Supplementary Information

Widespread potential loss of streamflow into underlying aquifers across USA

Scott Jasechko [1*], Hansjörg Seybold [2*], Debra Perrone [3], Ying Fan [4], James W. Kirchner [2,5,6]

[1] Bren School of Environmental Science and Management, University of California, Santa Barbara, California, 93106, USA
[2] Department of Environmental System Sciences, ETH Zürich, Universitätstrasse 16, CH-8092, Switzerland
[3] Environmental Studies Program, University of California, Santa Barbara, California, 93106, USA
[4] Department of Earth and Planetary Sciences, Rutgers University, New Brunswick, New Jersey, 08854, USA
[5] Swiss Federal Research Institute WSL, Birmensdorf, CH-8903, Switzerland
[6] Department of Earth and Planetary Science, University of California, Berkeley, California, 94720, USA
[*] these authors contributed equally

Contents

S1. Compiled local-scale studies of aquifer-stream exchanges

1.1. Conceptual models derived from decades of local-scale studies

We reviewed 77 local-scale studies of interactions between rivers and aquifers (Supplementary Table 1).

Our compilation of local-scale studies exemplifies the wide spatial variability in gaining versus losing conditions across the contiguous United States. These field-based findings provide key insights and form the core of current conceptual models of aquifer-stream exchanges, which encompass the following three generalized conditions (see ref. [19]):

a) a gaining stream—where the water table overlies or intersects the stream, and groundwater flows into the stream;

b) a losing stream that is hydraulically connected to the aquifer—where the water table intersects the stream but streamwater seeps into the surrounding aquifer; or

c) a losing stream that is hydraulically disconnected to its underlying aquifer—where the water table lies below the stream and streambed infiltration rates are independent of water table elevations (see ref. [22] for discussion of disconnected conditions).

The great majority of these local-scale studies go beyond just identifying which condition (i.e., condition a), b) or c) above) characterizes a given stream, by quantifying spatiotemporal patterns of river-aquifer exchanges, evaluating physical characteristics that moderate rates of exchange between aquifers and rivers, and demonstrating how river-aquifer exchanges influence streamwater quality and ecosystem health.

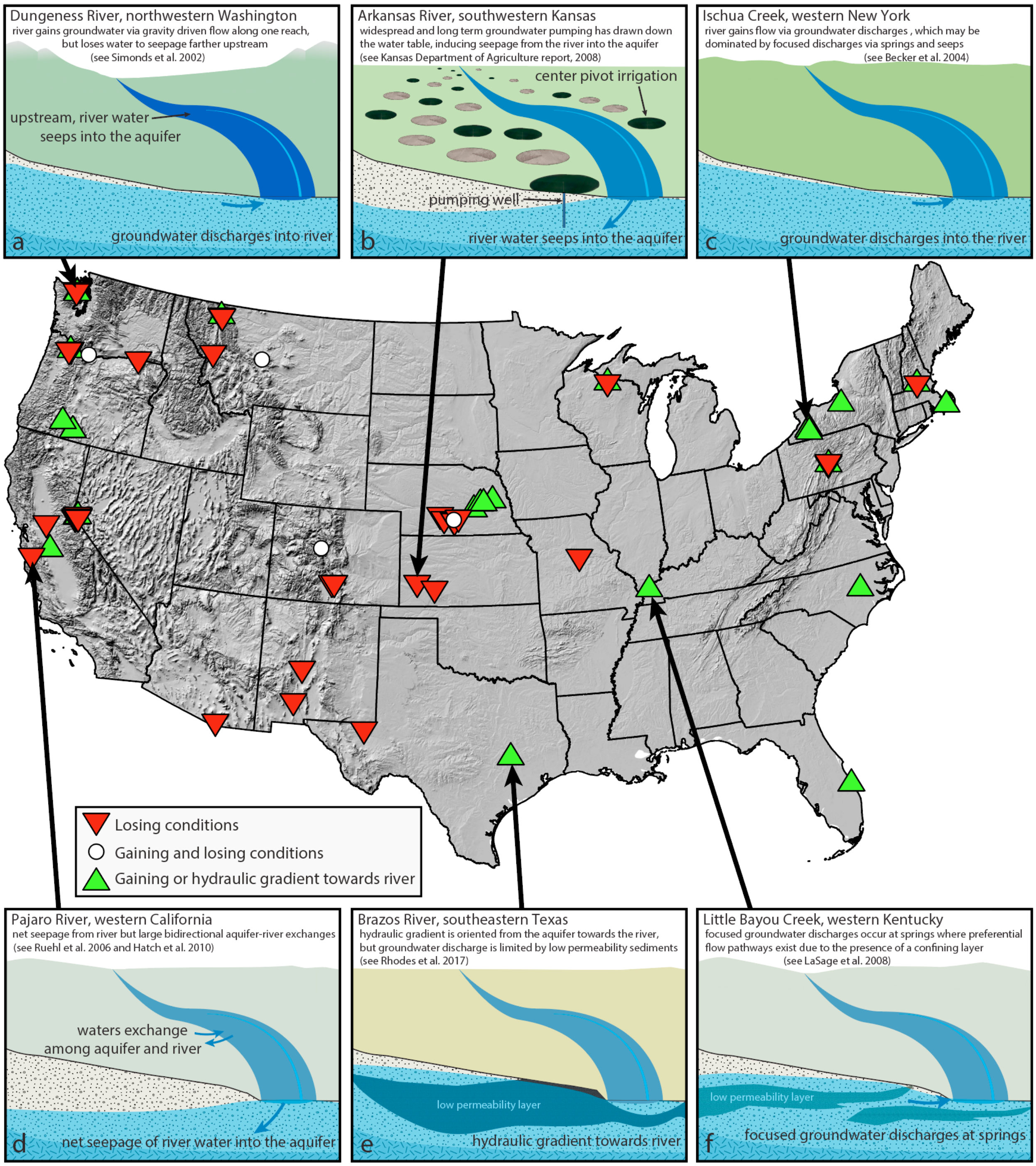
For example, local-scale studies highlight how certain stream reaches can lose water to aquifers during one time interval but gain water via groundwater discharges at other times (e.g., see ref. [44]). Changes in the directions of flow between aquifers and streams can arise in numerous ways, including "bank flow", where floodwaters infiltrate streambanks and cause normally losing stream reaches to temporarily gain flow instead, as floodwaters in streambanks seep back into the streams that they came from (e.g., see ref. [45]). Furthermore, the reviewed local-scale studies highlight how streams may switch from gaining conditions along one stretch to losing conditions farther downstream (and vice versa; Supplementary Figure 1a).

Six conceptual models presented in Supplementary Figure 1 demonstrate:

a) how some streams switch from losing along one reach to gaining farther downstream, and vice versa (see ref. [46]) – Supplementary Figure 1a;
b) how groundwater withdrawals from wells near streams can reduce groundwater storage and create a hydraulic gradient from the stream into the underlying aquifer (see ref. [47]) – Supplementary Figure 1b;
c) how groundwater can flow into streams to augment streamflow (see ref. [48]) – Supplementary Figure 1c;

d) how even in net-losing streams, large bidirectional exchanges occur between streams and groundwaters (see refs. [49,50]) – Supplementary Figure 1d;
e) how low-permeability sediments can impede groundwater influxes to streams, even where the water table adjacent to the stream overlies the stream surface, creating a hydraulic gradient from the aquifer to the stream (see ref. [21]) – Supplementary Figure 1e;
f) how permeable layers of rock and/or sediment near streams can lead to spatially focused groundwater discharges at springs (see refs. [15,51]) – Supplementary Figure 1f;

These local-scale studies are highly relevant to conceptualizing aquifer-stream exchanges in areas beyond just the locations that have been studied. Yet because of the necessarily limited spatial extent of local-scale studies, we lack sufficient observations to evaluate local-scale river-aquifer exchanges for the majority of river reaches. This motivates the first objective of our study: to use field observations of the local relationships between streams and their aquifers to evaluate the prevalence and spatial distribution of gaining versus losing streams across the contiguous United States.



Supplementary Figure 1. Local-scale studies of water fluxes between rivers and aquifers (references in Supplementary Table 1). Red triangles represent local-scale studies that describe locations where streamwater infiltrates into the streambed (i.e., 'losing' conditions). Green triangles represent locations where either (i) a hydraulic gradient from the aquifer to the stream was documented, or (ii) seepage of groundwater into the stream was documented (i.e., 'gaining' conditions). White circles represent local-scale studies where it was unclear whether gaining or losing conditions dominated. Panels (a-f) depict conceptual models for specific… *[caption continues on next page]*

