 664.2 km.

Two optional intermediate steps are utilized to visualize the buffer around I- 90 and all of the parks in the parks table. The first step uses a buffer of 0.45 degrees, approximately fifty kilometers. The query is: SELECT ST_Union(ST_Buffer((ST_Transform(ST_SetSRID(i.geom,4269),4326)), 0.45)) FROM interstate AS i, state AS s WHERE ST_Within(i.geom,s.geom);. This not only creates the buffer, but, using ST_Union after using ST_Buffer, creates a single polygon instead of a polygon of each individual segment of I- 90. It uses degrees as a unit instead of kilometers because the geometry must be transformed into a geography using 4326 to be projected onto the basemap. The second step is to transform the park geometry by itself to 4326 to visualize all of the park polygons with reference to the basemap. It is: SELECT ST_Transform(p.geom,4326) FROM parks AS p;.

Next, the buffer is made and the parks within it are selected using the DISTINCT modifier, so no duplicates are produced. CREATE TABLE park_buffer_50km AS SELECT DISTINCT p.parkname AS "Park Name", p.county AS "County", p.acres AS "Acres", ST_Transform(p.geom,4326) FROM interstate AS i, parks AS p WHERE ST_Intersects(ST_Buffer(ST_Transform(ST_SetSRID(i.geom,4269),4326), 0.45), ST_Transform(p.geom,4326)) ORDER BY p.county;. This query uses the ST_Intersects function to find where the buffer geometry overlaps or touches the parks geometry.

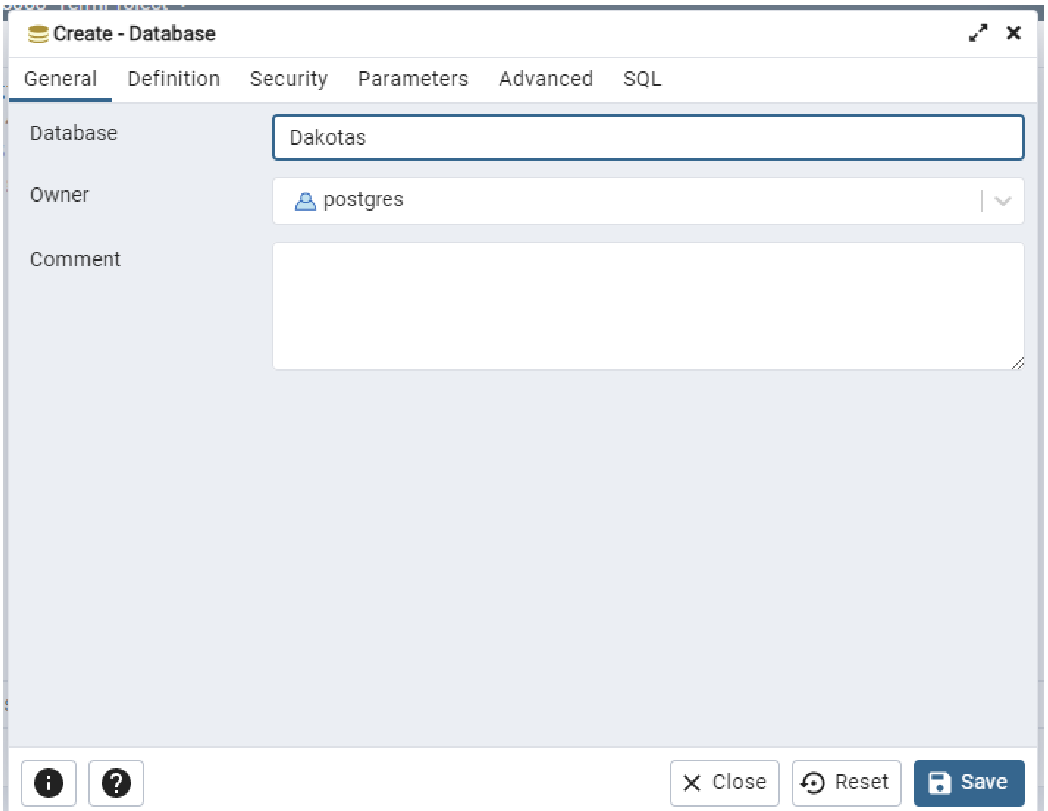
The summed area of the parks within the buffer, grouped by county, is selected using the following query: CREATE TABLE park_area_buffer_50km AS SELECT SUM(p.acres) AS "Total Acreage", p.county AS "County" FROM interstate AS i, parks AS p WHERE ST_Intersects(ST_Buffer(ST_Transform(ST_SetSRID(i.geom,4269),3857), 50000), ST_Transform(p.geom,3857)) GROUP BY p.county;. This returns twelve counties which contain parks that are intersected by the buffer, as well as their total acreage.

The final step is to calculate the area of the smallest and largest parks in the parks table, using the following query: LARGEST AND SMALLEST PARKS CREATE TABLE area_comparison AS SELECT ST_Area(ST_Transform(p.st_transform,4236))*0.00024710538146717 AS "Area", ST_Area(ST_Transform(p.st_transform,4236),true)*0.00024710538146717 AS "Area_true", ST_Area(ST_Transform(p.st_transform,4236),false)*0.00024710538146717 AS "Area_false", p."Park Name" FROM park_buffer_50km AS p WHERE p."Park Name" IN ('Fort George', 'Custer');. This query calculates the areas, originally in square meters, converted into acreage, of Custer and Fort George State Parks, using three types of ST_Area functions: one which utilizes a geometry, one which uses a geography on a spheroid, and one that uses a geography not on a spheroid. These results are then compared to the acreage listed in the attribute table in ArcGIS Pro in a Microsoft Excel spreadsheet. In summary, the ST_Area(geom) returns values that are almost zero acres, however, the differences between ArcGIS Pro values and ST_Area(geog) values where a spheroid are used are remarkably close; for Custer State Park they are within 0.21% of each other, and for Fort George State Park, -0.08%.

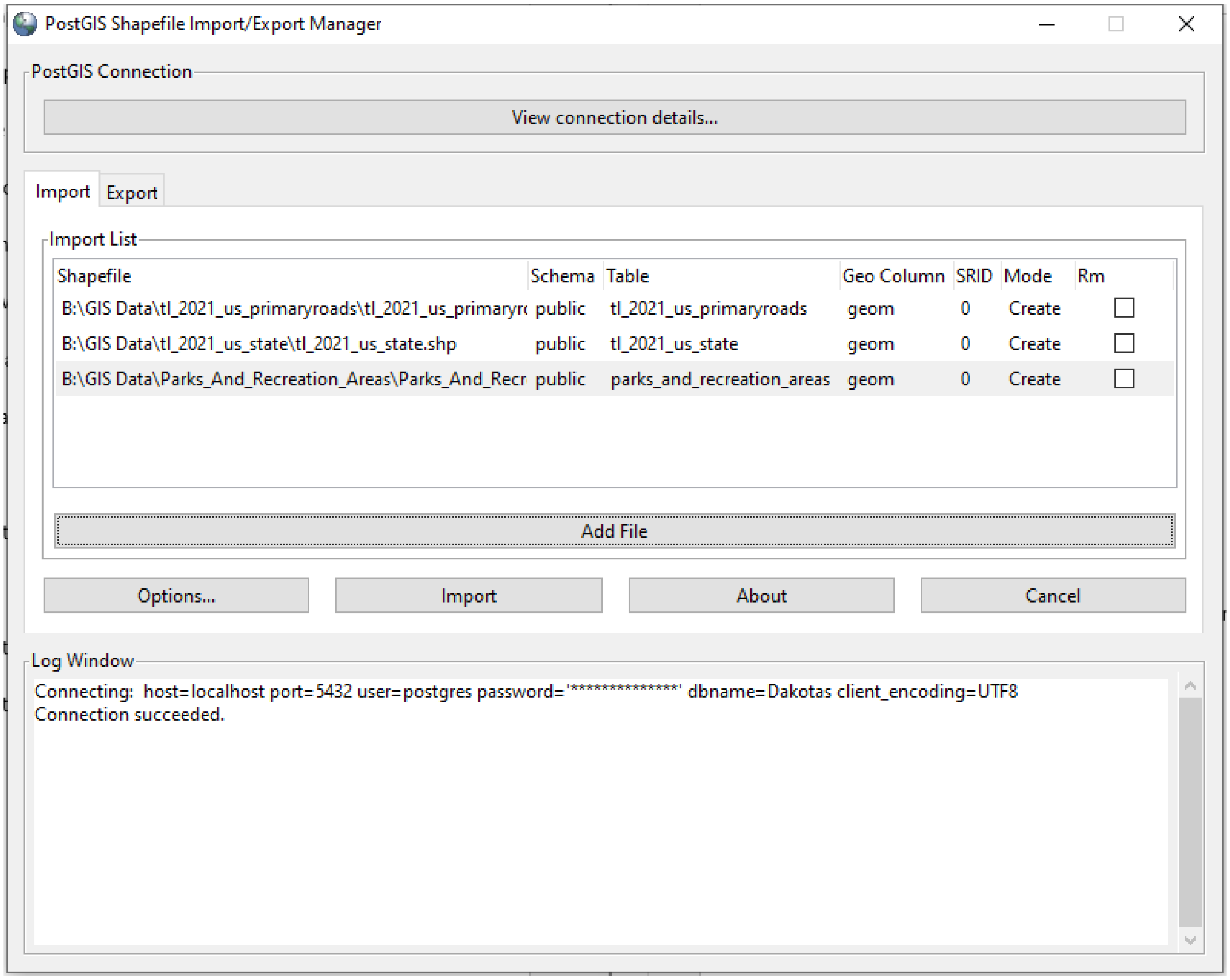
Results

Each step involved in this project was screenshotted and is presented below.

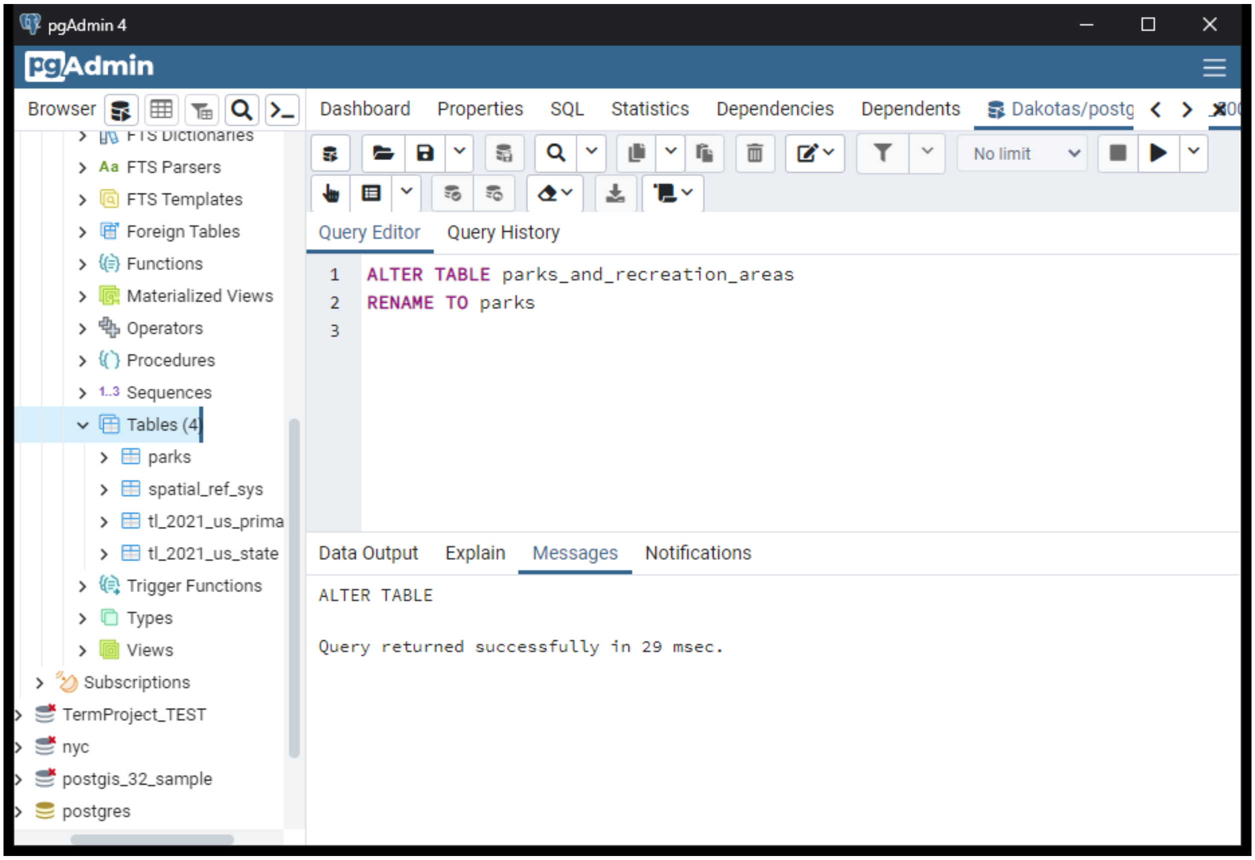
1. Create a new database in pgAdmin 4, named Dakotas:

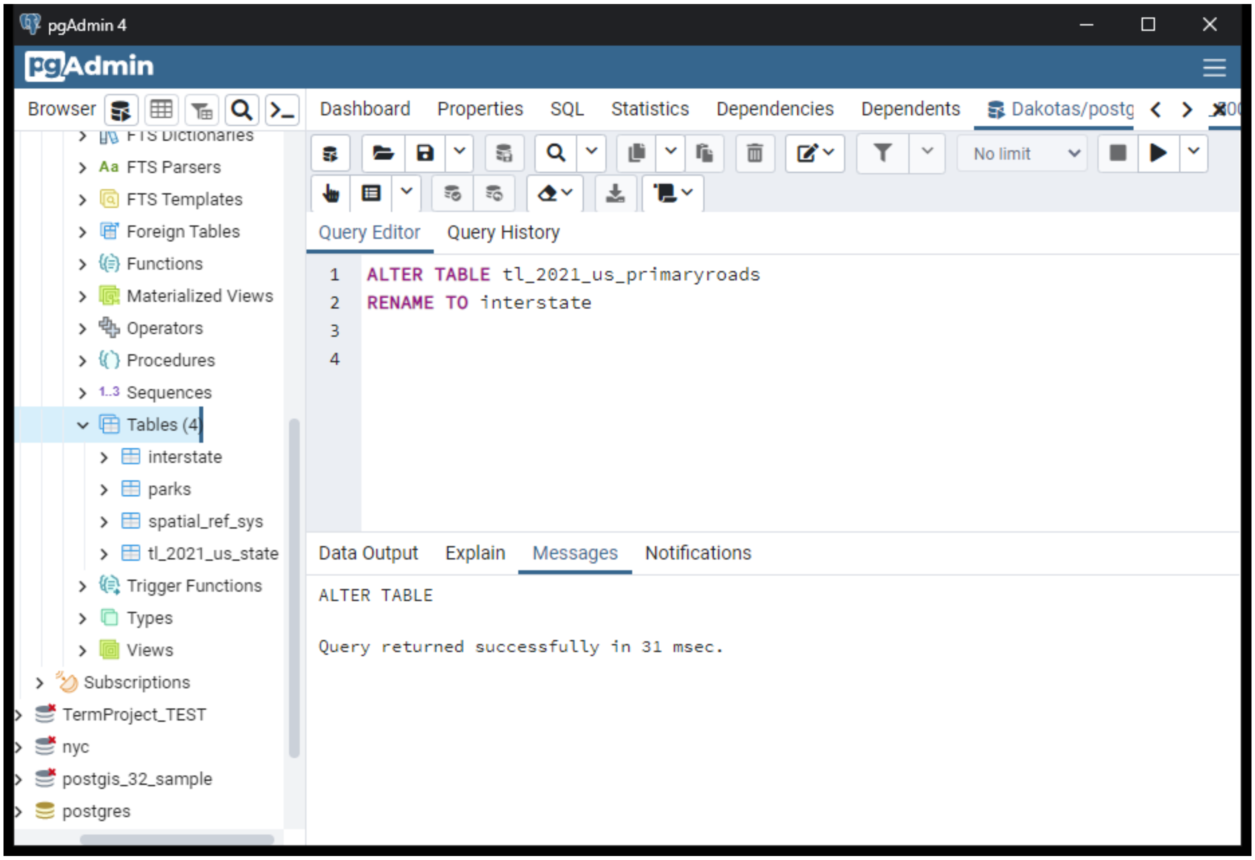


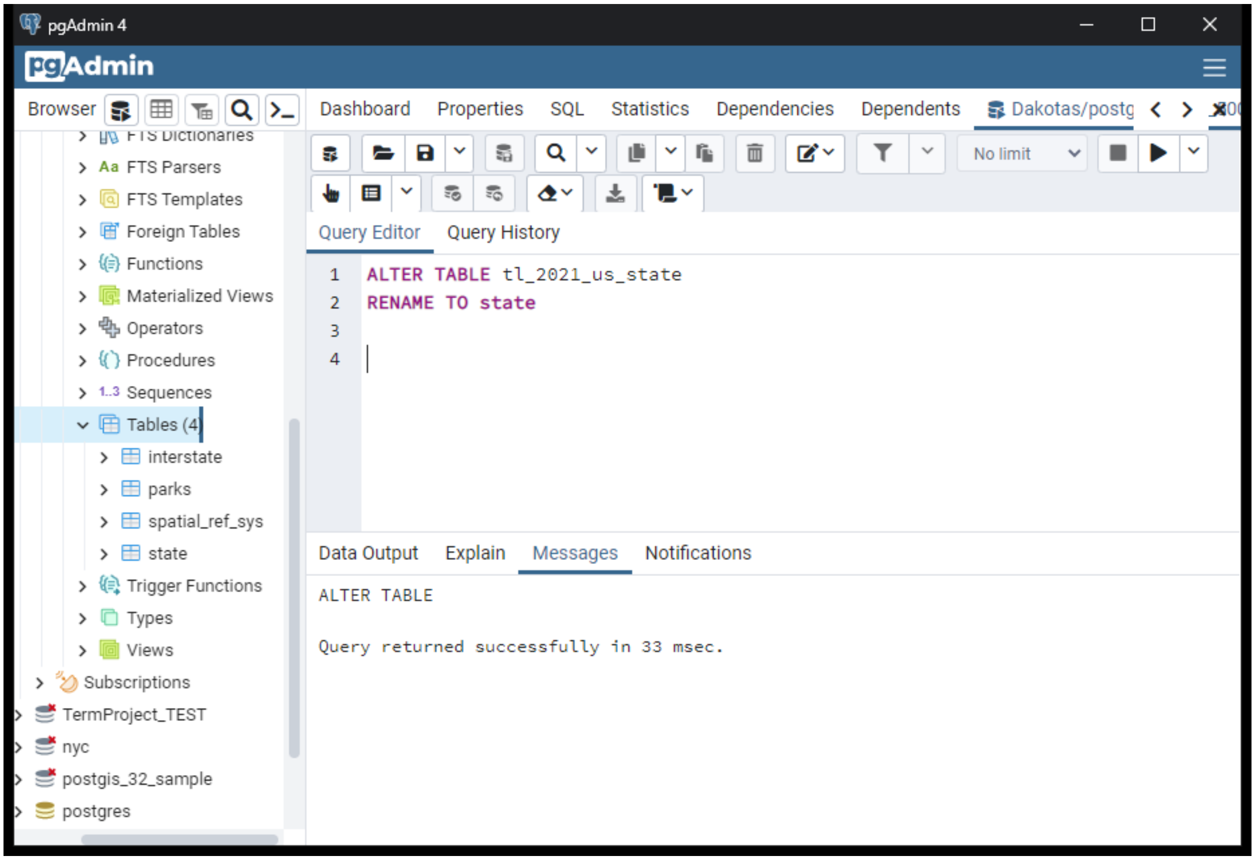
2. Import parks, state, and interstate shapefiles using PostGIS Shapefile Import/Export Manager:



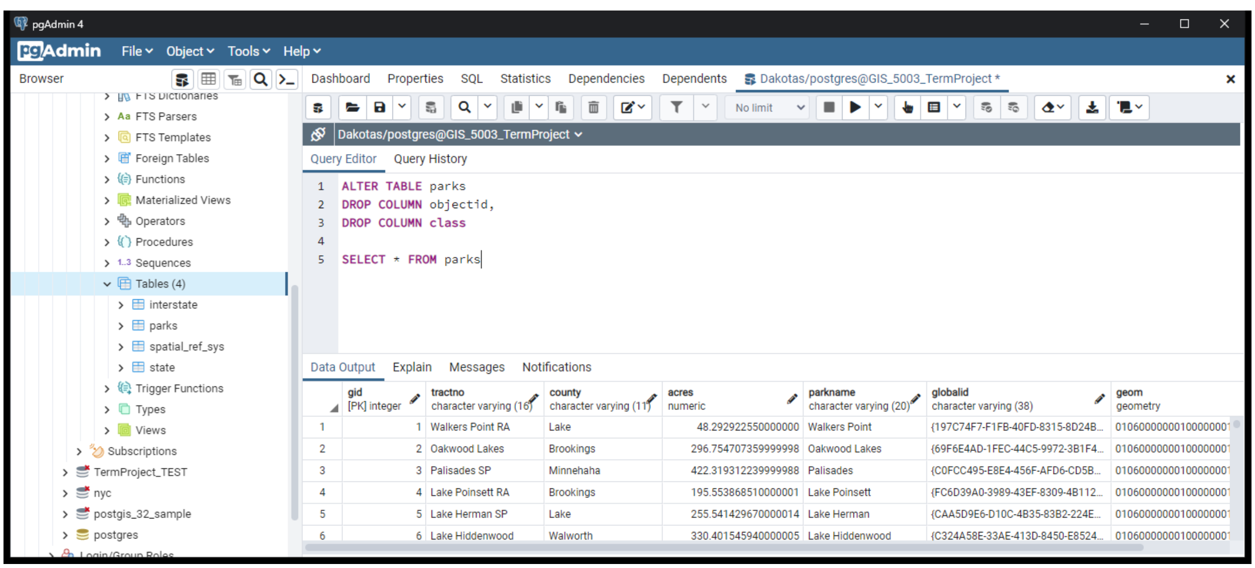
3. Simplify names of shapefile tables:

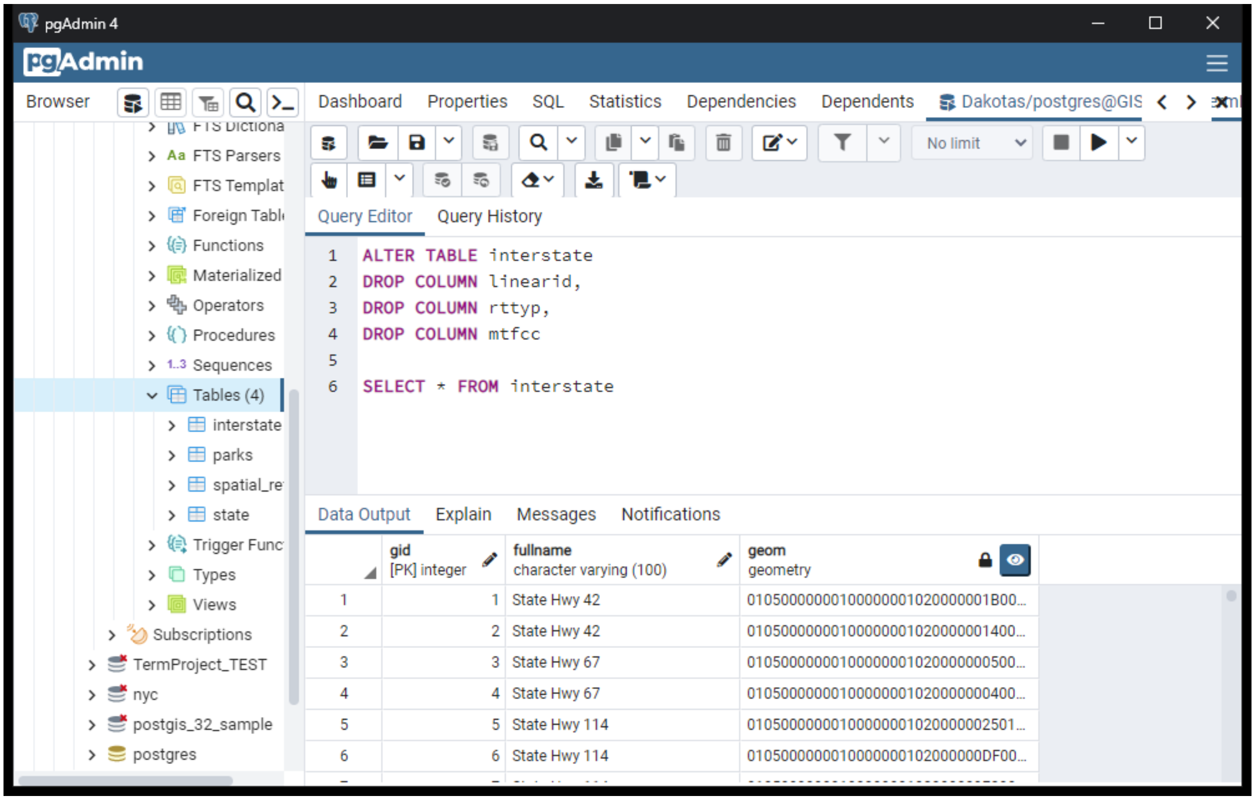


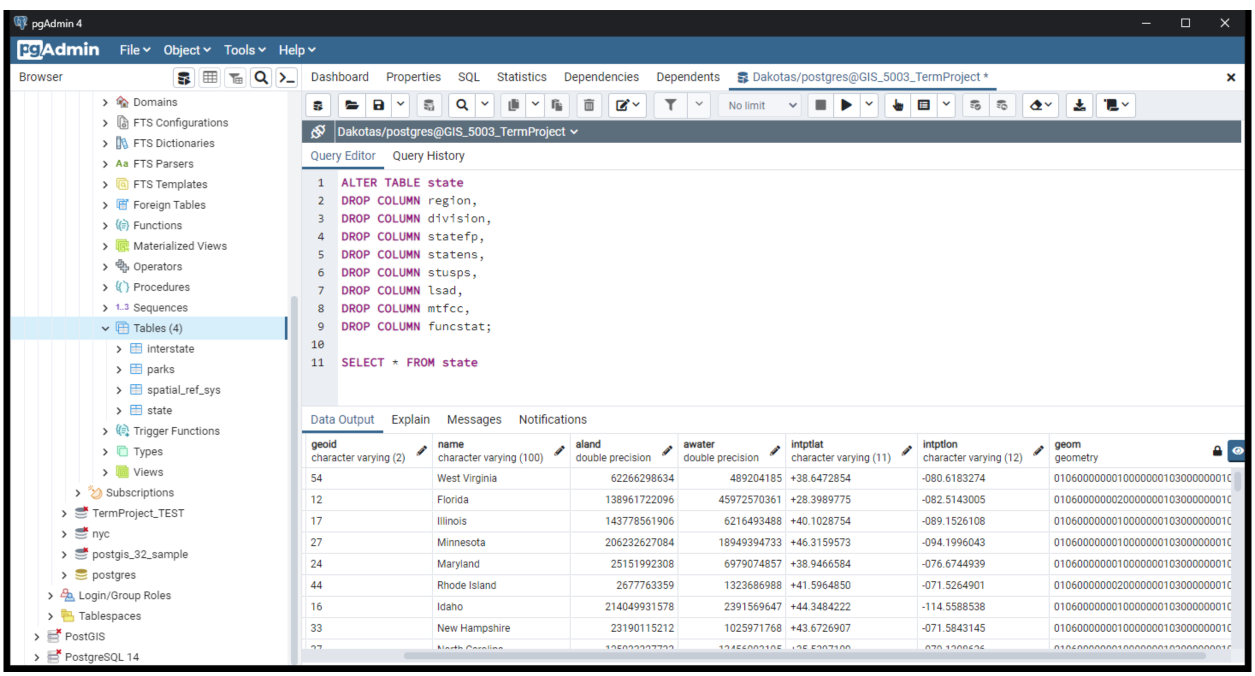

pgAdmin 4
Browser
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
Dakotas/postg
FTS Parsers
FTS Templates
Foreign Tables
Functions
Materialized Views
Operators
Procedures
Sequences
Tables (4)
interstate
parks
spatial_ref_sys
tl_2021_us_state
Trigger Functions
Types
Views
Subscriptions
TermProject_TEST
nyc
postgis_32_sample
postgres
No limit
Query Editor
Query History
ALTER TABLE tl_2021_us_primaryroads
RENAME TO interstate
Data Output
Explain
Messages
Notifications
ALTER TABLE
Query returned successfully in 31 msec.



