

Big Sandy Groundwater Basin Profile



Basin Summary Statistics

Size¹: 1,988 square miles

Elevation²: Range: 1,638-8,383 ft; Median: 4,817 ft

Top 3 land cover types by area³: Shrub/Scrub (86%), Evergreen Forest (12%), Grassland Herbaceous (1.2%)

Major surface watershed(s)⁴: Big Sandy River

Groundwater subbasins¹: Wikieup, Fort Rock

Groundwater-derived streamflow fraction⁵:

0.66 (Very High)



Mean Annual Hydrologic Cycle Components (1980-2020)
BIG SANDY

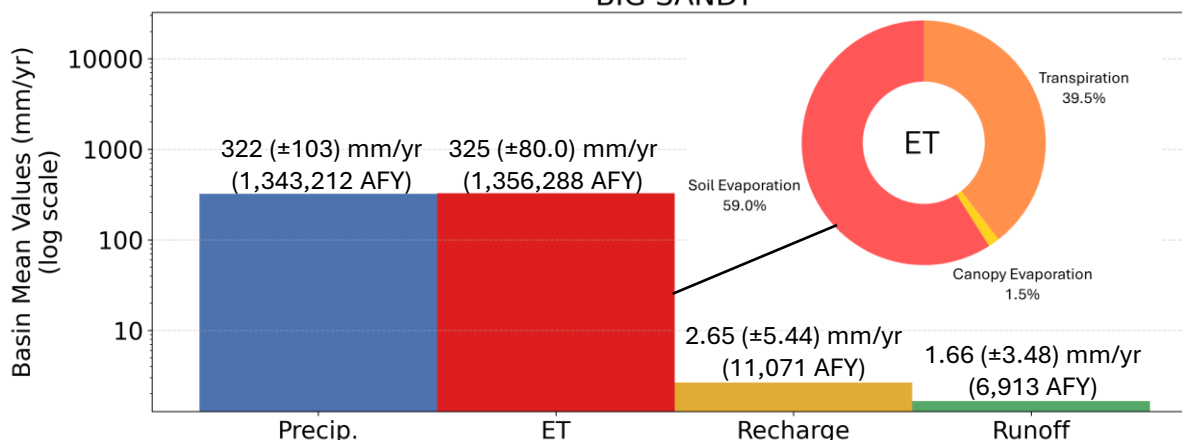


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.⁶ ET is partitioned into soil evaporation, canopy evaporation, and transpiration. It is possible for ET to be greater than P when there are other sources such as groundwater, surface water, or water in storage.

Mean Monthly Hydrologic Cycle Components (1980-2020)
BIG SANDY

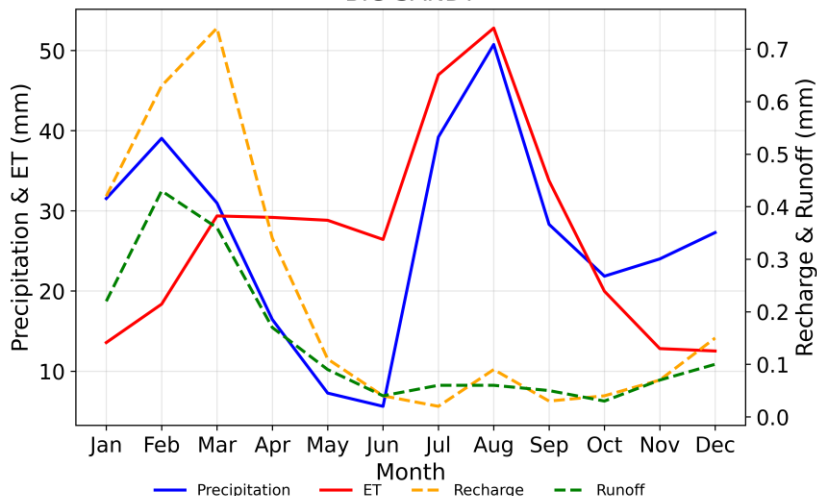


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.⁶

Precipitation (P) in the Big Sandy basin is affected by the North American Monsoon during the summer months and large frontal systems during the winter. On annual timescales, evapotranspiration (ET) is approximately equal to P, resulting in low basin-wide averages of natural recharge (2.65 mm/yr) and runoff (1.65 mm/yr). Soil evaporation makes up 59.0% of total ET in the basin, while transpiration comprises 39.5% and canopy evaporation accounts for the remainder (1.5%). Natural recharge and runoff are slightly higher in the cooler months when P exceeds ET. Groundwater is estimated to supply 66% of total streamflow in the Big Sandy basin.