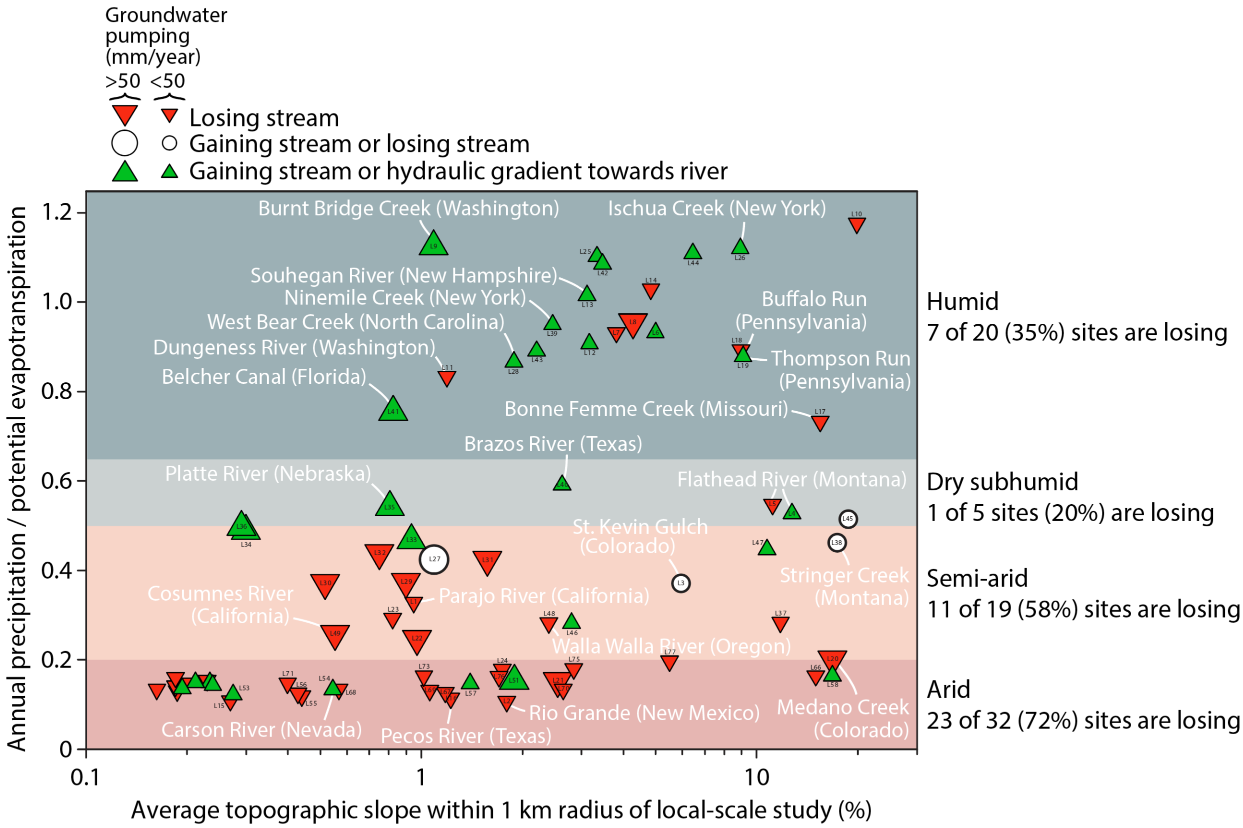
[continuation of caption on previous page] …local-scale studies based on primary references linked to each local-scale study. Specifically, the six conceptual models show (a) how a single stream may switch from losing along one reach to gaining farther downstream (see ref. [46]); (b) how groundwater pumping can lower the water table, creating a hydraulic gradient from the stream into the underlying aquifer (see ref. [47]); (c) how gravity-driven groundwater flow from the aquifer into the stream can increase streamflow (see ref. [48]); (d) how large bidirectional exchanges of water between a stream and the surrounding aquifer can occur even along a stream where a hydraulic gradient exists from the stream to the aquifer, leading to net losing conditions in the stream (see refs. [49,50]); (e) how low-permeability geologic features in the aquifer surrounding a stream can limit groundwater flow into the stream, even where a strong hydraulic gradient exists from the aquifer towards the stream (see ref. [21]); (f) how geologic features in the aquifer near the stream can lead to preferential flows through more permeable conduits, leading to spatially focused groundwater discharges at springs (see refs. [15,51]). For complete references see Supplementary Table 1.

1.2. Aquifer-stream net hydraulic gradients at local-scale study sites, compared to climate conditions, topographic slopes and groundwater withdrawals

To explore the compiled local-scale studies further, we evaluated topographic slopes and climate conditions near each local-scale study. Specifically, we calculated the average topographic slope within 1 km of each local-scale study (see, for example, the circular areas with 1 km radii in the maps presented in Supplementary Table 2) and determined the ratio of annual precipitation to annual potential evapotranspiration (i.e., P/PET) at each local-scale study location (Supplementary Figure 2). We also report, for each local-scale study, its county's estimated annual groundwater withdrawal rate (normalized by county area; data are for the year 2015, from ref. [32]).

The ratio P/PET—annual precipitation divided by annual potential evapotranspiration—is higher in more humid climates and lower in more arid climates. This ratio has been referred to as the climatic aridity index in some studies (e.g., *"… climatic aridity index (ratio of precipitation to PET)…"* quoting ref. [52]) but also has been called the humidity index in others (e.g., *"The Global Humidity Index is based on a ratio of annual precipitation and potential evapotranspiration*" quote from NASA web page (accessed June 24, 2020) https://cmr.earthdata.nasa.gov/search/concepts/C1214599924-SCIOPS). In an attempt to limit confusion, we do not use either term—aridity index or humidity index—in the main text. Instead, we refer to this variable as "precipitation divided by potential evapotranspiration" or "P/PET" in our work (e.g., Figure 4 in the main text).

Topographic slopes and P/PET values at the sites of local-scale studies suggest that losing stream reaches may be more common in locations with drier climates and flatter topographic slopes, whereas gaining streams may be more common in locations with wetter climates and steeper terrain (Supplementary Figure 2). However, these local-scale studies represent only a small fraction of streams across America (see the large spatial gaps between local-scale studies in Supplementary Figure 1). The limited coverage of local-scale studies motivates an analysis of observational data across the continental US to better understand the spatial distributions of aquifer-stream exchanges. Specifically, our review of dozens of local-scale studies (Supplementary Figure 2) motivates the second objective of our analysis: to measure the local relationships between streams and their aquifers to test the hypothesis that losing streams are more prevalent in more arid climates, in flatter landscapes, and in regions with greater groundwater pumping.



Supplementary Figure 2. Groundwater withdrawals, topographic gradients, and precipitation divided by potential evapotranspiration at the locations of our compiled local-scale studies. Each point represents one compiled local-scale study. Red downward-oriented triangles represent local-scale studies where the study reach has been identified as losing. Green upward-oriented triangles represent local-scale studies where the study reach has been described as gaining (i.e., receiving groundwater influxes) or where a hydraulic gradient from the aquifer to the river has been identified (see ref. [21]). White circles represent local-scale studies where the study reach could not be clearly defined as gaining or losing (e.g., gaining on one streambank but losing on the other). Background shades represent different climatic aridity classifications, ranging from arid (light red shading) to humid (greenish-blue shading). Losing reaches tend to be more common in arid and flatter regions; gaining reaches tend to be more common in steep and humid areas. However, we note that both gaining and losing reaches have been identified in many regions, and no one type of stream – i.e., gaining or losing – encompasses all reaches in any one part of the climate-topography space plotted here. Local-scale studies in counties where annual groundwater withdrawals (normalized to county area) exceed 50 mm/year (as of 2015) are presented as larger points; local-scale studies in counties with less than 50 mm/year of groundwater withdrawals are presented as smaller points (annual groundwater withdrawal estimates provided by ref. [32]).

Supplementary Table 1. Local-scale studies of water fluxes between streams and their surrounding aquifers. The rightmost column identifies the local-scale studies for which we have sufficient nearby well water level observations to compare our findings against the results of the local-scale study. These comparisons—local-scale studies compiled from the primary literature versus well water level observations analyzed in this study—are presented in Supplementary Section S2.

#	River	Latitude	Longitude	Status	Methods	Reference(s)	Included in Supplement. Table 2?
L1	Pajaro River	36.91	-121.68	Losing	Stream gauging and tracer tests	Refs. [49,50]	Yes
L2	Rio Grande	34.13	-106.88	Losing	Cross-river groundwater level and river stage monitoring (range of well depths is 5 m-25.6 m)	Ref. [53]	Yes
L3	St. Kevin Gulch	39.27	-106.34	Gaining and losing reaches	Tracer test (first paper); model + piezometric measurements + tracer test for second paper	Refs. [54,55]	Yes
L4	Flathead River	48.49	-113.84	Gaining	Piezometric measurements	Ref. [56]	No‡
L5	Flathead River	48.44	-113.80	Losing	Piezometric measurements	Ref. [56]	No‡
L6	Allequash Wetland	46.03	-89.60	Gaining	Distributed Temperature Sensor (DTS)	Ref. [57]	No‡
L7	Allequash Wetland	46.03	-89.61	Losing	Distributed Temperature Sensor (DTS)	Ref. [57]	No‡
L8	Burnt Bridge Creek	45.63	-122.62	Losing	Seepage assessments	Ref. [58]	Yes
L9	Burnt Bridge Creek	45.66	-122.52	Gaining	Seepage assessments	Ref. [58]	No (30 m hydrography does not include this study reach)
L10	Dungeness River *	48.03	-123.14	Losing	Instream piezometers, temperature monitoring, seepage runs	Ref. [46]	Yes
L11	Dungeness River *	48.10	-123.15	Losing	Instream piezometers, temperature monitoring, seepage runs	Ref. [46]	Yes
L12	Dungeness River *	48.07	-123.15	Gaining	Instream piezometers, temperature monitoring, seepage runs	Ref. [46]	Yes
L13	Souhegan River	42.85	-71.68	Gaining	Differential gauging	Ref. [59]	No‡
L14	Souhegan River	42.84	-71.70	Losing	Differential gauging	Ref. [59]	Yes
L15	Rio Grande	32.68	-107.20	Losing	Piezometric and streamflow time series	Ref. [60]	Yes
L16	Pecos River	31.70	-103.62	Losing	Piezometric and stream stage measurements	Ref. [61]	No‡
L17	Bonne Femme Creek	38.84	-92.30	Losing	Temperature measurements	Ref. [62]	No‡
L18	Buffalo Run	40.85	-77.89	Losing	Temperature measurements	Ref. [63]	Yes
L19	Thompson Run	40.81	-77.84	Gaining	Temperature measurements	Ref. [63]	No‡
L20	Medano Creek	37.78	-105.51	Losing	Streamflow and groundwater level monitoring	Ref. [64]	No‡