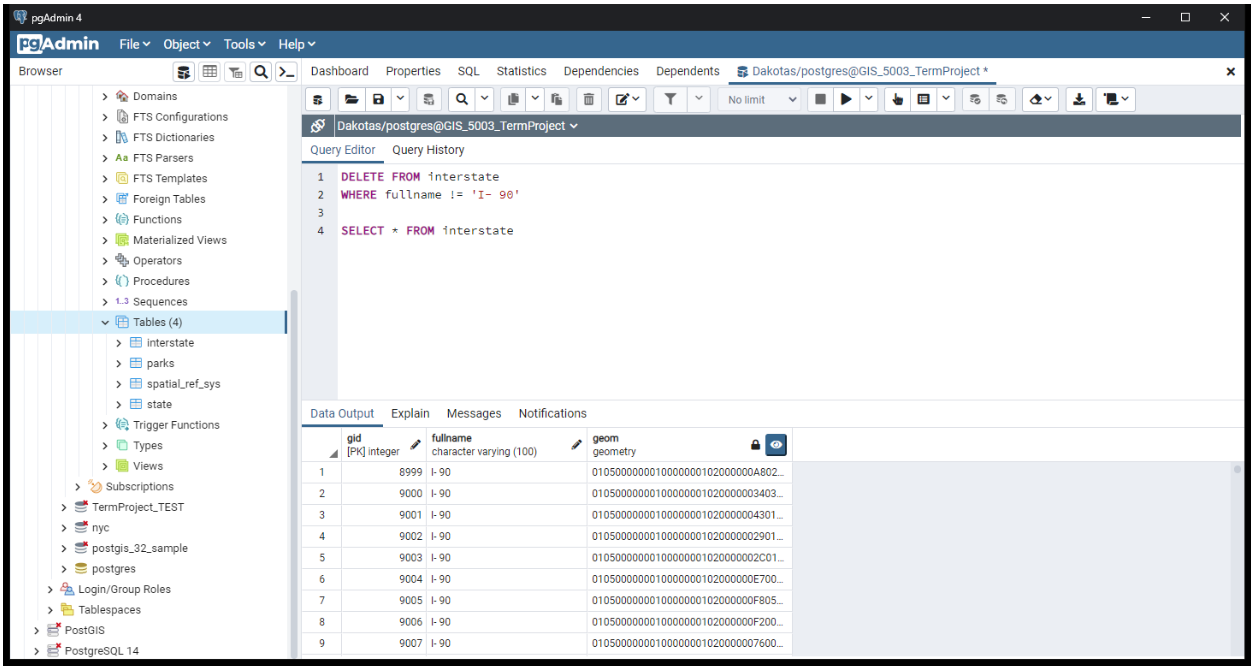
4. Drop unnecessary columns and verify:

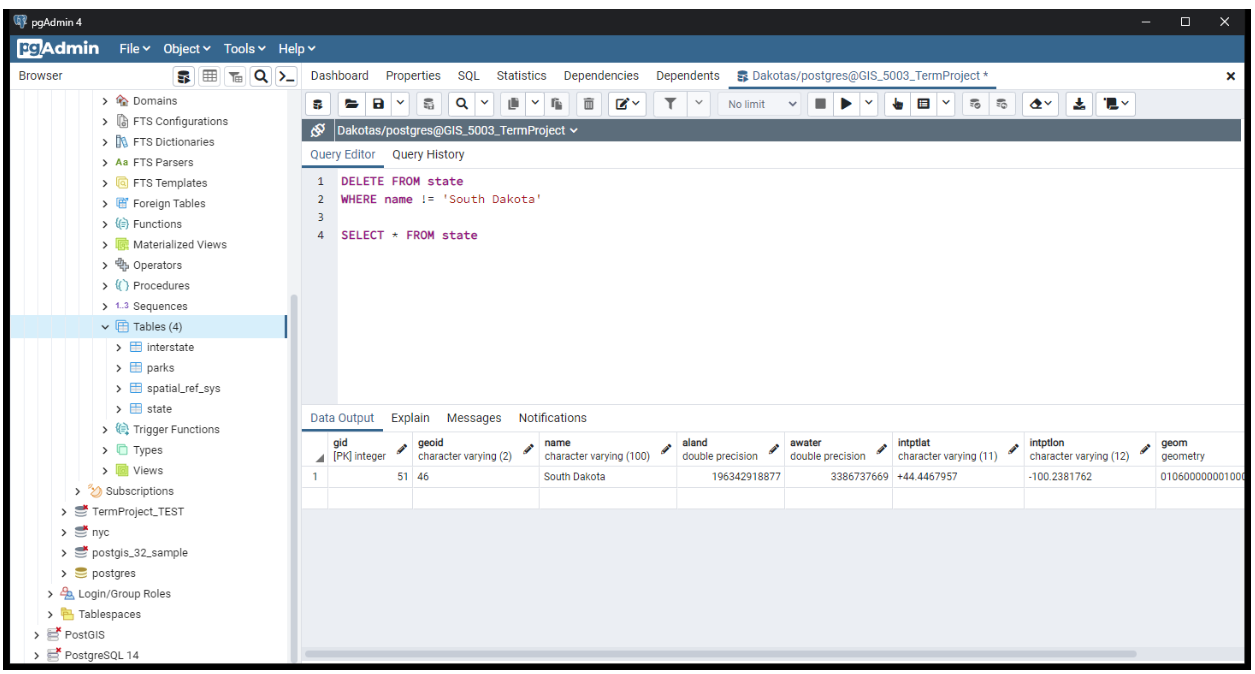



pgAdmin 4
Query Editor
Query History
ALTER TABLE interstate
DROP COLUMN linearid,
DROP COLUMN rttyp,
DROP COLUMN mtfcc
SELECT * FROM interstate
Data Output
Explain
Messages
Notifications
gid [PK] integer
fullname character varying (100)
geom geometry
1 State Hwy 42
2 State Hwy 42
3 State Hwy 67
4 State Hwy 67
5 State Hwy 114
6 State Hwy 114

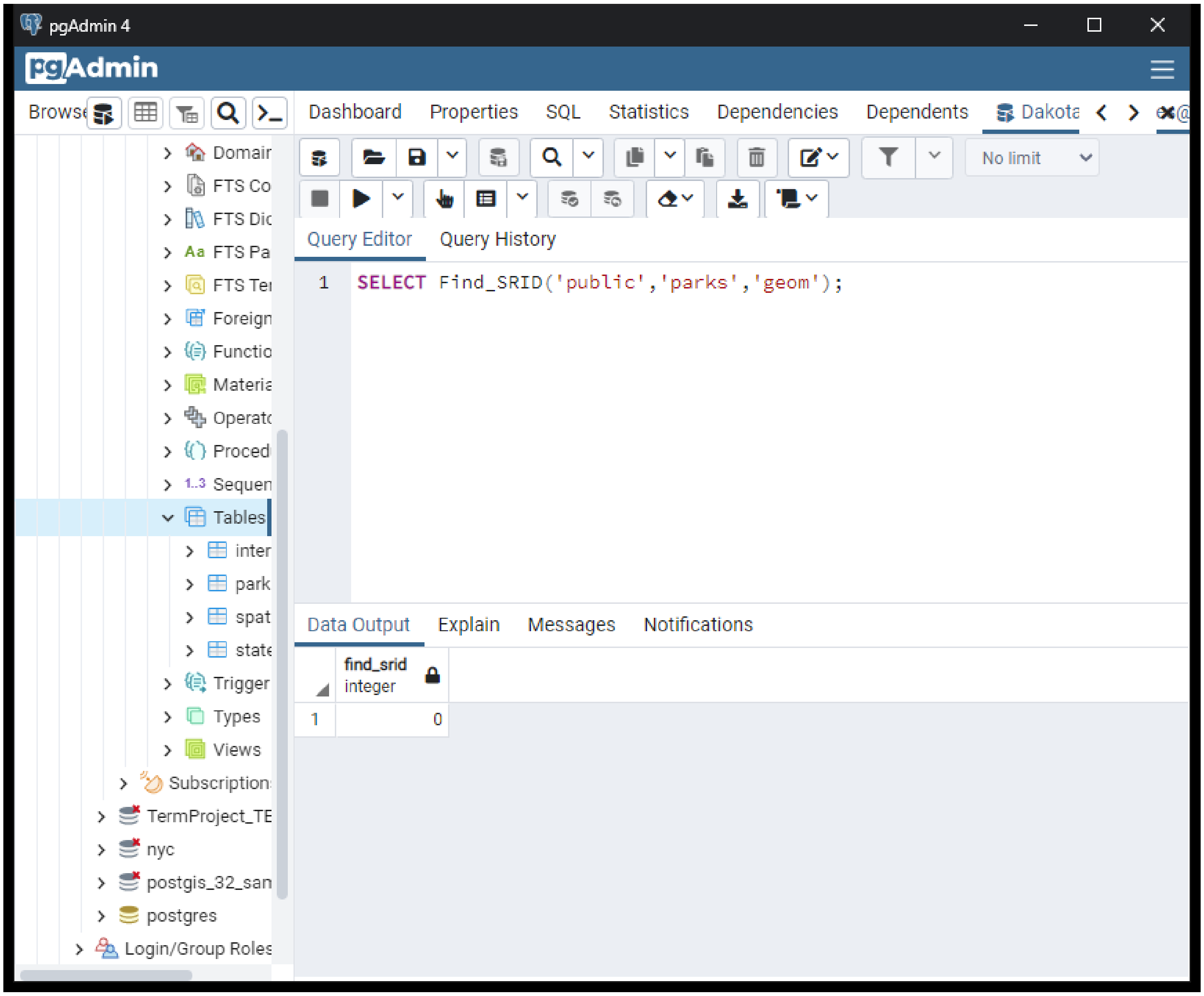

pgAdmin 4
Dakotas/postgres@GIS_5003_TermProject
Query Editor
Query History
ALTER TABLE state
DROP COLUMN region,
DROP COLUMN division,
DROP COLUMN statefp,
DROP COLUMN statens,
DROP COLUMN stusps,
DROP COLUMN lsad,
DROP COLUMN mtfcc,
DROP COLUMN funcstat;
SELECT * FROM state
Data Output
Explain
Messages
Notifications
geoid character varying (2)
name character varying (100)
aland double precision
awater double precision
intptlat character varying (11)
intptlon character varying (12)
geom geometry
54 West Virginia 62266298634 489204185 +38.6472854 -080.6183274
12 Florida 138961722096 45972570361 +28.3989775 -082.5143005
17 Illinois 143778561906 6216493488 +40.1028754 -089.1526108
27 Minnesota 206232627084 18949394733 +46.3159573 -094.1996043
24 Maryland 25151992308 6979074857 +38.9466584 -076.6744939
44 Rhode Island 2677763359 1323686988 +41.5964850 -071.5264901
16 Idaho 214049931578 2391569647 +44.3484222 -114.5588538
33 New Hampshire 23190115212 1025971768 +43.6726907 -071.5843145

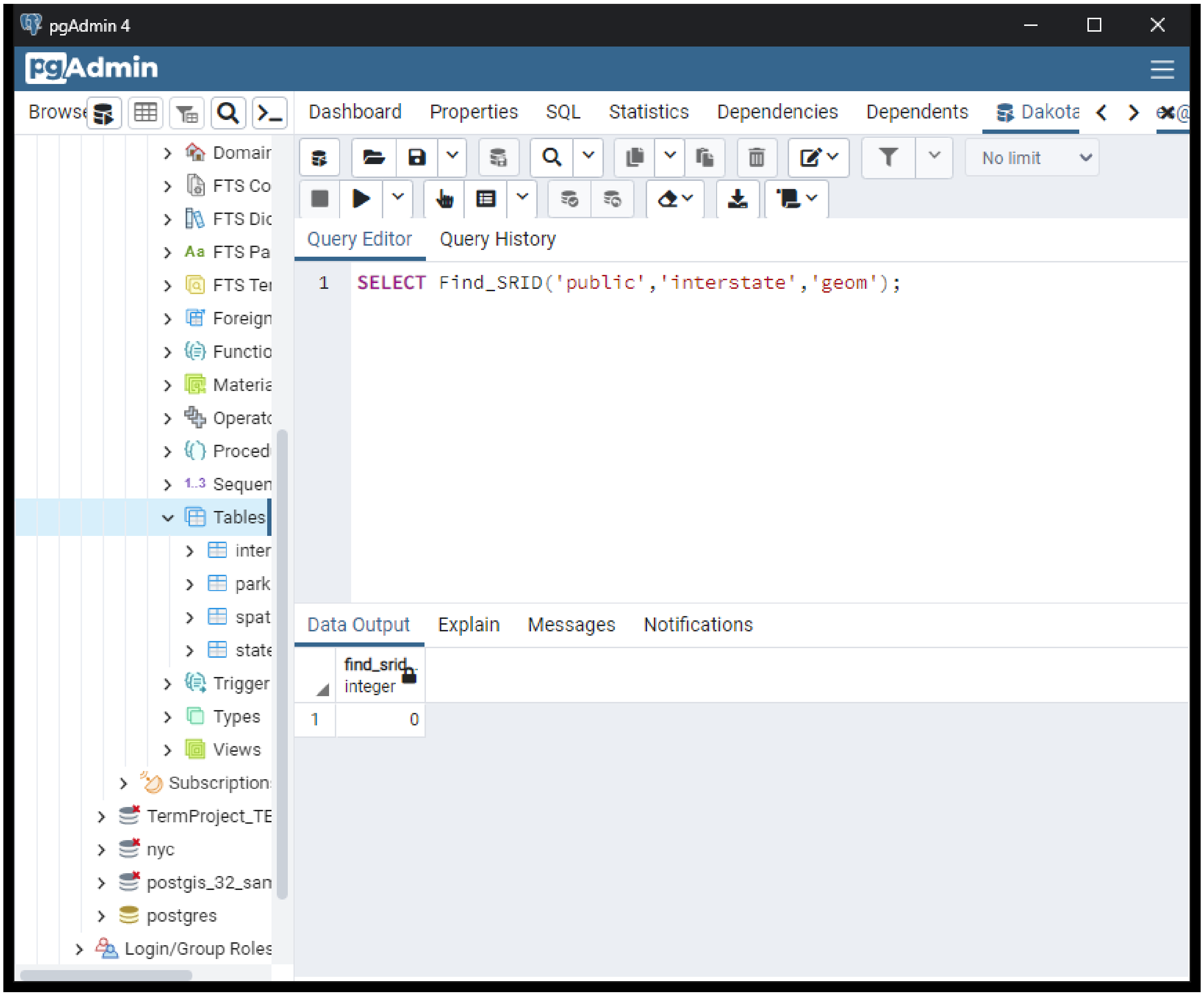
5. Delete unnecessary rows and verify:

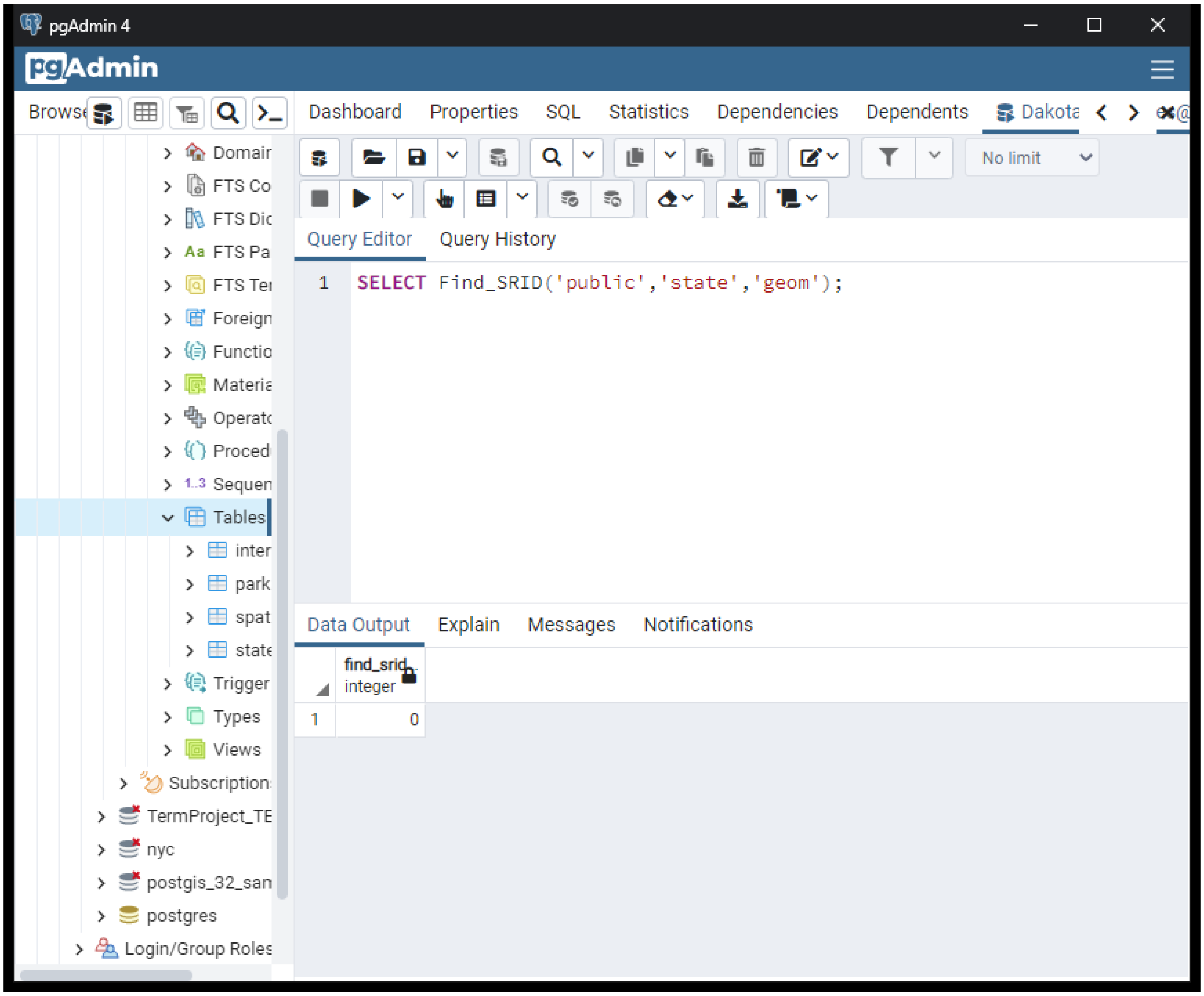




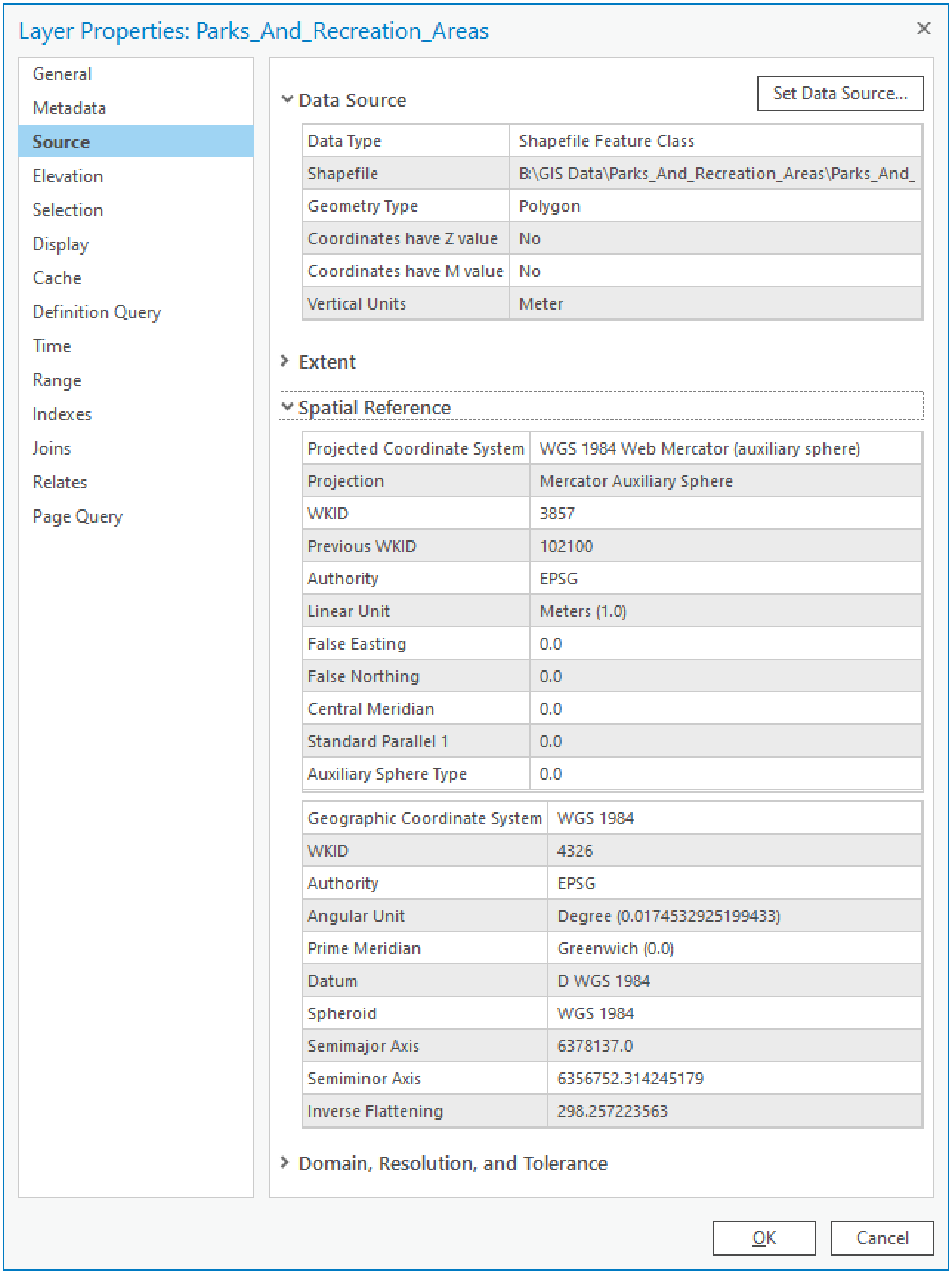
6. Find SRID of all tables:



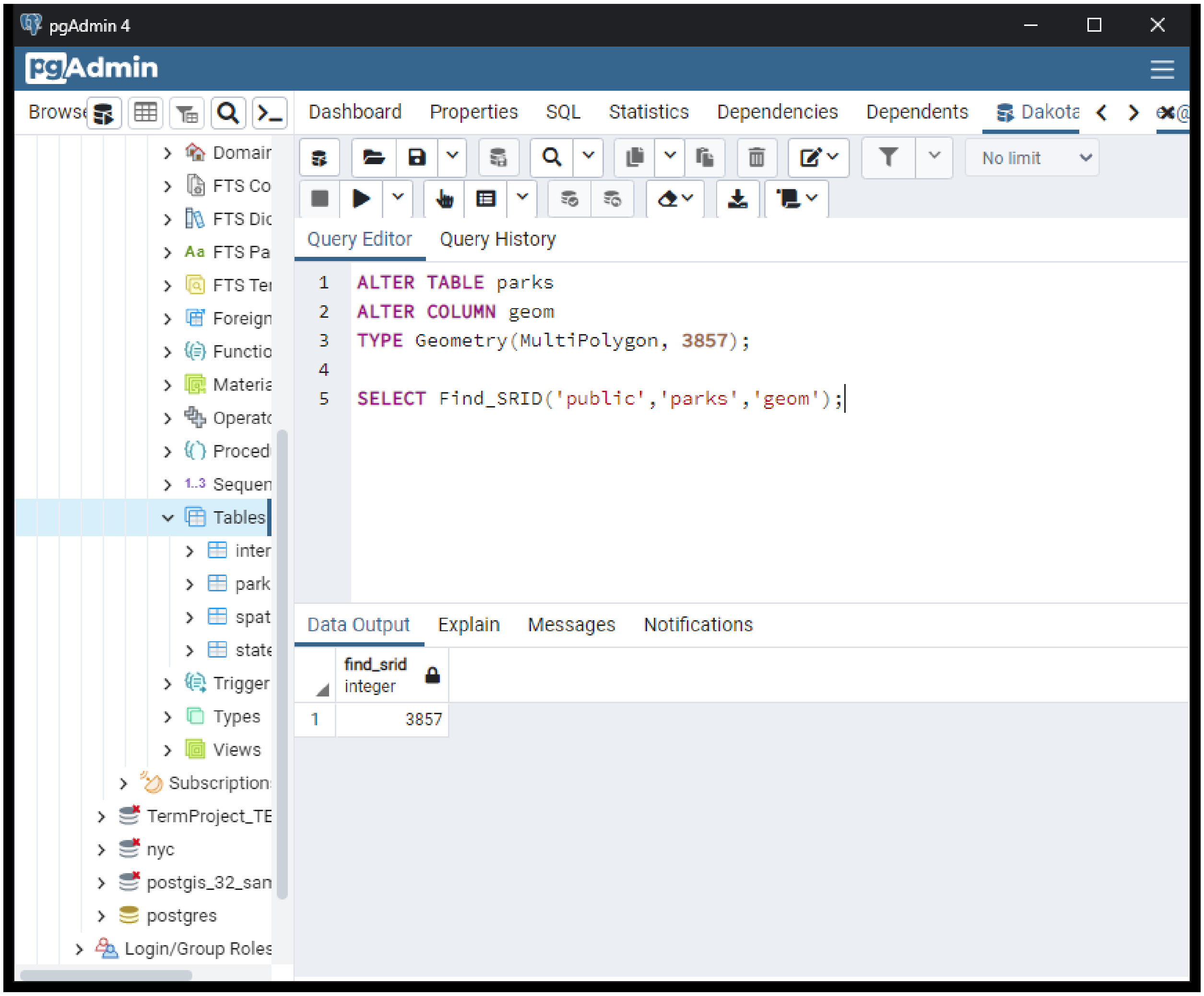

pgAdmin 4
pgAdmin
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
Query Editor
Query History
SELECT Find_SRID('public','interstate','geom');
Data Output
Explain
Messages
Notifications
find_srid
integer
0
Tables
Login/Group Roles
postgres
nyc
No limit