Big Sandy



Figure 3 (below). Gridded depiction of mean annual water fluxes across the groundwater basin from Noah-MP modeling (1980-2020): (a) precipitation, (b) evapotranspiration, (c) recharge, (d) runoff.⁶ Major cities/towns⁷ and Native American Reservation boundaries⁸ are shown (as applicable) to help orient the reader.

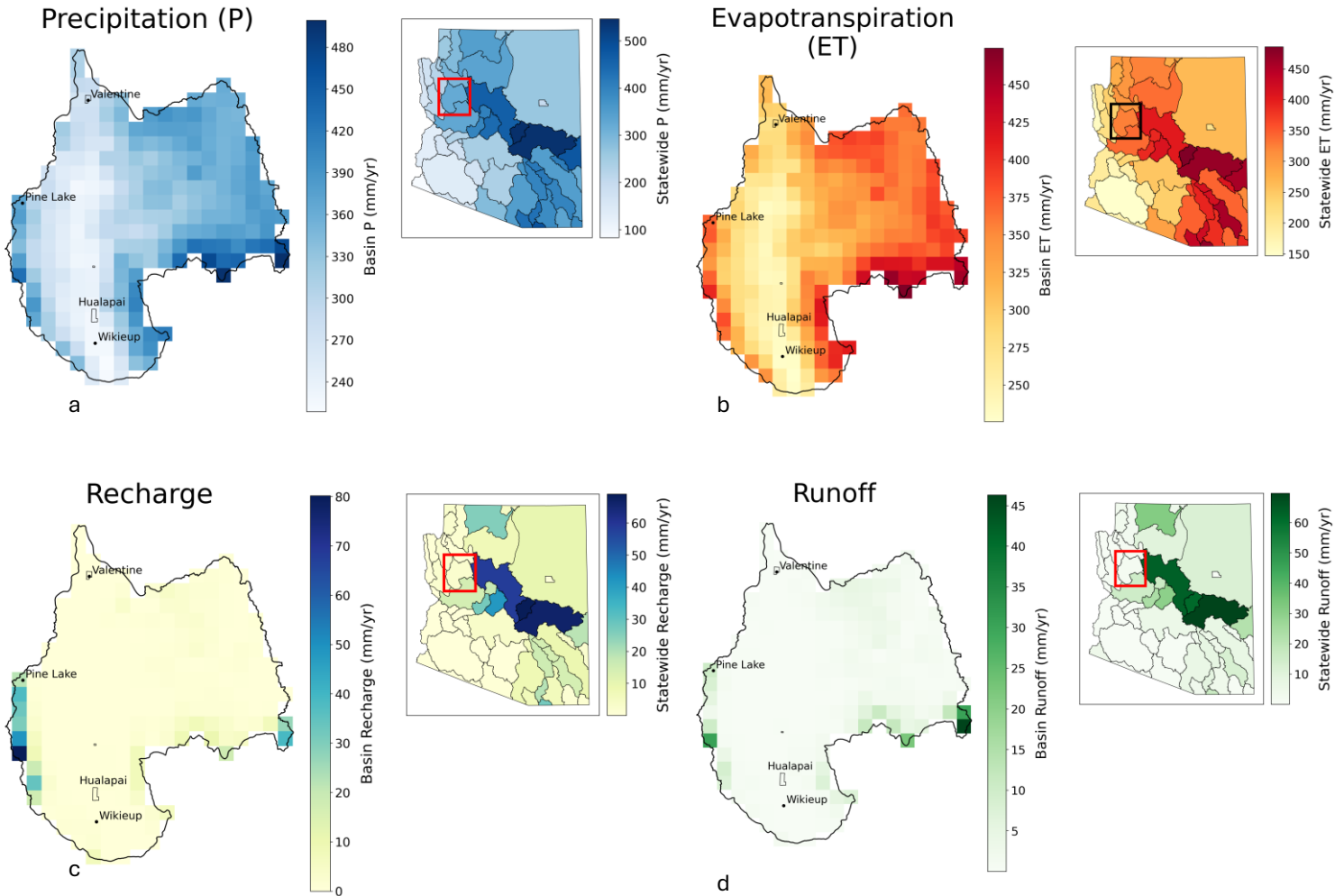
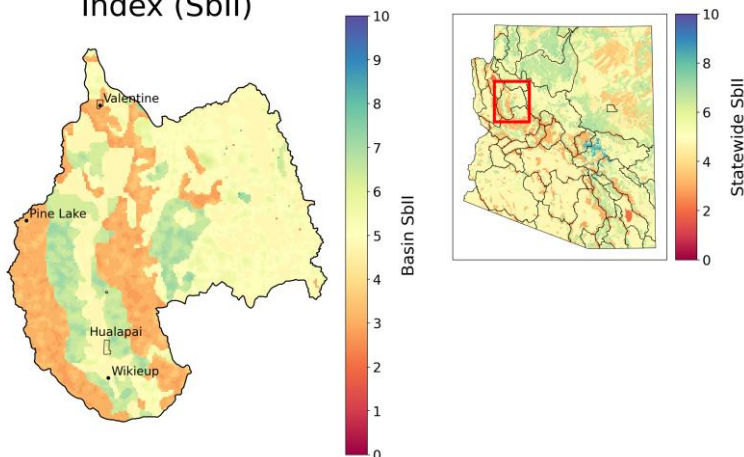