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#	River	Latitude	Longitude	Status	Methods	Reference(s)	Included in Supplement. Table 2?
L21	Sand Creek	37.82	-105.63	Losing	Streamflow and groundwater level monitoring	Ref. [64]	Yes
L22	Arkansas River (west Kansas)	37.99	-101.08	Losing	Streamflow monitoring	Ref. [47]	Yes
L23	Arkansas River (central Kansas)	37.76	-100.15	Losing	Streamflow monitoring	Ref. [47]	Yes
L24	Upper Santa Cruz River **	31.46	-110.98	Losing	Piezometers, seepage pans, hydrochemical measurements	Ref. [65]	Yes**
L25	Ischua Creek ***	42.41	-78.49	Gaining	Differential streamflow, temperature measurements	Ref. [48]	Yes
L26	Ischua Creek ***	42.33	-78.47	Gaining	Differential streamflow, temperature measurements	Ref. [48]	Yes
L27	Platte River	40.66	-99.09	Gaining and losing (different sides of the river)	Groundwater monitoring, modelling	Ref. [66]	Yes
L28	West Bear Creek	35.36	-77.85	Gaining	Piezometric measurements	Ref. [67]	No[ǂ]
L29	Platte River ****	40.69	-99.62	Losing	Unclear	Ref. [68]	No[ǂ]
L30	Spring Creek ****	40.85	-99.82	Losing	Unclear	Ref. [68]	Yes
L31	Lost Creek ****	40.60	-99.07	Losing	Unclear	Ref. [68]	Yes
L32	Wood River ****	40.75	-98.85	Losing	Unclear	Ref. [68]	Yes
L33	Platte River ****	41.10	-97.96	Gaining	Model	Ref. [68]	Yes
L34	Platte River ****	41.34	-97.59	Gaining	Model	Ref. [68]	Yes
L35	Platte River ****	41.46	-96.89	Gaining	Model	Ref. [68]	Yes
L36	Clear Creek ****	41.35	-97.41	Gaining	Temperature and hydraulic head measurements	Ref. [69]	No[ǂ]
L37	Clark Fork *****	46.88	-113.91	Losing*	Piezometric measurements and model	Ref. [70]	No[ǂ]

Supplementary Table 1. Local-scale studies of water fluxes between streams and their surrounding aquifers. The rightmost column identifies the local-scale studies for which we have sufficient nearby well water level observations to compare our findings against the results of the local-scale study. These comparisons—local-scale studies compiled from the primary literature versus well water level observations analyzed in this study—are presented in Supplementary Section S2.

#	River	Latitude	Longitude	Status	Methods	Reference(s)	Included in Supplement. Table 2?
L38	Stringer Creek	46.93	-110.89	Gaining and losing concurrently	Tracer tests	Ref. [71]	No[‡]
L39	Ninemile Creek	43.08	-76.25	Gaining	Dye dilution gauging, acoustic Doppler velocimeter (ADV) differential gauging, and geochemical end-member mixing" and distributed temperature sensing	Refs. [72,73]	No[‡]
L40	Brazos River	30.56	-96.42	Hydraulic gradient from aquifer to river	Piezometric measurements	Ref. [21]	No[‡]
L41	Belcher Canal [X]	27.47	-80.35	Gaining	^{222}Rn	Ref. [74]	No[‡]
L42	Quashnet River	41.60	-70.50	Gaining	Distributed temperature sensors, seepage meters	Ref. [75]	Yes
L43	Little Bayou Creek	37.15	-88.79	Gaining	Stream- and spring-flow measurements, spring temperature measurements, temperature profiling along the stream-bed, and geologic mapping	Refs. [15,51]	Yes
L44	Elton Creek	42.45	-78.44	Gaining	Piezometric measurements	Refs. [76,77]	Yes
L45	Mosier Creek	45.67	-121.38	Gaining and losing	Well water levels	Ref. [78]	Yes
L46	Sprague River	42.45	-121.15	Gaining	Well water levels	Ref. [79]	No[‡]
L47	Williamson River	42.72	-121.83	Gaining	Well water levels	Ref. [79]	No[‡]
L48	Walla Walla River	45.99	-118.38	Losing	Distributed temperature sensors, piezometers	Ref. [80]	Yes
L49	Cosumnes River	38.38	-121.32	Losing	Model output, well water levels	Ref. [5]	No[‡]
L50	Juday Creek	couldn't identify from publication[T]	couldn't identify from publication [T]	Gaining and losing reaches	Stream and sediment temperature measurements; groundwater level measurements	Ref. [81]	No (could not locate study site)

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#	River	Latitude	Longitude	Status	Methods	Reference(s)	Included in Supplement. Table 2?
L51	Merced River	37.39	-120.80	Gaining	Groundwater levels	Ref. [82]	Yes
L52	Carson River (West Fork)	38.97	-119.82	Gaining	Streambed temperature measurements	Ref. [83]	No‡
L53	Carson River	39.05	-119.78	Gaining	Streambed temperature measurements	Ref. [83]	Yes
L54	Carson River	39.03	-119.82	Gaining	Streambed temperature measurements	Ref. [83]	No‡
L55	Heyburn Ditch	39.03	-119.76	Losing	Streambed temperature measurements	Ref. [83]	Yes
L56	Heyburn Ditch	39.00	-119.76	Losing	Streambed temperature measurements	Ref. [83]	No (30 m hydrography does not include this study reach)
L57	Unnamed Ditch	39.00	-119.83	Gaining	Streambed temperature measurements	Ref. [83]	Yes
L58	Unnamed Ditch	38.97	-119.84	Gaining	Streambed temperature measurements	Ref. [83]	No‡
L59	West Fork Carson River	38.97	-119.82	Gaining	Streambed temperature measurements	Ref. [83]	No‡
L60	Unnamed Ditch	38.97	-119.81	Gaining	Streambed temperature measurements	Ref. [83]	No (30 m hydrography does not include this study reach)
L61	Unnamed Ditch	38.97	-119.80	Gaining	Streambed temperature measurements	Ref. [83]	No (30 m hydrography does not include this study reach)
L62	Williams Slough	39.00	-119.81	Losing	Streambed temperature measurements	Ref. [83]	No‡
L63	Unnamed Ditch	39.00	-119.81	Losing	Streambed temperature measurements	Ref. [83]	No‡
L64	Carson River	39.00	-119.82	Losing	Streambed temperature measurements	Ref. [83]	No‡
L65	Unnamed Ditch	38.98	-119.82	Losing	Streambed temperature measurements	Ref. [83]	No‡
L66	Brockliss Slough	38.97	-119.84	Losing	Streambed temperature measurements	Ref. [83]	Yes
L67	Buckeye Creek	38.96	-119.73	Losing	Streambed temperature measurements	Ref. [83]	Yes
L68	Martin Slough	38.95	-119.75	Losing	Streambed temperature measurements	Ref. [83]	Yes
L69	Virginia Ditch	38.94	-119.72	Losing	Streambed temperature measurements	Ref. [83]	No (30 m hydrography does not include this study reach)
L70	Allerman Canal	38.91	-119.70	Losing	Streambed temperature measurements	Ref. [83]	No (30 m hydrography does not include this study reach)

Supplementary Table 1. Local-scale studies of water fluxes between streams and their surrounding aquifers. The rightmost column identifies the local-scale studies for which we have sufficient nearby well water level observations to compare our findings against the results of the local-scale study. These comparisons—local-scale studies compiled from the primary literature versus well water level observations analyzed in this study—are presented in Supplementary Section S2.

#	River	Latitude	Longitude	Status	Methods	Reference(s)	Included in Supplement. Table 2?
L71	Henningson Slough	38.93	-119.78	Losing	Streambed temperature measurements	Ref. [83]	Yes
L72	Brockliss Slough	38.93	-119.81	Losing	Streambed temperature measurements	Ref. [83]	Yes
L73	Big Ditch	38.93	-119.82	Losing	Streambed temperature measurements	Ref. [83]	No (30 m hydrography does not include this study reach)
L74	Brockliss Slough	38.91	-119.81	Losing	Streambed temperature measurements	Ref. [83]	Yes
L75	Fredericksburg Ditch	38.87	-119.79	Losing	Streambed temperature measurements	Ref. [83]	Yes
L76	Carson River	38.87	-119.76	Losing	Streambed temperature measurements	Ref. [83]	Yes
L77	Fredericksburg Ditch	38.82	-119.78	Losing	Streambed temperature measurements	Ref. [83]	No (30 m hydrography does not include this study reach)

* reaches 4 and 5 not shown as they include alternating gaining and losing segments
** study encompasses more than 31 km of river; possibly some time intervals when stream gains
*** compiled only for reaches 1-2 and 2-3, as reaches 3-4 and 4-5 show both gaining and losing conditions (see Fig. 2 in ref. [48])
**** locations digitized on the basis of Fig. 1, but are highly uncertain due to the small scale (i.e., zoomed out) perspective of the map in Fig. 1 of ref. [68]
***** major dam was removed just upstream of the study area in 2008
[x] unclear exactly where along the canal the study's findings indicate groundwater discharges
[‡] fewer than two wells in the immediate vicinity of the study area that are closer to the study river than any other river
[T] not included in Supplementary Figures

S2. Comparison of well water levels and local-scale study results

Here we compare:

- (a) local-scale studies that identify gaining versus losing streams, as compiled in Supplementary Section S1 (see Supplementary Table 1 and Supplementary Figure 1)

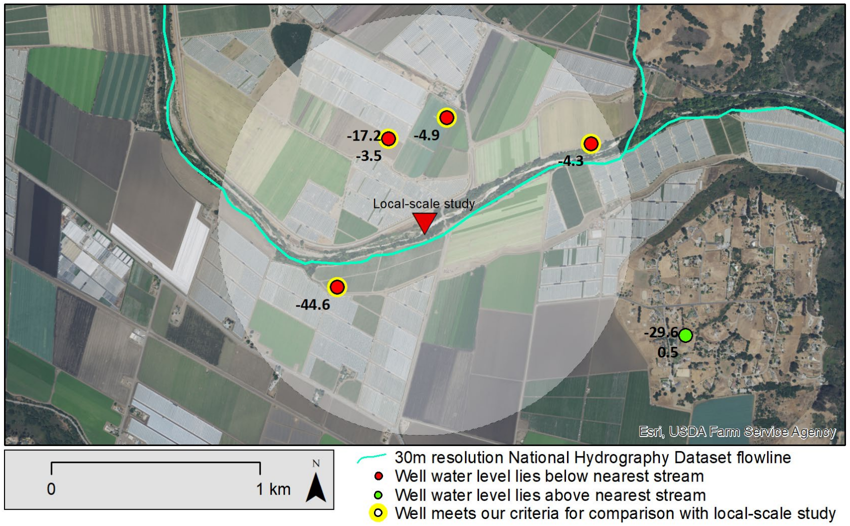
  versus

- (b) well water level observations—specifically: [median well water elevation] minus [elevation of nearest point on the nearest stream] plus [estimated height of riverbank]. The *median well water level elevation* is determined as: *land surface elevation at a well location* (from ref. [29]) minus *depth below the ground surface to water in a well*; where more than one well water level observation was available for a given well, the median was calculated and applied in our comparison.