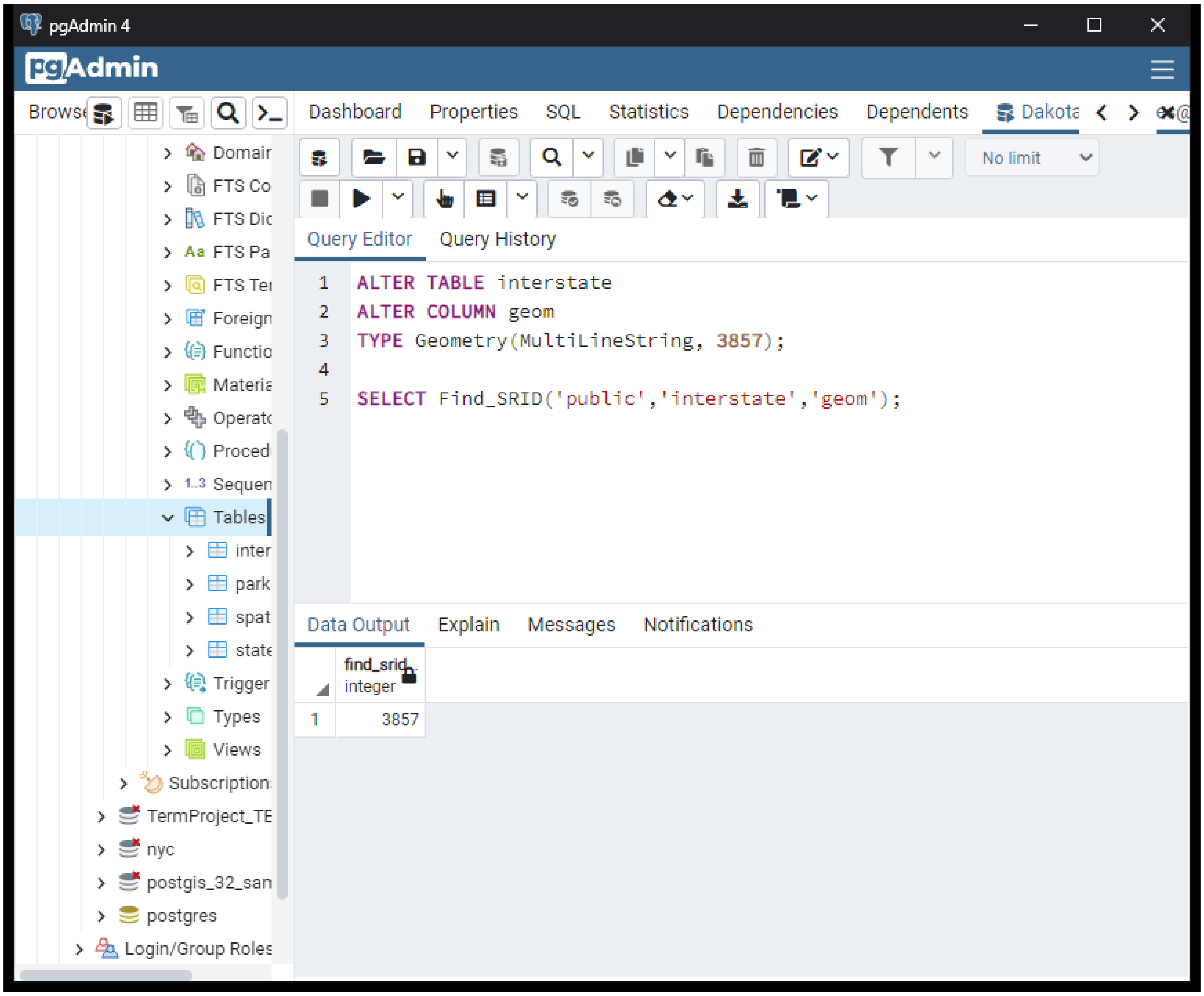

pgAdmin 4
pgAdmin
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
Query Editor
Query History
SELECT Find_SRID('public','state','geom');
Data Output
Explain
Messages
Notifications
find_srid
integer
0
No limit
Tables
Subscriptions
TermProject_TE
nyc
postgis_32_san
postgres
Login/Group Roles

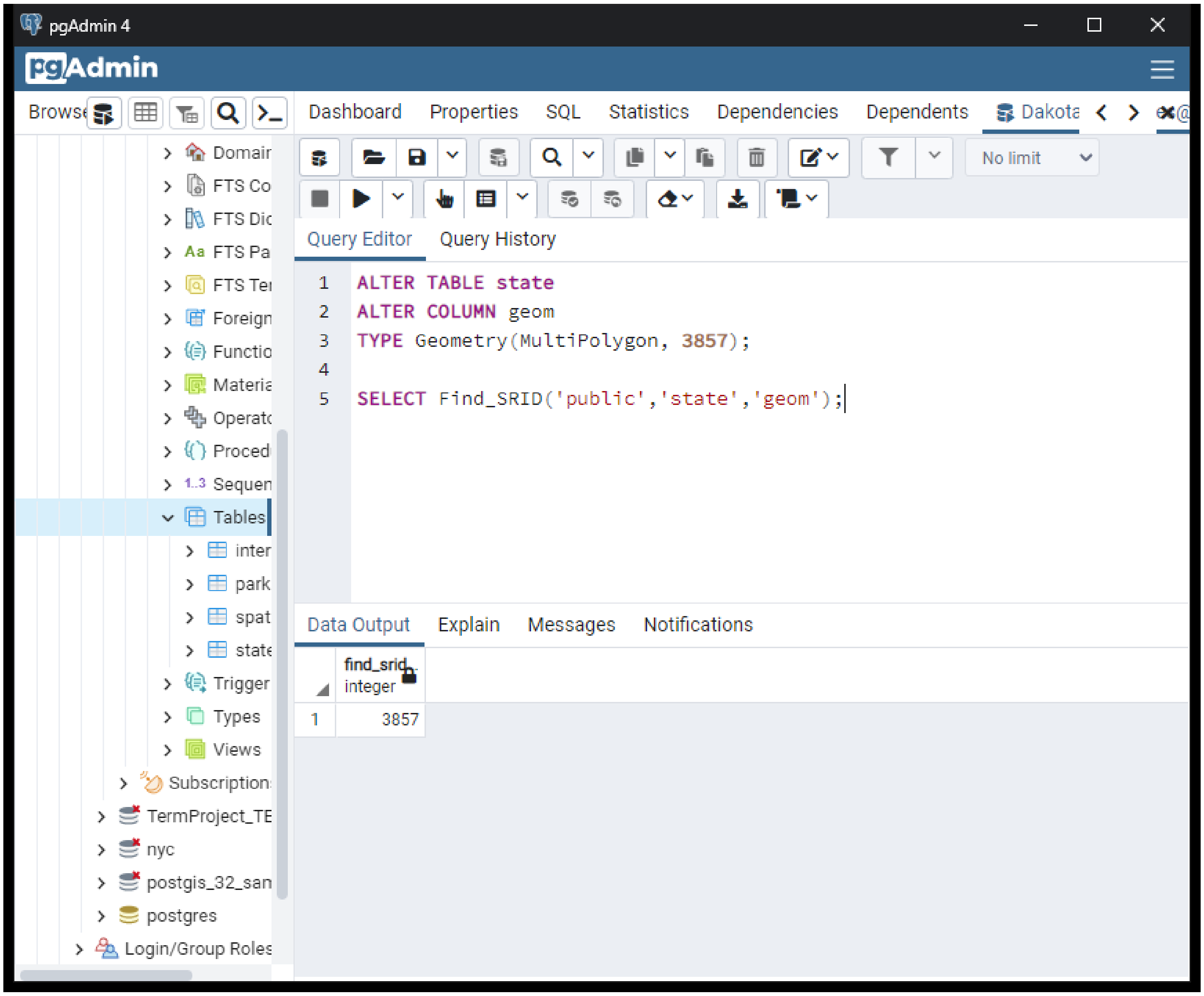
7. Utilize ArcGIS Pro to determine projected coordinate system of parks shapefile:



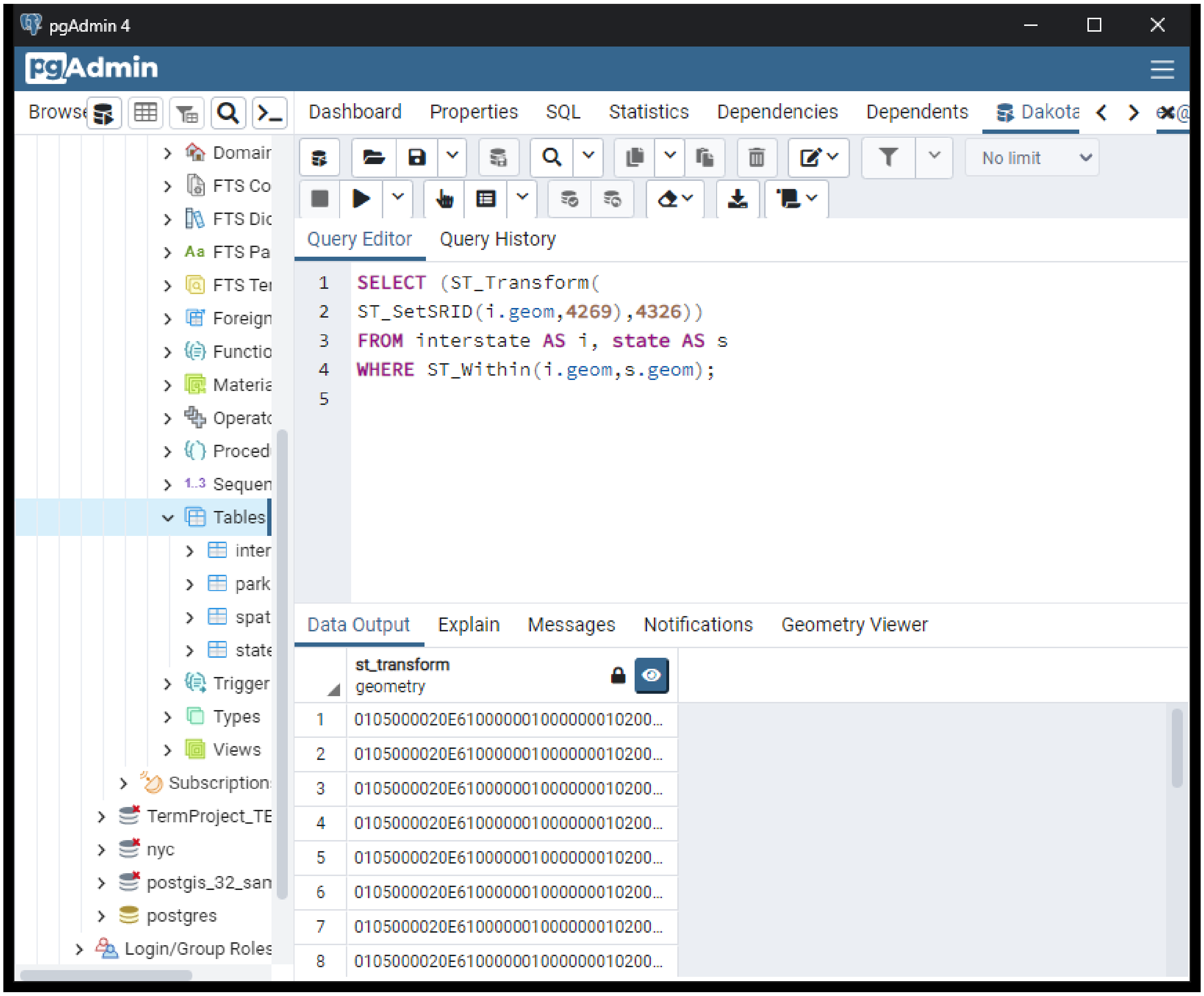
8. Set all the geometries' SRID's to match the projected coordinate system of parks, WKID = 3857, and verify:

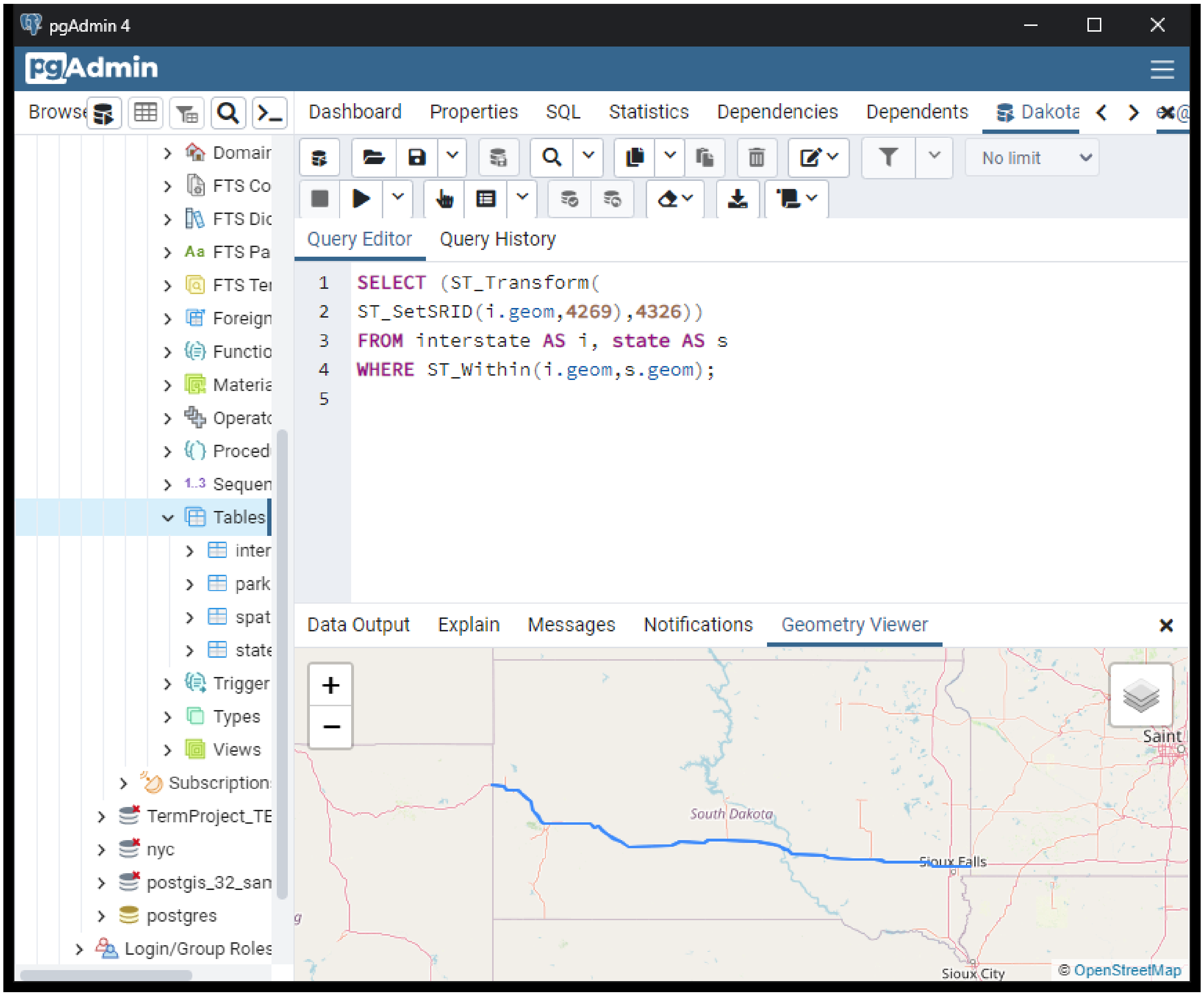



pgAdmin 4
pgAdmin
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
Query Editor
Query History
ALTER TABLE interstate
ALTER COLUMN geom
TYPE Geometry(MultiLineString, 3857);
SELECT Find_SRID('public','interstate','geom');
Data Output
Explain
Messages
Notifications
find_srid
integer
3857
Tables
Subscriptions
TermProject_TE
nyc
postgis_32_san
postgres
Login/Group Roles