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.⁹

Subsurface Infiltration Index (SbII)



Precipitation (P) in the Big Sandy basin is greatest at the higher elevations, particularly in the Hualapai and Mohon Mountains where P can exceed 430 mm/yr on average. ET (~430 mm/yr), natural recharge (~60 mm/yr), and runoff (~30 mm/yr) are also highest in these regions. Infiltration potential varies across the basin. Areas with higher potential result from higher permeability soils in the alluvial fans at the mountain fronts to the east and west of the Big Sandy River.



Climate Change Projections: Changes in Temperature, Precipitation, ET, Recharge, and Runoff (2060-2099 vs. 1981-2020)

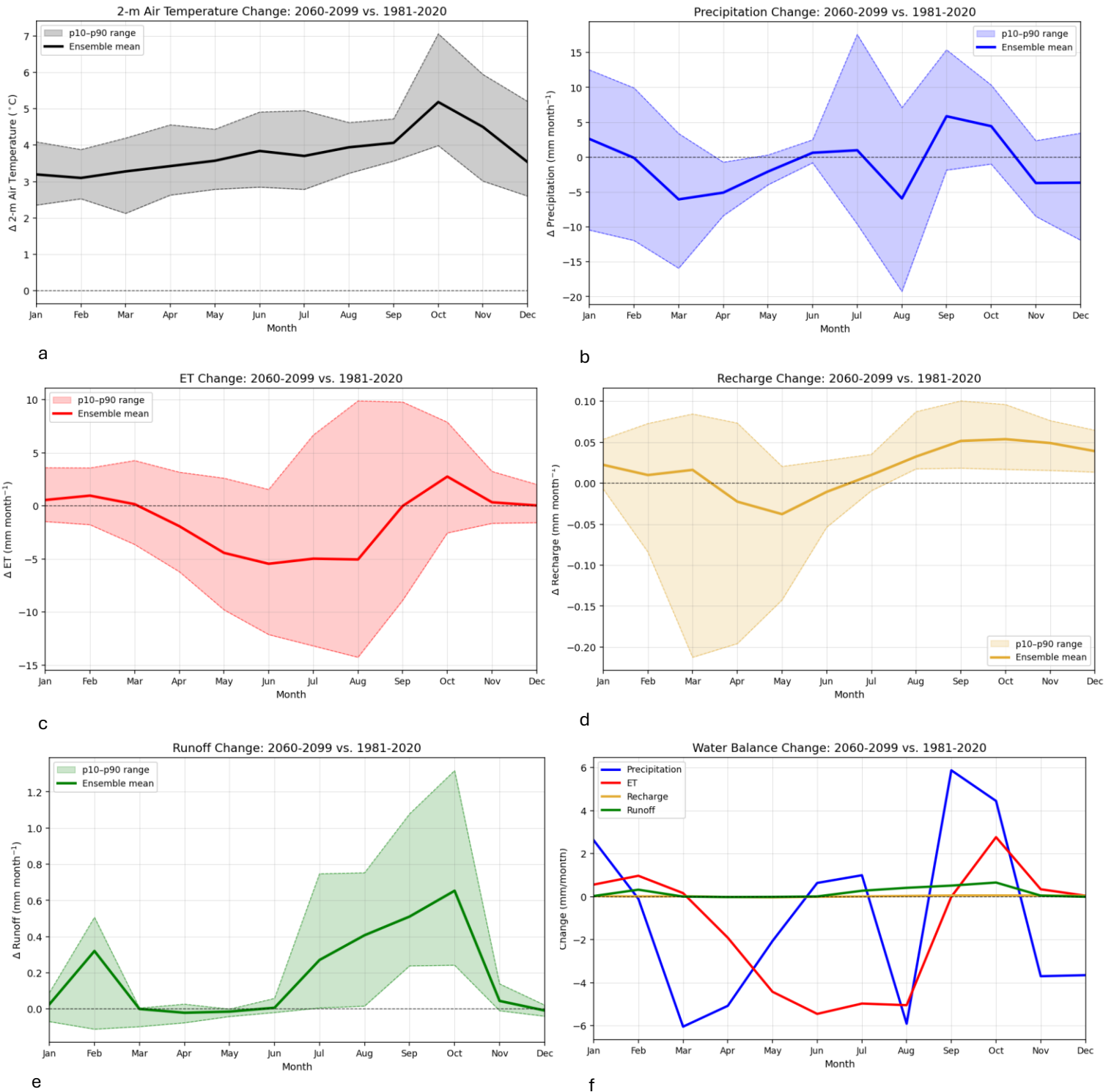


Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.¹⁰ Plot (f) shows the change in the water balance components (P, ET, recharge, and runoff) on a single graph for direct comparison. The analysis uses 14 dynamically downscaled global climate models (GCM) at 9-km resolution and the Noah-MP land surface model. The ensemble mean of the 14 GCMs is shown in bold for each component of the hydrologic cycle, with the 10-90th percentile shaded to show model projection uncertainty.



Climate change projections across the Big Sandy basin show drier springs (18-33% drier March through May), and a drier August (10%), November (17%), and December (13%). September and October are projected to be 19-20% (4.4-5.7 mm/month) wetter on average, which is consistent with a projected increase in extreme events associated with hurricane and tropical cyclone activity by the end of the century. Natural recharge is projected to remain near zero throughout the year and be slightly negative from May through February (-0.02 to -0.11 mm/month).^{*} While runoff is projected to remain below 0.9 mm/month, minor increases of 0.28-0.67 mm/month are projected for July-October. Projected increases in temperature range from approximately 3.1 °C in February to 5.2 °C in October. Less precipitation in August leads to a projected 9% (-4.9 mm) decrease in evapotranspiration (ET), while higher temperatures and greater water availability lead to a projected 13% (2.7 mm) increase in ET in October compared to the baseline period.