We only compare local-scale studies against well water levels if at least two wells with water level measurements meet the following criteria: (i) well is within one kilometer of the local-scale study, (ii) well is closer to the local-scale study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and (iii) well has a total well depth that is no more than 100 m. The wells meeting these criteria are displayed with a yellow background in the map figures accompanying our detailed examinations of each local-scale study (see Supplementary Table 2 maps; imagery derived from https://www.arcgis.com/home/item.html?id=3f8d2d3828f24c00ae279db4af26d566 with National Agriculture Imagery Program data sourced from https://registry.opendata.aws/naip/). Our comparison of local-scale study findings against results from our well water level analyses is detailed in Supplementary Figure 3 and Supplementary Tables 3-4.

Supplementary Table 2. Well water levels near local-scale river-aquifer exchange studies

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L1</td><td>Pajaro River</td><td>California</td><td>east of Watsonville, California</td><td>Losing</td><td>Stream gauging and tracer tests</td><td>Refs. [49,50]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

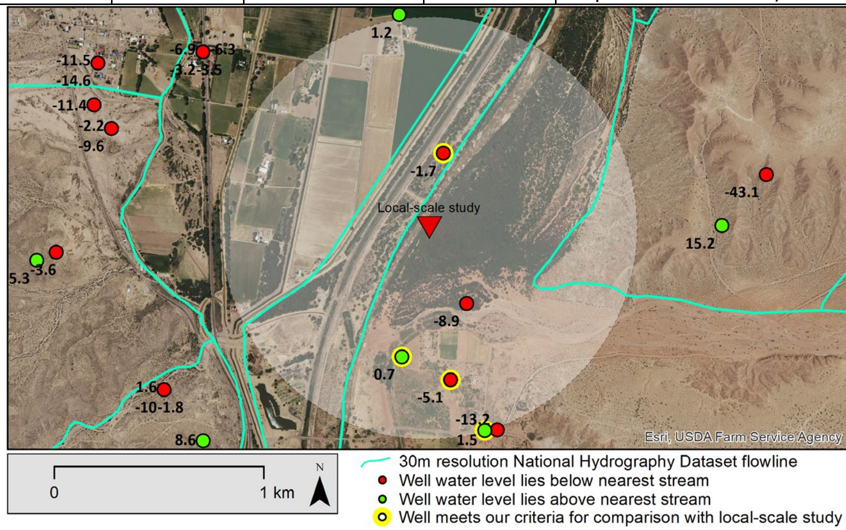


Pajaro River (i.e, local-scale study L1) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Tertiary- to Holocene-aged unconsolidated or semi-consolidated clastic sedimentary formations. Holocene alluvium is underlain by a confining layer that separates it from the underlying Aromas Formation (see Fig. 2b in ref. [49]), which is comprised of clastic sedimentary materials (clay, silt, sand and gravel sized particles). Groundwater is extracted “mainly from the alluvial and underlying Aromas aquifers” (quote ref. [49]). The Pliocene-aged Purisima Formation underlies the Aromas. Granodiorite forms the geologic basement; the boundary between these endogenous rocks and the overlying sediments exists hundreds of meters beneath the land surface.

5 of 5 wells (100%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

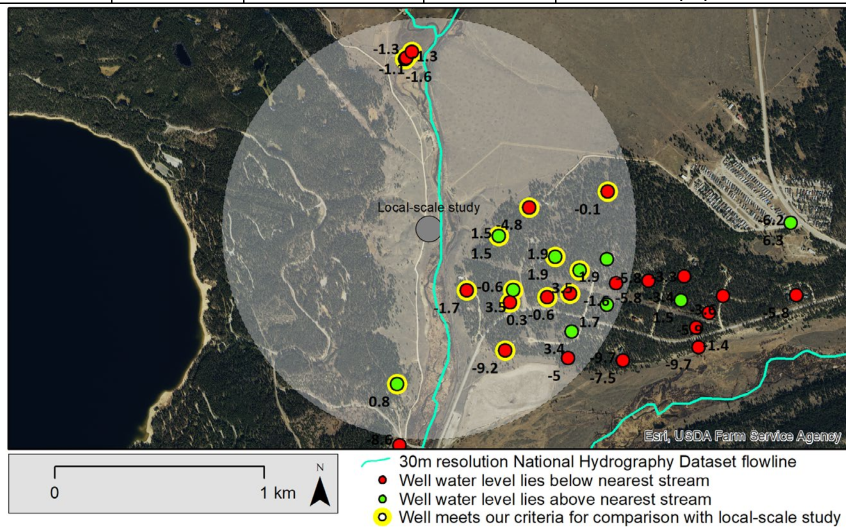
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L2</td><td>Rio Grande</td><td>New Mexico</td><td>near Socorro, New Mexico</td><td>Losing</td><td>Cross-river groundwater level and river stage monitoring (range of well depths is 5 m-25.6 m)</td><td>Ref. [53]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

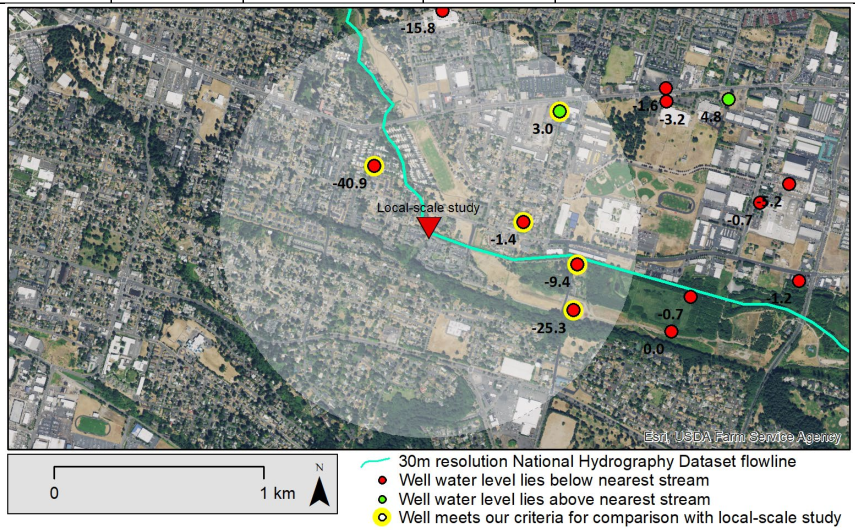


Rio Grande (i.e, local-scale study L2) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Unconsolidated alluvial deposits surround the Rio Grande. These deposits include clay-, silt- and sand-sized particles, with some local gravel-dominated lenses.

n=2 of n=4 wells (50%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L3	St. Kevin Gulch	Colorado	northwest of Leadville, Colorado	Gaining and losing reaches	Tracer test (first paper); model + piezometric measurements + tracer test for second paper	Ref. [54,55]
30 m DEM and hydro-graphy	 **St. Kevin Gulch (i.e, local-scale study L3) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The grey circle is the location (sometimes approximate) of a local-scale study (see reference above) where it was unclear whether gaining or losing conditions dominate.					**Local geology (based on reference(s) above):** Alluvium that "extends 5 m laterally on either side of the stream and is approximately 2 m in depth. The alluvium is composed of a large fraction of sand and fine gravel in the size range between 0.5 and 5 mm with pebbles and cobbles interspersed throughout." (quote from ref. [55]). Underlying bedrock is endogenous (schist, gneiss; ref. [55]). **n=11 of n=19 wells (58%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L8</td><td>Burnt Bridge Creek</td><td>Washington</td><td>near east 18th Street</td><td>Losing</td><td>Seepage assessments</td><td>Ref. [58]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">


Burnt Bridge Creek (i.e, local-scale study L8) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.
</td><td>Local geology (based on reference(s) above): Fluvial sediments ("..up to 800+ feet" thick – quoting ref. [58]); these sediments are underlain by volcanic rocks (e.g., basalt) of Eocene to Miocene age. Local deposit is known as the Sandy River Mudstone, and is comprised of claystone and sandstone. Near the study site, this Sandy River Mudstone deposit is overlain by coarse-grained cemented gravels, conglomerate and sandstone (the "Troutdale Formation"), which forms a regional aquifer.