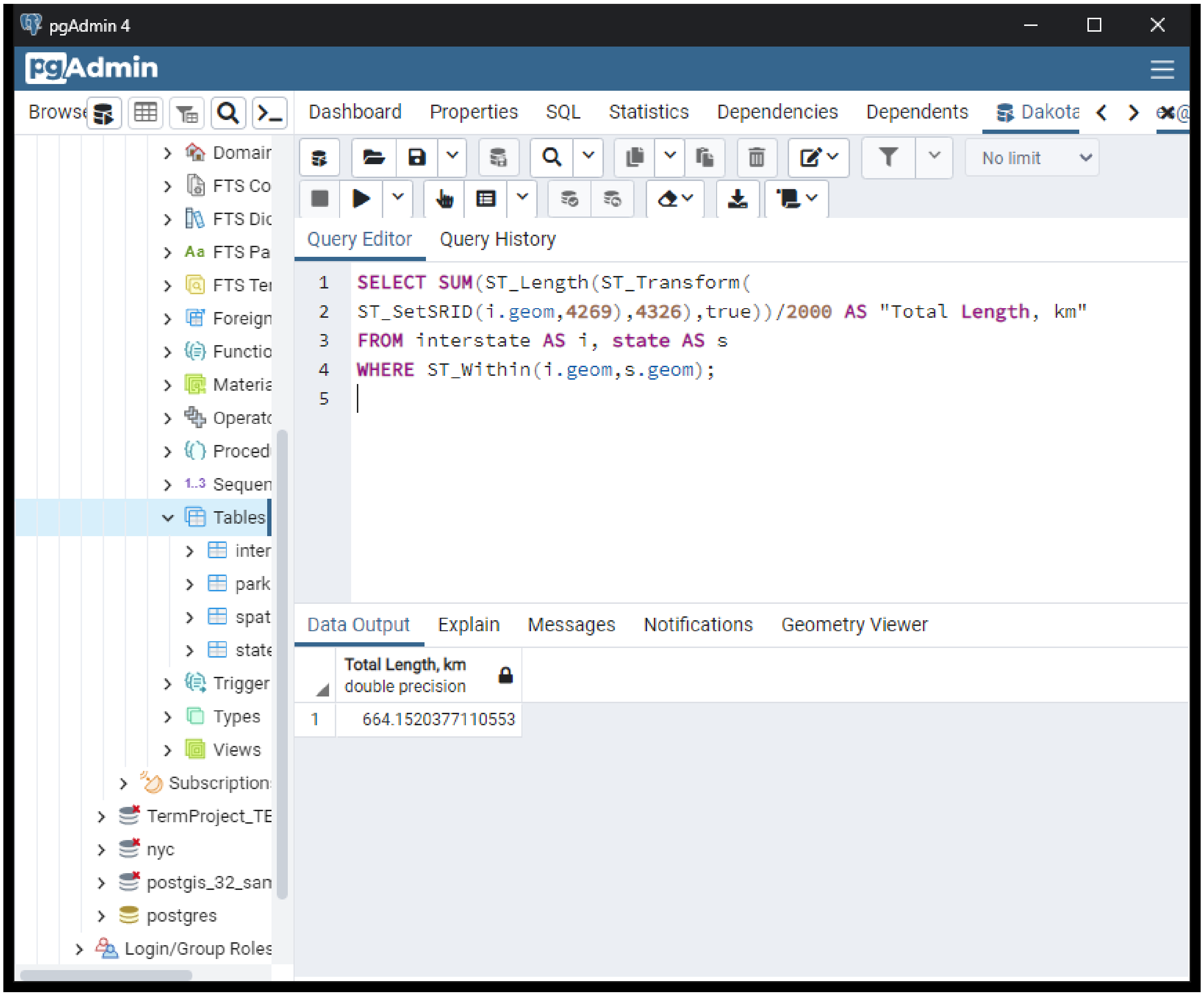

pgAdmin 4
Dashboard Properties SQL Statistics Dependencies Dependents
Query Editor Query History
ALTER TABLE state
ALTER COLUMN geom
TYPE Geometry(MultiPolygon, 3857);
SELECT Find_SRID('public','state','geom');
Data Output Explain Messages Notifications
find_srid integer
1 3857
Tables
TermProject_TE
nyc
postgis_32_san
postgres
Login/Group Roles

9. Determine the portion of the interstate shapefile that is within the state of South Dakota shapefile, where the interstate name is I- 90 (referred to simply as "I- 90" hereafter), and verify using Geometry Viewer:

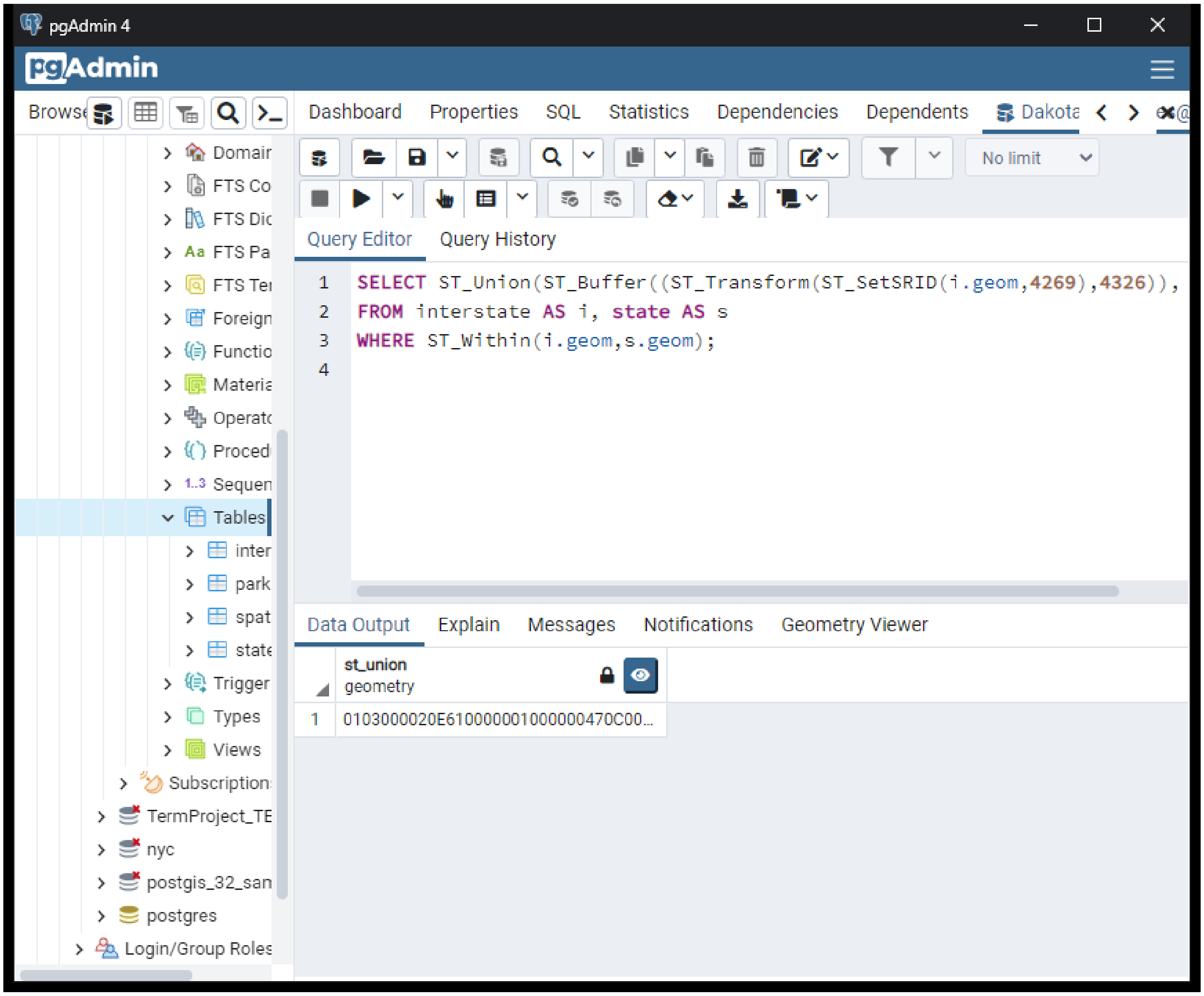


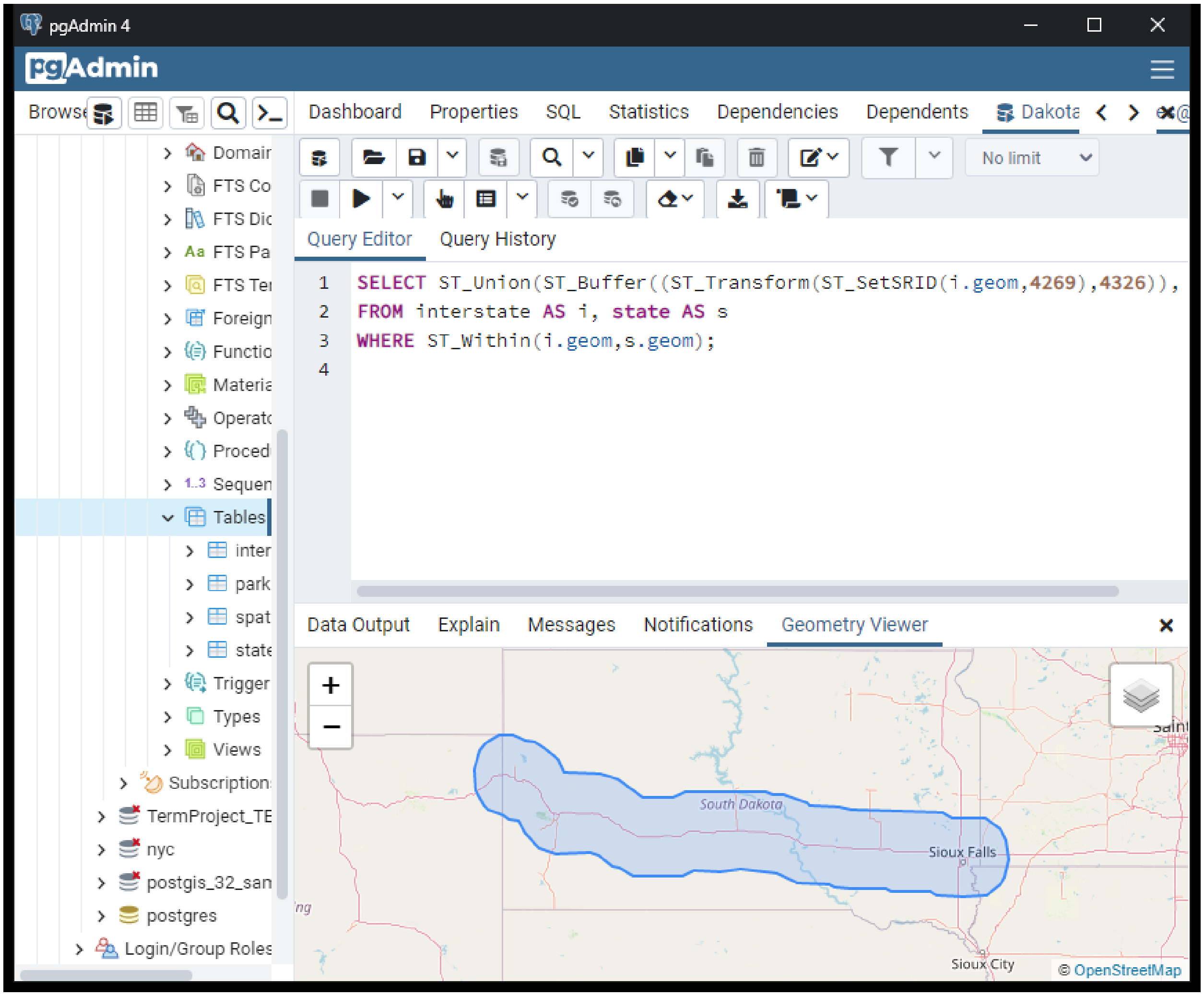

pgAdmin 4
pgAdmin
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
Query Editor
Query History
SELECT (ST_Transform(
ST_SetSRID(i.geom,4269),4326))
FROM interstate AS i, state AS s
WHERE ST_Within(i.geom,s.geom);
Data Output
Explain
Messages
Notifications
Geometry Viewer
No limit
Tables
Subscription
nyc
postgres
Login/Group Roles
South Dakota
Sioux Falls
Sioux City
© OpenStreetMap