^{*}Projected negative recharge values are attributed to increased capillary rise from the aquifer through the vadose zone due to climate factors, resulting in water loss from the system. Because the Noah-MP model does not include groundwater pumping, this indicates that climate-driven factors play a significant role in groundwater storage decline in Arizona.

References

1. ADWR Groundwater Basin and Subbasin shapefiles. Retrieved from: <https://gisdata2016-11-18t150447874z-azwater.opendata.arcgis.com/>
2. USGS Digital Elevation Model data. Retrieved from: <https://apps.nationalmap.gov/downloader/>
3. Annual National Land Cover Database – Land Cover (2024). Retrieved from the Multi-Resolution Land Characteristics Consortium: <https://www.mrlc.gov/data>
4. USGS HUC8 Watersheds. Retrieved from: <https://hydro.nationalmap.gov/arcgis/rest/services/wbd/MapServer>
5. Mroczek, C., Springer, A. E., Gupta, N., Sankey, T., & Lucas, B. (2025). Regional base-flow index in arid landscapes using machine learning and instrumented records. *Journal of Hydrology: Regional Studies*, 62, 102778. <https://doi.org/10.1016/j.ejrh.2025.102778>
6. Gupta, A., Qiu, Y., Behrangi, A., & Niu, G. (2026). Noah-MP 40-Years Climatology for Water Balance over Ground Water Basins in Arizona, HydroShare, <http://www.hydroshare.org/resource/a3cc182071124849a463b6132213af23>. (Figures by Hinkley, M. & Mohsenzadeh Karimi, S.)
7. AZGeo City Points shapefile. Retrieved from AZGeo Data Hub: <https://azgeo-open-data-agic.hub.arcgis.com/datasets/azgeo::city-points/about>
8. Federal American Indian Reservation boundaries shapefile. Retrieved from: https://services2.arcgis.com/FiaPA4ga0iQKduv3/arcgis/rest/services/Federal_American_Indian_Reservations_v1/FeatureServer
9. Lima, R., Springer, A., Sankey, T. (2026). Arizona Subsurface Infiltration Index v.2, HydroShare, <https://doi.org/10.4211/hs.abcd8aa1a793463ab33677ce9d46db58>
10. Qiu, Y. (2026). Future Projection of Hydroclimate over Arizona Version 2, HydroShare, <https://doi.org/10.4211/hs.a5751f0af305483682501f79d9af0bd7>