n=4 of n=5 wells (80%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
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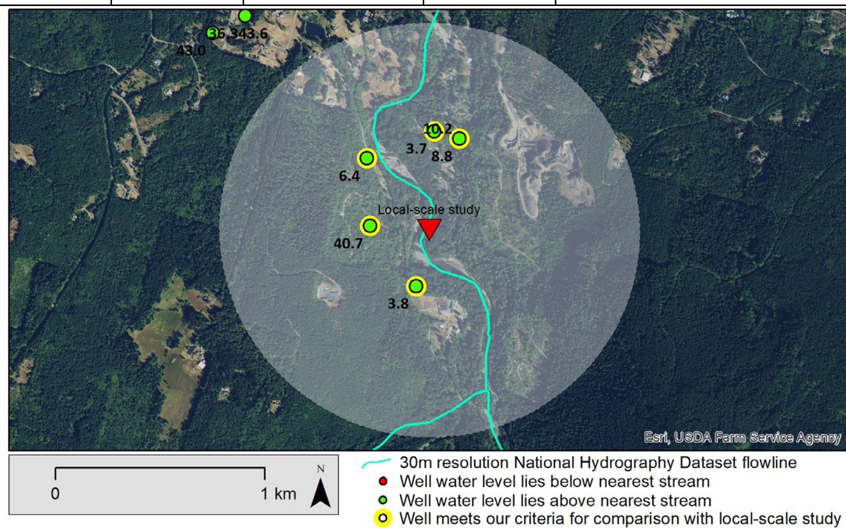
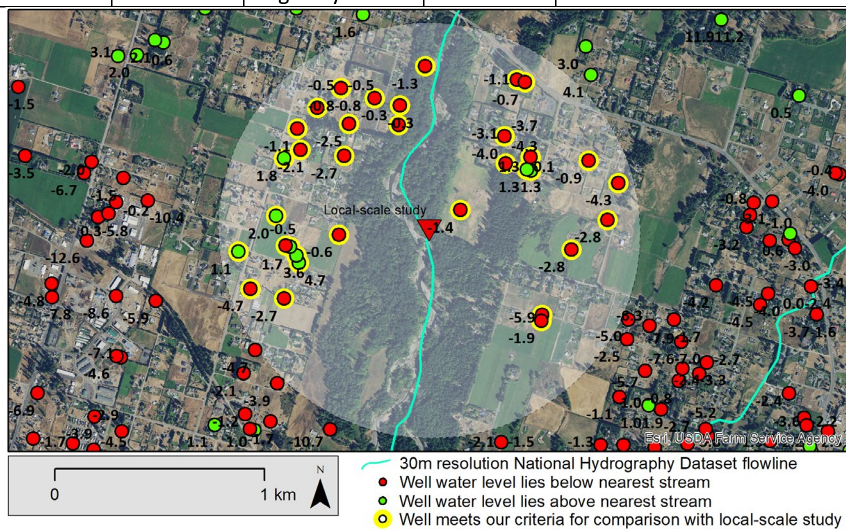
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L10</td><td>Dungeness River</td><td>Washington</td><td>Reach 1: USGS stream gauging station to Dungeness Meadows</td><td>Losing</td><td>Instream piezometers, temperature monitoring, seepage runs</td><td>Ref. [46]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



Dungeness River (i.e, local-scale study L10) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Alluvium dominates the river corridor. These fluvial deposits are underlain by alternating sedimentary layers deposited during Pleistocene glacial and interglacial time periods. This study (ref. [46]) identifies three aquifer units and two confining layers. The aquifers are comprised of sand and gravels, whereas the confining units are dominated by silts and clays. Bedrock in the headwaters of the study area is dominated by volcanic rocks and sedimentary rocks that make up the Olympic Mountains (ref. [46]).

n=0 of n=6 wells (0%) are indicative of losing stream conditions*

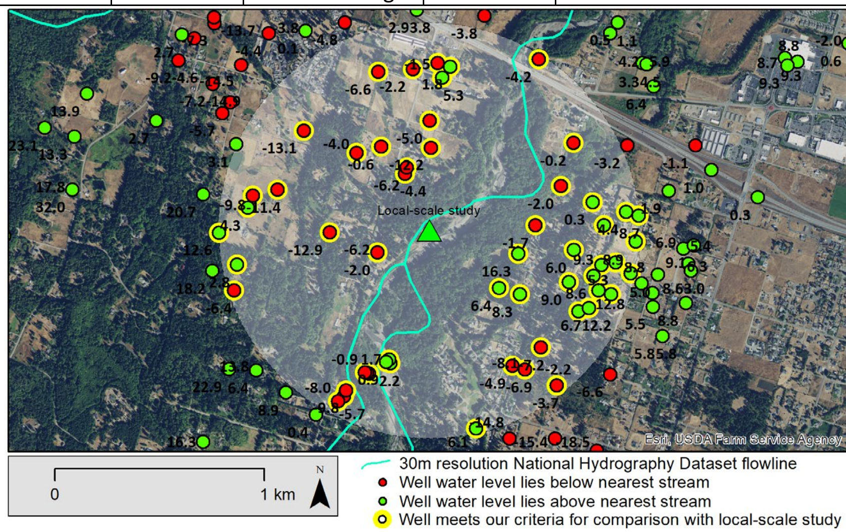
*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

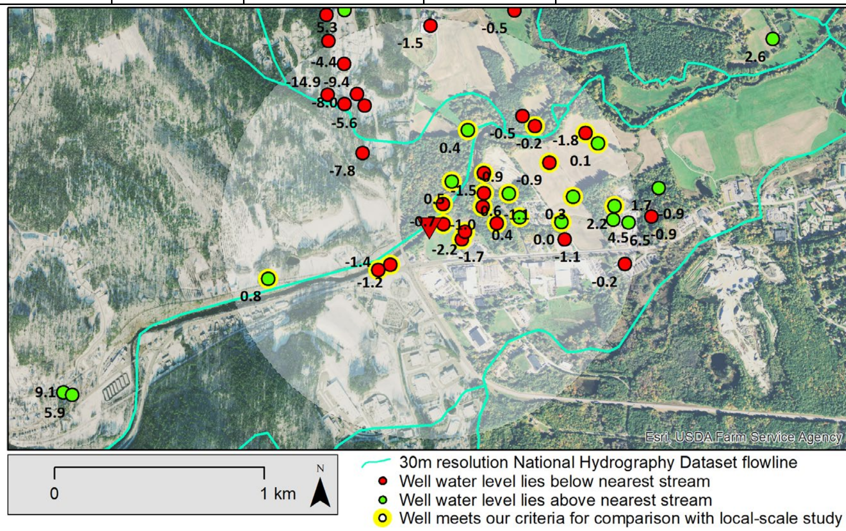
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L11</td><td>Dungeness River</td><td>Washington</td><td>Reach 3: Dungeness at Railroad Bridge to Dungeness at Old Olympic Highway</td><td>Losing</td><td>Instream piezometers, temperature monitoring, seepage runs</td><td>Ref. [46]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

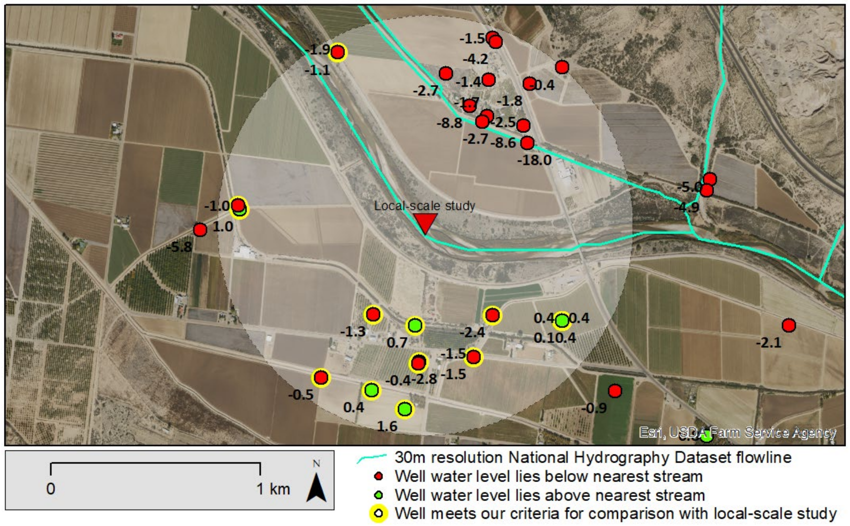
Dungeness River (i.e, local-scale study L11) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Alluvium dominates the river corridor. These fluvial deposits are underlain by alternating sedimentary layers deposited during Pleistocene glacial and interglacial time periods. This study (ref. [46]) identifies three aquifer units and two confining layers. The aquifers are comprised of sand and gravels, whereas the confining units are dominated by silts and clays. Bedrock in the headwaters of the study area is dominated by volcanic rocks and sedimentary rocks that make up the Olympic Mountains (ref. [46]).