10. Determine the length of I- 90, in kilometers:

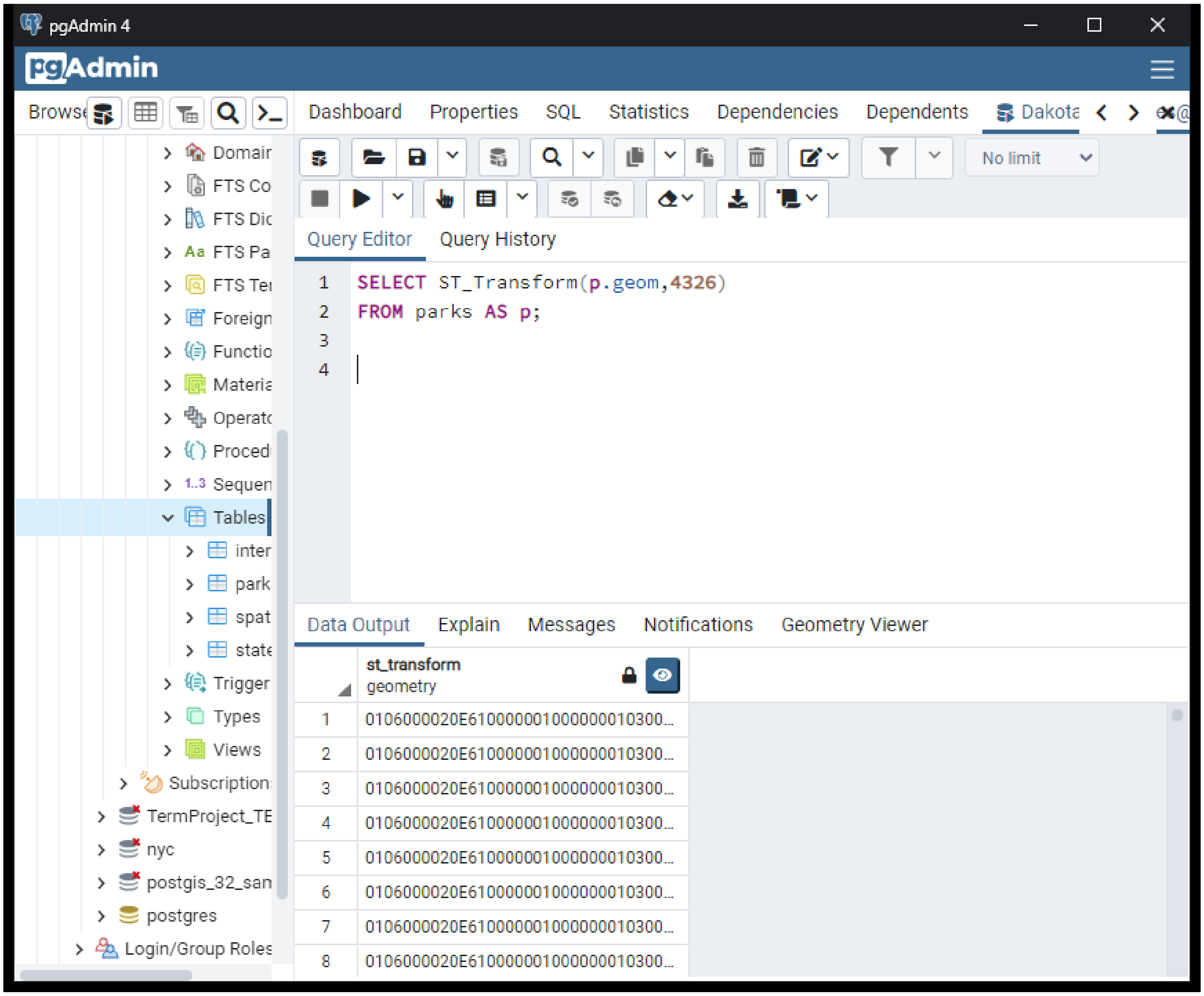


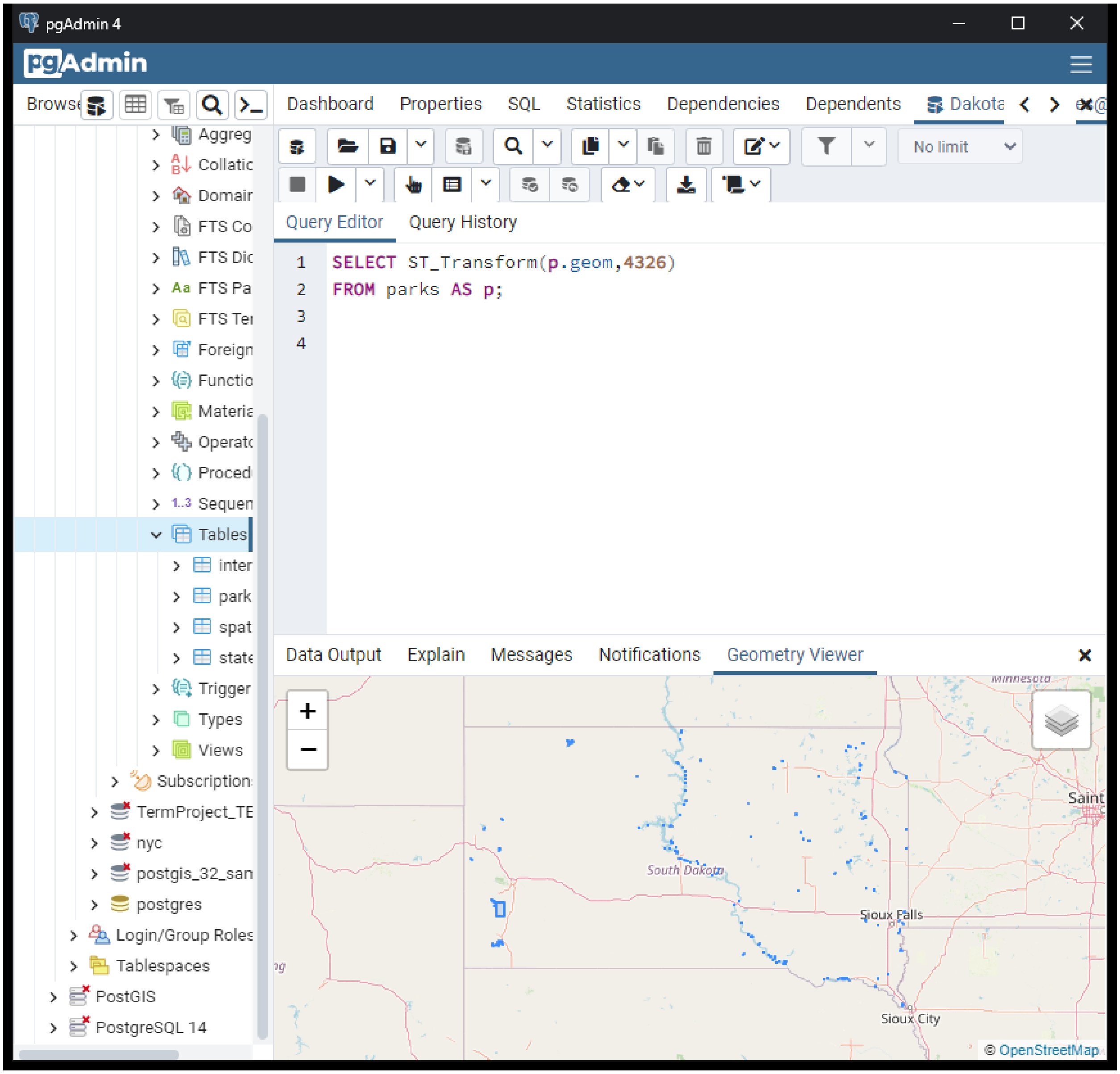
11. Intermediate step: Create a buffer around I- 90 of 0.45 degrees, or approximately fifty-kilometers, and verify using Geometry Viewer:



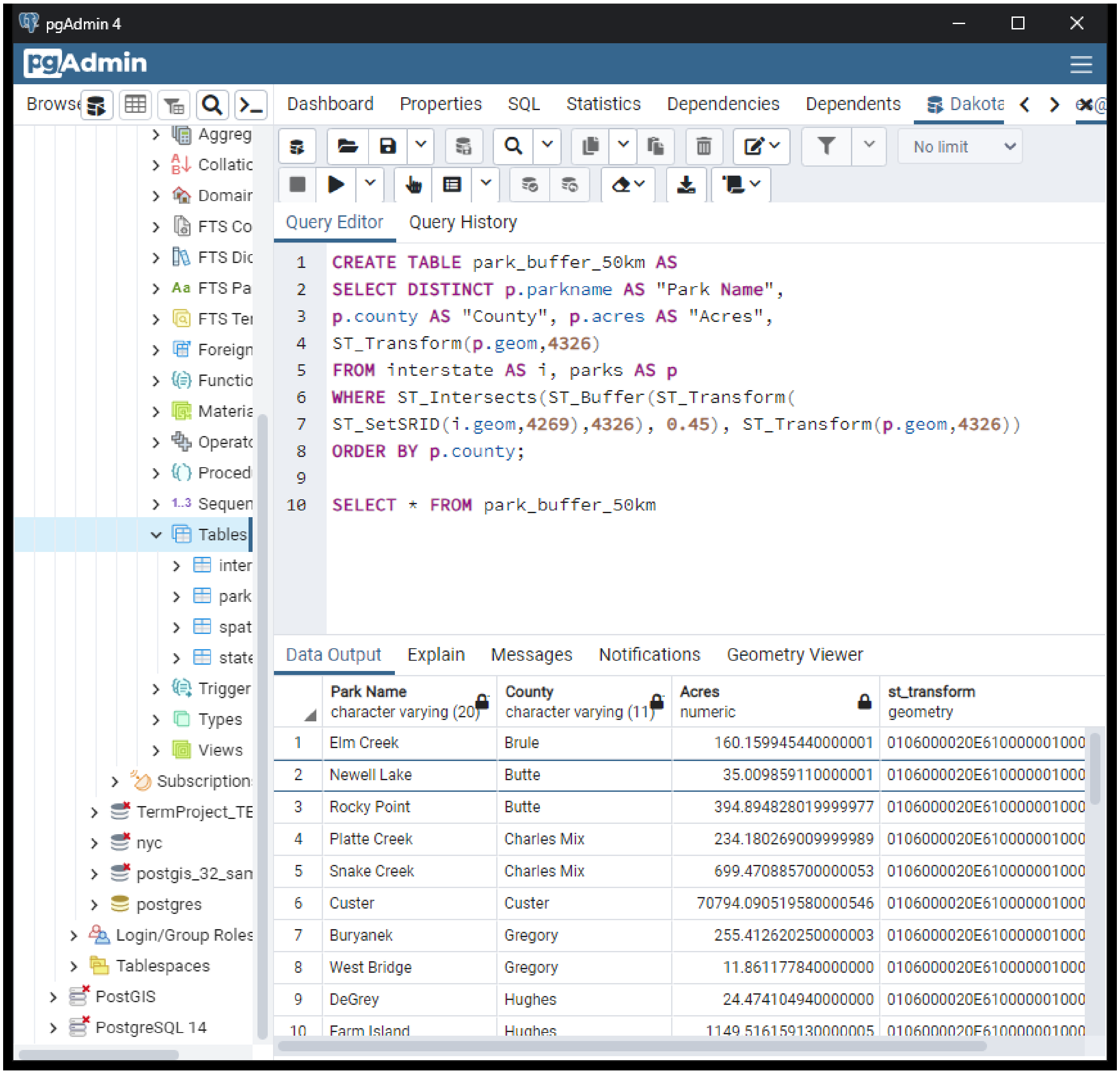

pgAdmin 4
pgAdmin
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
No limit
Query Editor
Query History
SELECT ST_Union(ST_Buffer((ST_Transform(ST_SetSRID(i.geom,4269),4326)),
FROM interstate AS i, state AS s
WHERE ST_Within(i.geom,s.geom);
Domair
FTS Co
FTS Dic
FTS Pa
FTS Tei
Foreign
Functio
Materia
Operatc
Proced
Sequen
Tables
inter
park
spat
state
Trigger
Types
Views
Subscription
TermProject_TE
nyc
postgis_32_san
postgres
Login/Group Roles
Data Output
Explain
Messages
Notifications
Geometry Viewer
South Dakota
Sioux Falls
Sioux City
© OpenStreetMap