n=34 of n=46 wells (74%) are indicative of losing stream conditions*

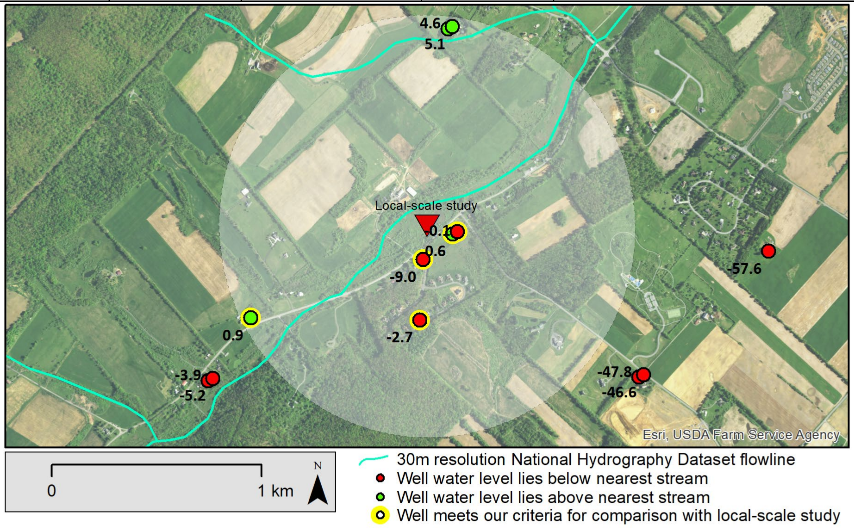
*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L12	Dungeness River	Washington	Reach 2: Dungeness Meadows to Dungeness at Railroad Bridge	Gaining	Instream piezometers, temperature monitoring, seepage runs	Ref. [46]
30 m DEM and hydro-graphy	 **Dungeness River (i.e, local-scale study L12) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Alluvium dominates the river corridor. These fluvial deposits are underlain by alternating sedimentary layers deposited during Pleistocene glacial and interglacial time periods. This study (ref. [46]) identifies three aquifer units and two confining layers. The aquifers are comprised of sand and gravels, whereas the confining units are dominated by silts and clays. Bedrock in the headwaters of the study area is dominated by volcanic rocks and sedimentary rocks that make up the Olympic Mountains (ref. [46]). **n=14 of n=36 wells (39%) are indicative of losing stream conditions*** [x] *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m. [x] *we only analyzed wells for which the closest National Hydrography Dataset flowline to the well is downstream of (i.e., north of) the confluence of the two channels located just south of the local-scale study (i.e., just south of the green triangle on the map)*

#	River	State	Site	Status	Methods	Reference
L14	Souhegan River	New Hampshire	Upstream reach	Losing	Differential gauging	Ref. [59]
30 m DEM and hydro-graphy	 **Souhegan River (i.e, local-scale study L14) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Unconsolidated sediments (*Milford-Souhegan* glacial deposits) comprised of recent deposits and glacial drift. Units identified as aquifers contain sands and gravels with some till (ref. [59]). **n=13 of n=22 wells (59%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

#	River	State	Site	Status	Methods	Reference
L15	Rio Grande	New Mexico	Rincon Valley (near Placitas)	Losing	Piezometric and streamflow time series	Ref. [60]
30 m DEM and hydro-graphy	 **Rio Grande (i.e, local-scale study L15) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Alluvial layers characterized by interbedded clay, silt, sand and gravel. A thick layer of fine grained alluvium underlies the river corridor, forming a local confining layer. **n=10 of n=19 wells (53%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L18</td><td>Buffalo Run</td><td>Pennsylvania</td><td></td><td>Losing</td><td>Temperature measurements</td><td>Ref. [63]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



Buffalo Run (i.e, local-scale study L18) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Carbonate rocks in a karst landscape. Ridges are characterized by clastic rocks (shale, sandstone, quartzite).

n=3 of n=5 wells (60%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
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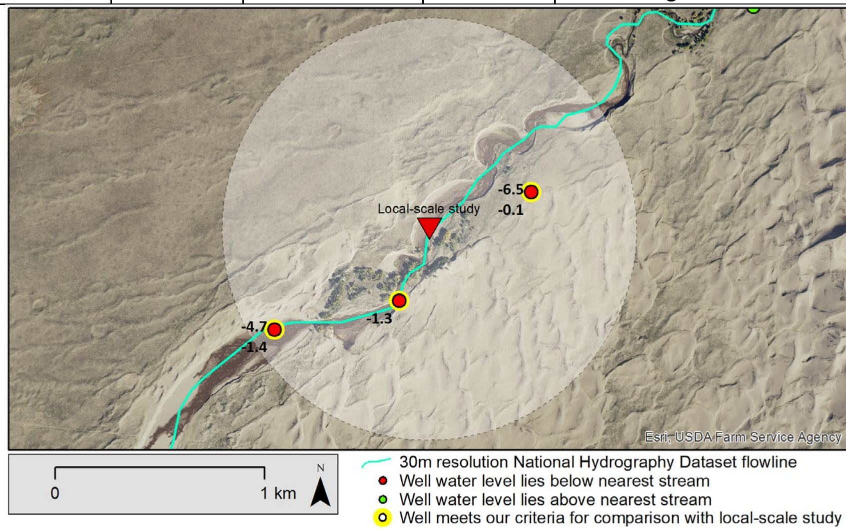
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L21</td><td>Sand Creek</td><td>Colorado</td><td></td><td>Losing</td><td>Streamflow and groundwater level monitoring</td><td>Ref. [64]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



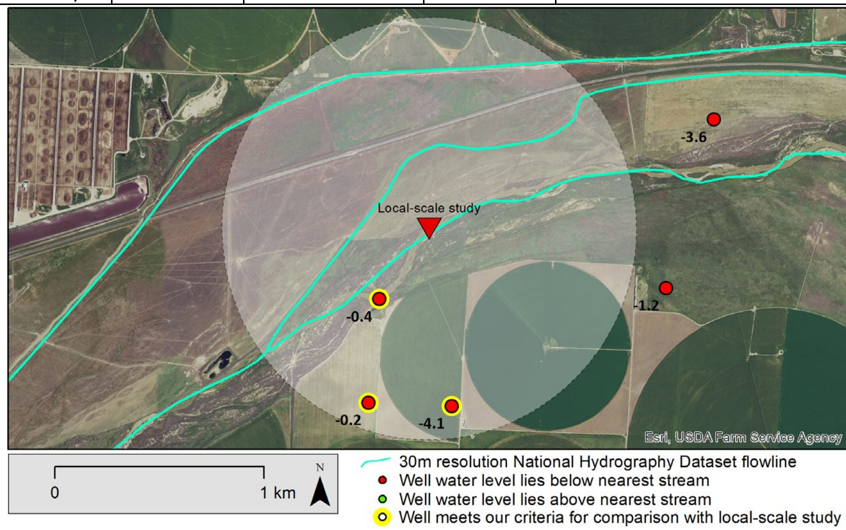
Sand Creek (i.e, local-scale study L21) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.
</td><td>
Local geology (based on reference(s) above): Alluvial materials that create an aquifer system consisting of (i) a shallow perched aquifer in the uppermost ~5-6m of the system, (ii) an aquitard, (iii) an unconfined aquifer (iv) another confining layer at a depth of ~28m, and (v) a confined aquifer beneath this layer (ref. [64]).

n=5 of n=5 wells (100%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.
</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L22	Arkansas River (west Kansas)	Kansas		Losing	Streamflow monitoring	Ref. [47]

30 m DEM and hydro-graphy



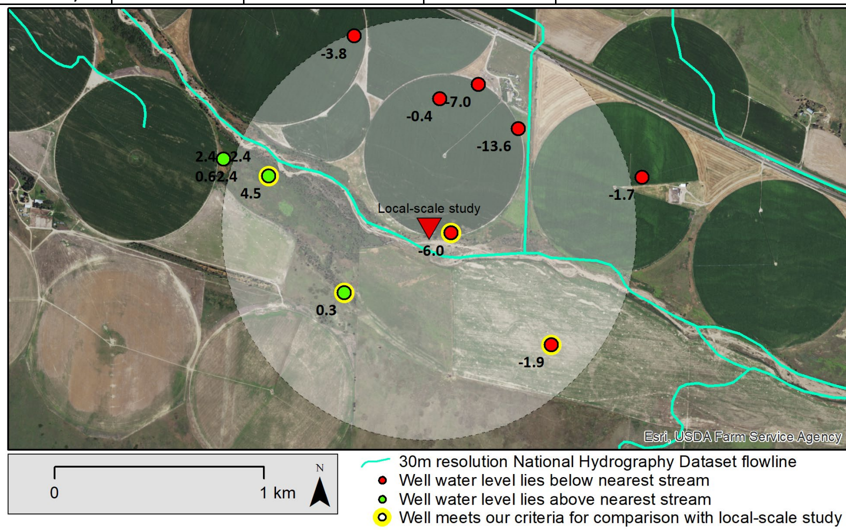
Arkansas River (i.e, local-scale study L22) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

Local geology (based on reference(s) above): Alluvial unconsolidated shallow aquifer comprised of clastic sediments and some local confining units. Study notes the presence of a strong downward hydraulic gradient induced by pumping from deeper formations (Ogallala-High Plains).

n=3 of n=3 wells (100%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L23</td><td>Arkansas River (central Kansas)</td><td>Kansas</td><td></td><td>Losing</td><td>Streamflow monitoring</td><td>Ref. [47]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



Arkansas River (i.e, local-scale study L23) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Alluvial unconsolidated shallow aquifer comprised of clastic sediments and some local confining units. Study notes the presence of a strong downward hydraulic gradient induced by pumping from deeper formations (Ogallala-High Plains).

n=2 of n=4 wells (50%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
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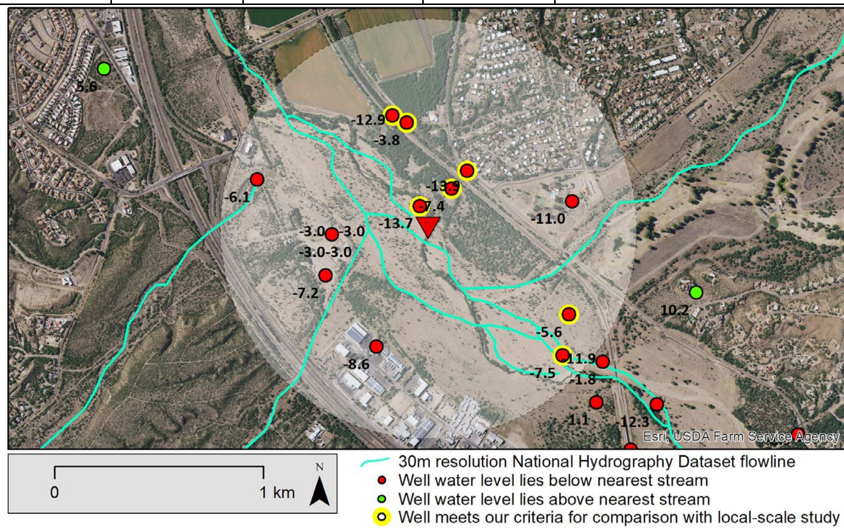
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L24</td><td>Upper Santa Cruz River</td><td>Arizona</td><td></td><td>Losing/Disconnected *</td><td>Piezometers, seepage pans, hydrochemical measurements</td><td>Ref. [65]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

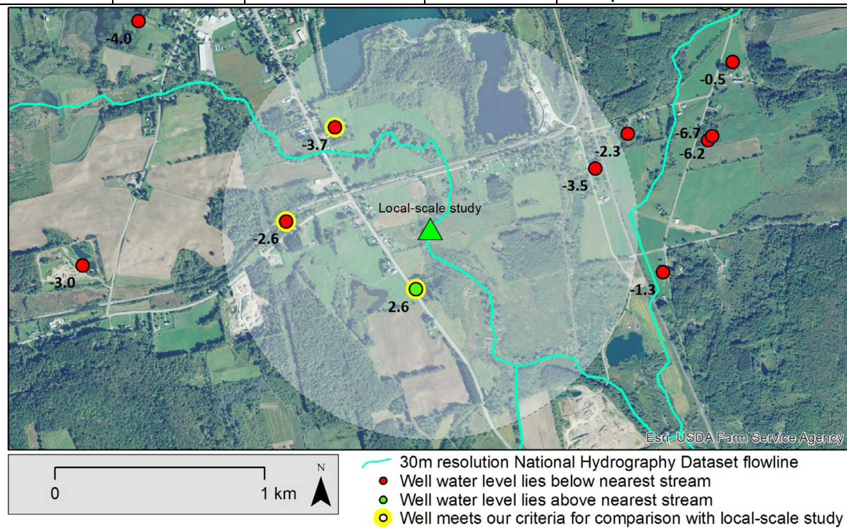
Upper Santa Cruz River (i.e, local-scale study L24) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Alluvial basin with three formations highlighted by ref. [65] as important: Nogales Formation (deepest), Older Alluvium and Younger Alluvium (shallowest). The Nogales formation is a Pliocene-Miocene-aged conglomerate comprised of volcanic clasts (rhyolite). The overlying “Older Alluvial Unit” is a basin-fill deposit consisting of clay-to-gravel-sized particles. The late-Pleistocene “Younger Alluvial Unit” contains cobbles with only little fine-grained particles (clay, silt; all geologic descriptions described here derive from ref. [84])

n=7 of n=7 wells (100%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L25	Ischua Creek	New York	Reach 1-2	Gaining	Differential streamflow, temperature measurements	Ref. [48]

30 m DEM and hydrography



Ischua Creek (i.e, local-scale study L25) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

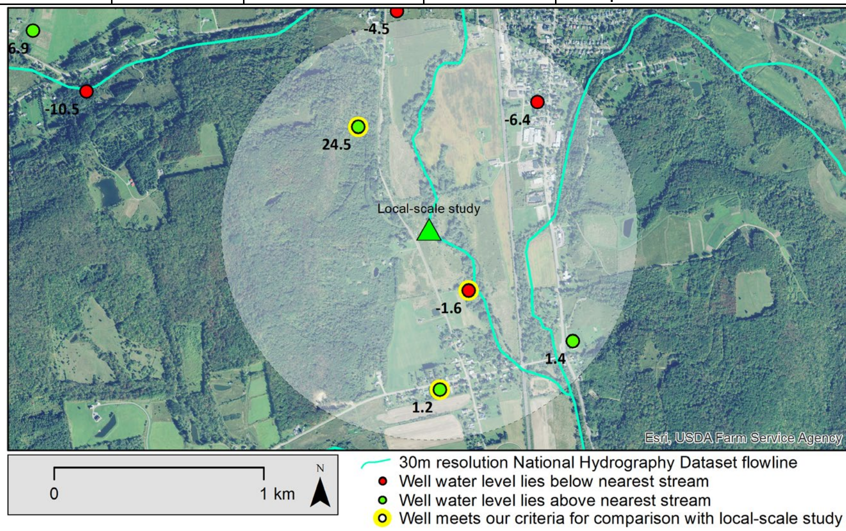
Local geology (based on reference(s) above): Glacial drift and more recent alluvial deposits. Till consists of sands and gravels and has a low-permeability in places. Shallower sediments are gravels, sands, and some till, with glaciofluvial deposits in lower elevation portions of the watershed.

n=2 of n=3 wells (67%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

#	River	State	Site	Status	Methods	Reference
L26	Ischua Creek	New York	Reach 2-3	Gaining	Differential streamflow, temperature measurements	Ref. [48]

30 m DEM and hydro-graphy

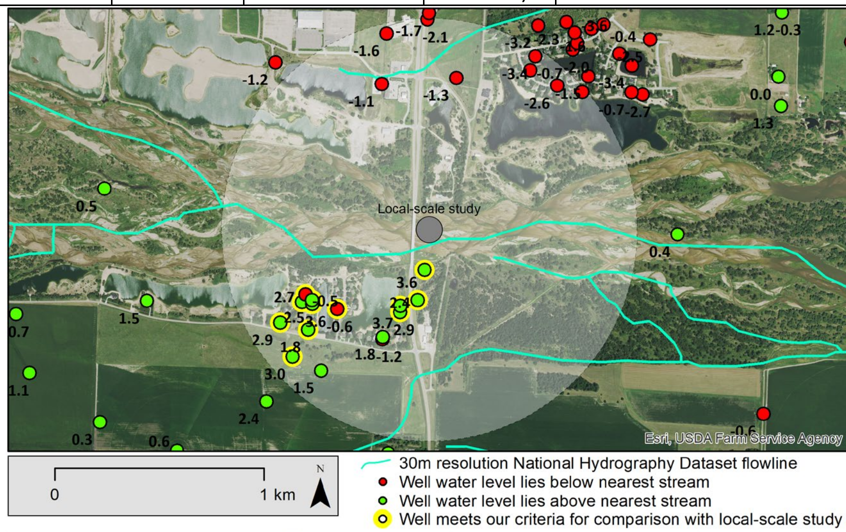


Ischua Creek (i.e, local-scale study L26) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

Local geology (based on reference(s) above): Glacial drift and more recent alluvial deposits. Till consists of sands and gravels and has a low-permeability in places. Shallower sediments are gravels, sands, and some till, with glaciofluvial deposits in lower elevation portions of the watershed.

n=1 of n=3 wells (33%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

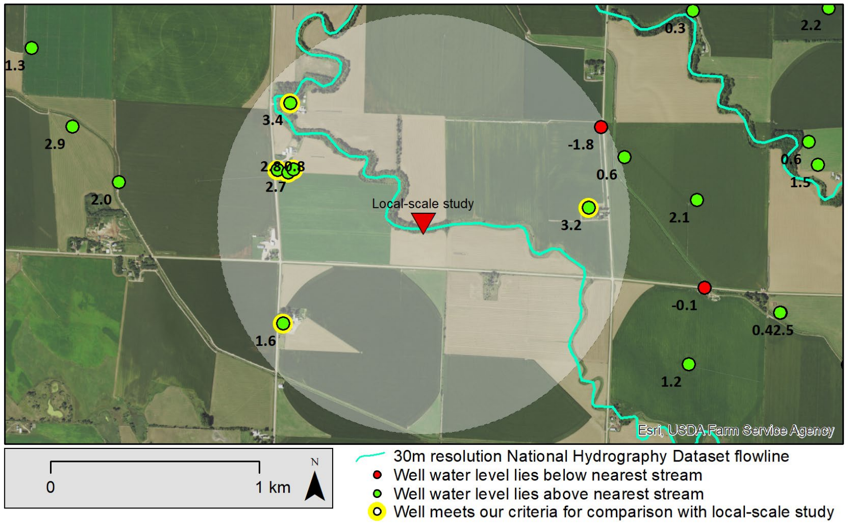
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L27</td><td>Platte River</td><td>Nebraska</td><td>near Kearney</td><td>Gaining and losing (different sides of the river)</td><td>Groundwater monitoring, modelling</td><td>Ref. [66]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

Platte River (i.e, local-scale study L27) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The grey circle is the location (sometimes approximate) of a local-scale study (see reference above) where it was unclear whether gaining or losing conditions dominate.</td><td>Local geology (based on reference(s) above): Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones.

n=2 of n=12 wells (17%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

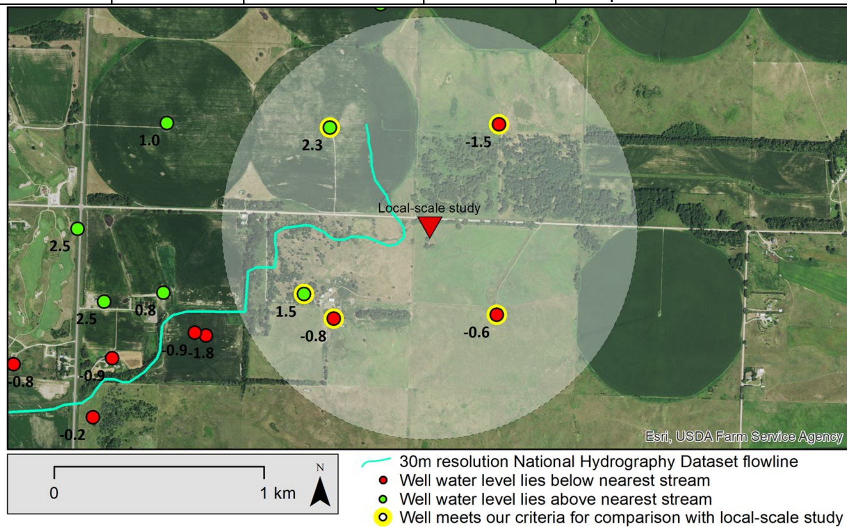
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L30</td><td>Spring Creek</td><td>Nebraska</td><td></td><td>Losing</td><td>Stream and air temperatures</td><td>Ref. [68]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