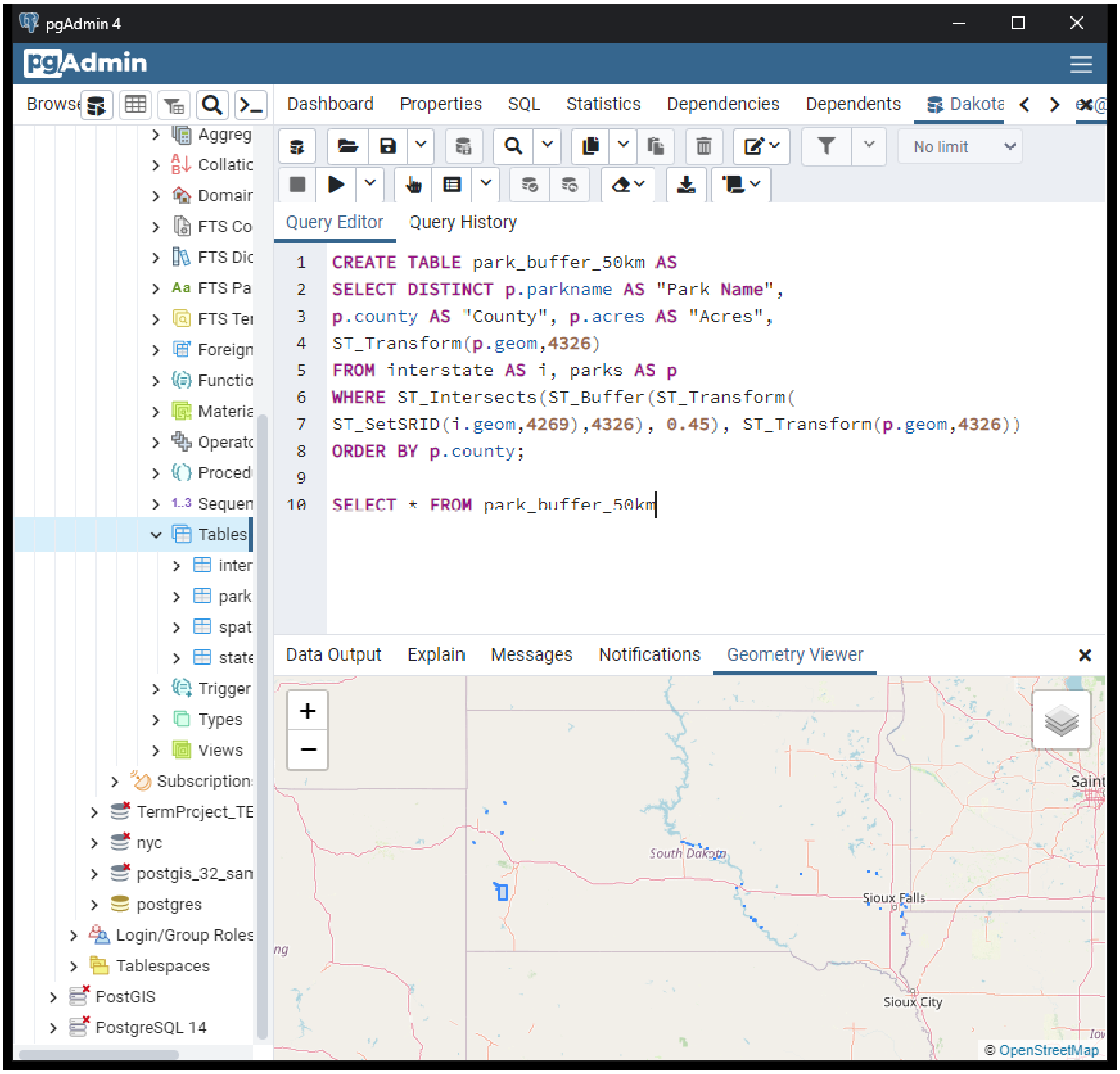
12. Intermediate step: Transform park geometry to 4326 to visualize all park polygons relative to basemap, and verify using Geometry Viewer:



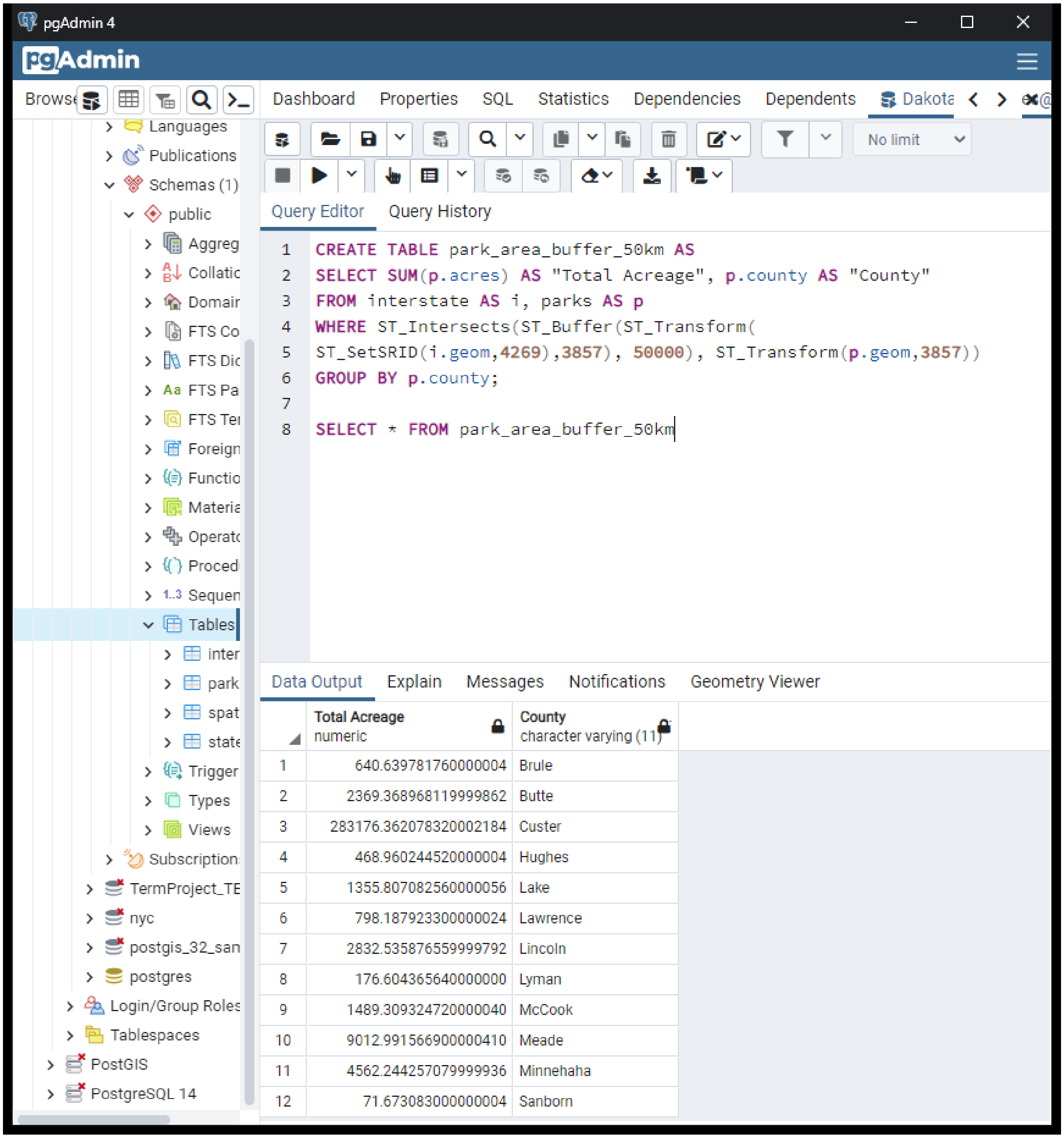

pgAdmin 4
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
Query Editor
Query History
SELECT ST_Transform(p.geom,4326)
FROM parks AS p;
Tables
Data Output
Explain
Messages
Notifications
Geometry Viewer
South Dakota
Sioux Falls
Sioux City
© OpenStreetMap

13. Create a table, park_buffer_50km, to contain all parks within the fifty-kilometer buffer, and verify:

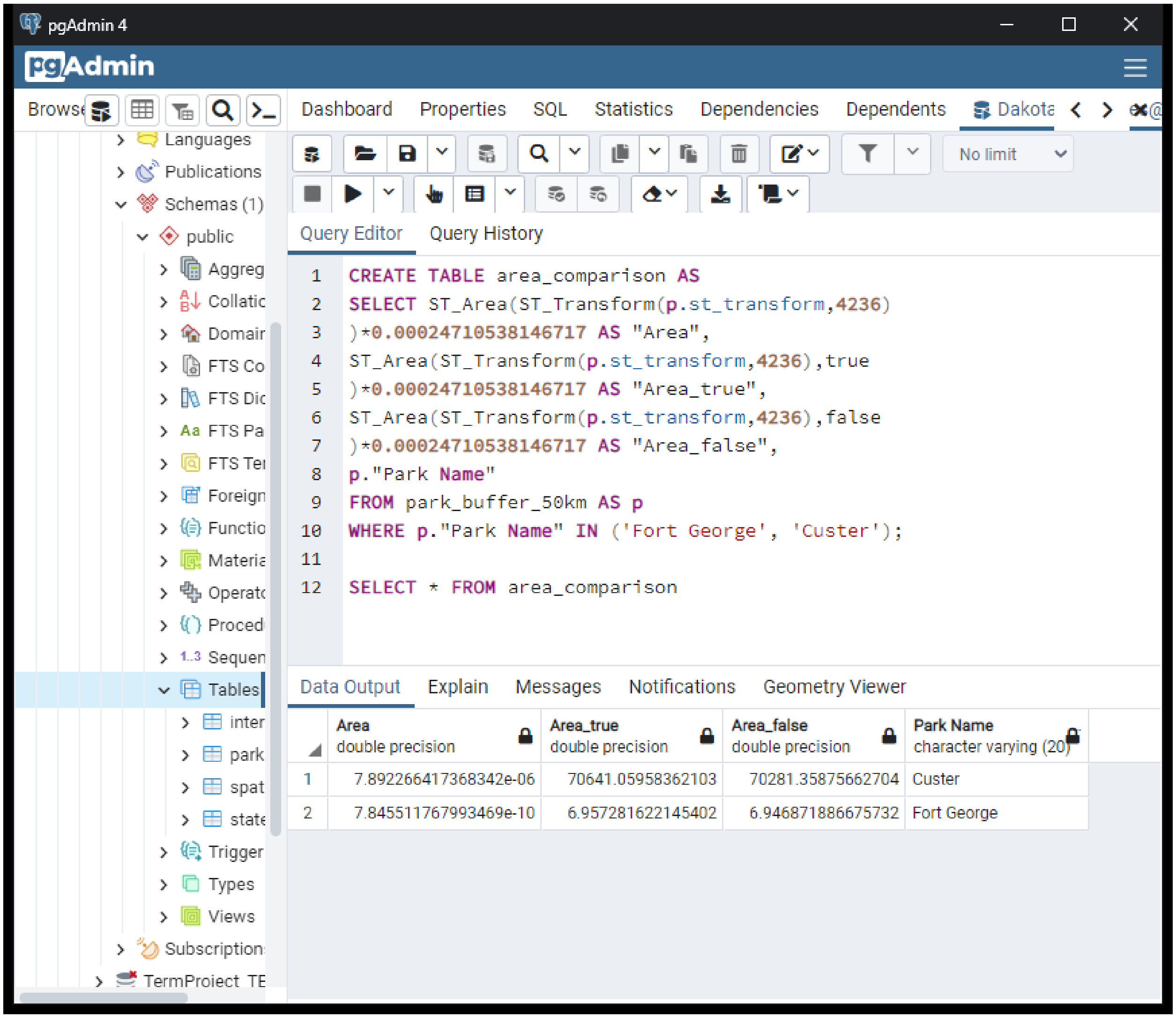



pgAdmin 4
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
Query Editor
Query History
CREATE TABLE park_buffer_50km AS
SELECT DISTINCT p.parkname AS "Park Name",
p.county AS "County", p.acres AS "Acres",
ST_Transform(p.geom,4326)
FROM interstate AS i, parks AS p
WHERE ST_Intersects(ST_Buffer(ST_Transform(
ST_SetSRID(i.geom,4269),4326), 0.45), ST_Transform(p.geom,4326))
ORDER BY p.county;
SELECT * FROM park_buffer_50km
Data Output
Explain
Messages
Notifications
Geometry Viewer
South Dakota
Sioux Falls
Sioux City
© OpenStreetMap

14. Create a table, park_area_buffer_50km, and calculate the area of parks in the buffer, grouped by county:



15. Create a table, area_comparison, to compare the smallest and largest park areas within the buffer:



16. Compare results from the area comparison pgAdmin query to the attribute table in ArcGIS Pro to observe differences, if any, using a Microsoft Excel spreadsheet and the equation ArcGIS Pro - pgAdmin = value:

Parks_And_Recreation_Areas × | tl_2021_us_state | tl_2021_us_primaryroads

Field: Selection: Highlighted:

	FID	Shape	OBJECTID	TRACTNO	COUNTY	ACRES	Class	ParkName	GlobalID
1	92	Polygon	95	Fort George	Hughes	6.951724	LUA	Fort George	{C80DA94C-B85A-45F0-
2	116	Polygon	120	Custer SP	Custer	70794.09052	SP	Custer	{DDCE128F-9C2C-444...
	Click to add new row.								

CUSTER	pgadmin		
ArcGIS Pro	area	area - true	area - false
70794.09052	0.0000078923	70641.0595836210	70281.3587566270
ArcGIS Pro - pgAdmin	70794.0905116877	153.0309359590	512.7317629530

FORT GEORGE	pgadmin		
ArcGIS Pro	area	area - true	area - false
6.951724	0.0000000008	6.9572816221	6.9468718867
ArcGIS Pro - pgAdmin	6.9517239992	-0.0055576221	0.0048521133

As mentioned in Materials and Methods, the area value utilizing ST_Area(geometry) for both parks are practically zero, and is also in degrees as a unit. However, comparing the values when ST_Area used a geography *and* a spheroid returns close values, at less than 1% difference between the two.

Discussion and Conclusion

Overall, some portions of this project I really liked, and some portions I really disliked. The portions that I liked were those that reminded me of the planning, and eventual execution of my plans, for my road trip in 2019. Those include creating buffers around the interstates and selecting parks within them, and finally figuring out which ones were "bigger and better" than the others. Using this method, I was able to visit Frontier Village and Theodore Roosevelt National Park in North Dakota, Devil's Tower in Wyoming, and in South Dakota, Black Hills National Forest, Mount Rushmore, Crazy Horse Memorial, Custer State Park, Badlands National Park, Wall Drug, and the Dignity Statue - all places I would never have seen if I had only driven on the interstates. After multiple meetings with Dr. Koch, it was finally starting to click how powerful a tool pgAdmin can be as an everyday application for spatial analyses as compared to something like ESRI's ArcGIS Pro. The portions I did not like were the trial and error and the quick pace at which functions became immensely complicated to keep track of. It would be nice if there were more auto-complete functionality built into pgAdmin, as assurance that a function was written and executed properly. More specific error messages would also have been incredibly helpful in alleviating stress, frustration, and wasted time that occurred at more than one point in this project.

This project yielded surprising, but interesting results: There are thirty-six state parks within approximately fifty kilometers of I- 90 in South Dakota, spread across twelve counties. The largest state park is Custer State Park in Custer County, and the smallest is Fort George State Park in Hughes County. In the entirety of the buffer, there exists nearly 307,000 acres of state parks which await any traveler seeking adventure within less than an hour's drive off of interstate I- 90. Armed with this knowledge, it is my hope that anyone considering a road trip through the Upper Great Plains take a moment to look at what lies just off their planned route, and consider setting aside some extra time to do some exploring at places many people passing by simply never know exist.

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