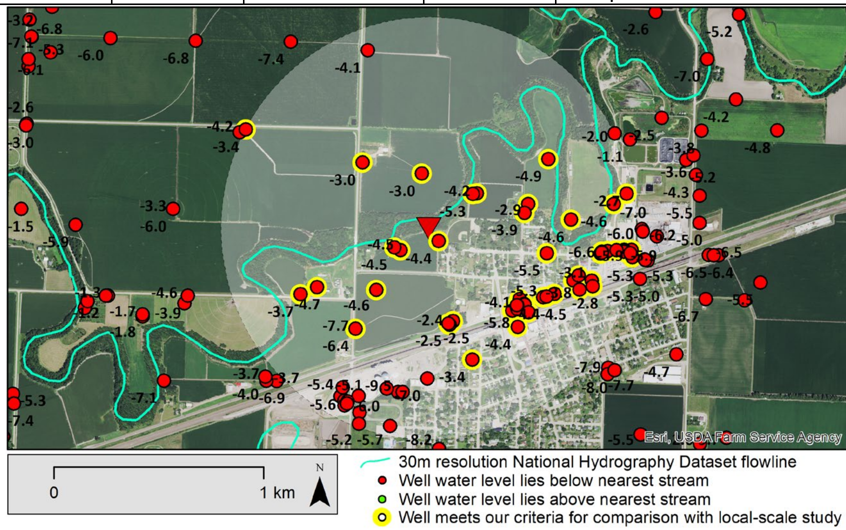


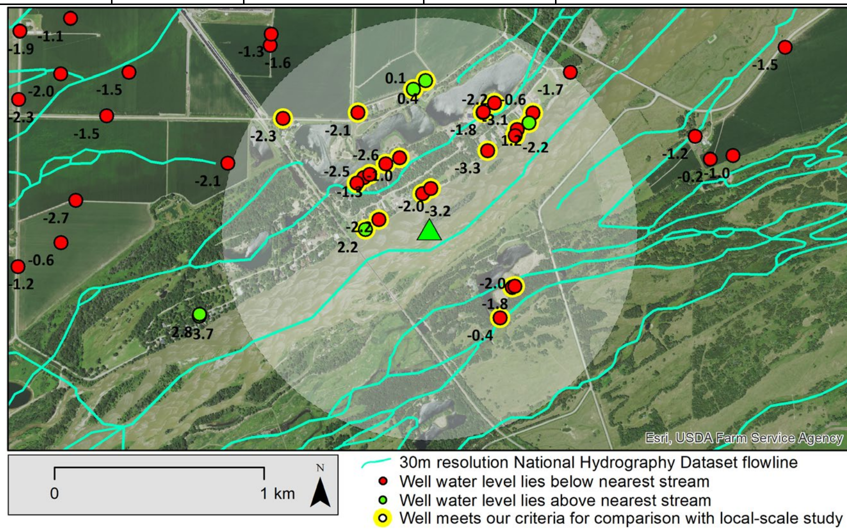
Spring Creek (i.e, local-scale study L30) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones (based on description in ref. [66]).

n=0 of n=6 wells (0%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L31	Lost Creek	Nebraska		Losing	Stream and groundwater temperatures	Ref. [68]
30 m DEM and hydro-graphy	 **Lost Creek (i.e, local-scale study L31) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones (based on description in ref. [66]). **n=3 of n=5 wells (60%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

#	River	State	Site	Status	Methods	Reference
L32	Wood River	Nebraska		Losing	Stream and groundwater temperatures	Ref. [68]
30 m DEM and hydro-graphy	 **Wood Creek (i.e, local-scale study L32) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones (based on description in ref. [66]). **n=53 of n=53 wells (100%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L33</td><td>Platte River</td><td>Nebraska</td><td>Clarks Site</td><td>Gaining</td><td>Model</td><td>Ref. [68]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">


Platte River (i.e, local-scale study L33) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.
</td><td>
Local geology (based on reference(s) above): Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones (based on description in ref. [66]).

n=20 of n=24 wells (83%) are indicative of losing stream conditions* [x]

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

[x] all wells within 1 km of local-scale study analyzed, as the river is braided and consequently is represented by multiple National Hydrography Dataset flowlines
</td></tr>
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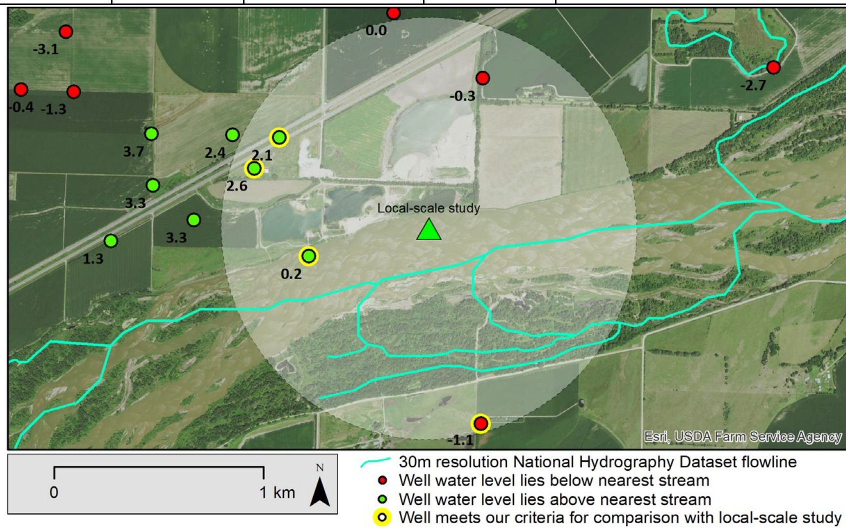
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L34</td><td>Platte River</td><td>Nebraska</td><td>Duncan Site</td><td>Gaining</td><td>Model</td><td>Ref. [68]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



Platte River (i.e, local-scale study L34) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

</td><td>

Local geology (based on reference(s) above): Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones (based on description in ref. [66]).

n=1 of n=4 wells (25%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

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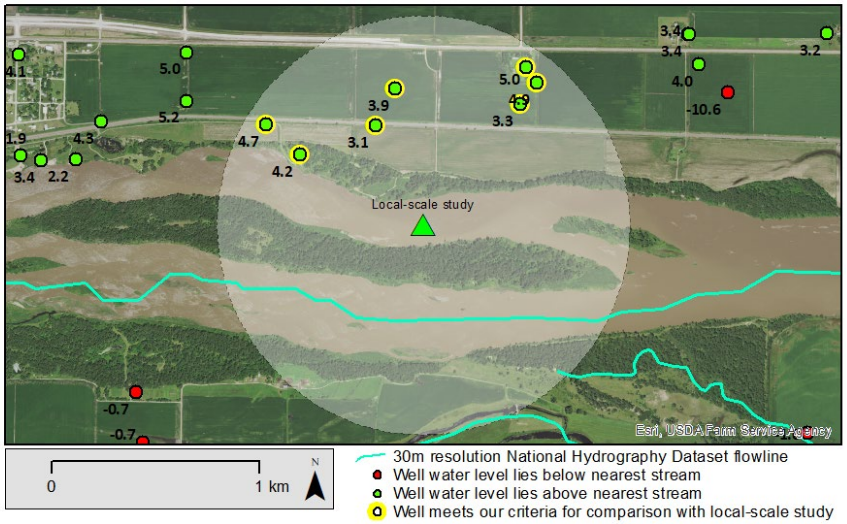
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L35</td><td>Platte River</td><td>Nebraska</td><td>North Bend Site</td><td>Gaining</td><td>Model</td><td>Ref. [68]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



Platte River (i.e, local-scale study L35) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

</td><td>

Local geology (based on reference(s) above): Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones (based on description in ref. [66]).

n=0 of n=7 wells (0%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

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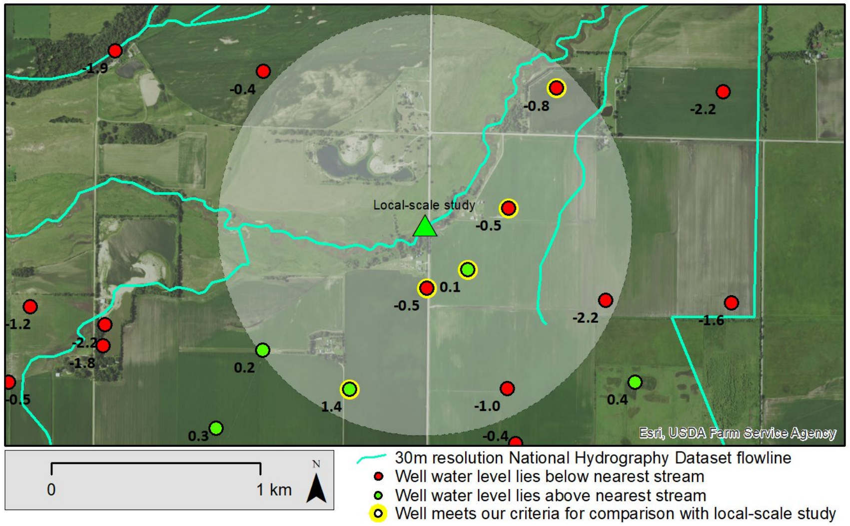
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L36</td><td>Clear Creek</td><td>Nebraska</td><td></td><td>Gaining</td><td>Temperature and hydraulic head measurements</td><td>Ref. [69]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

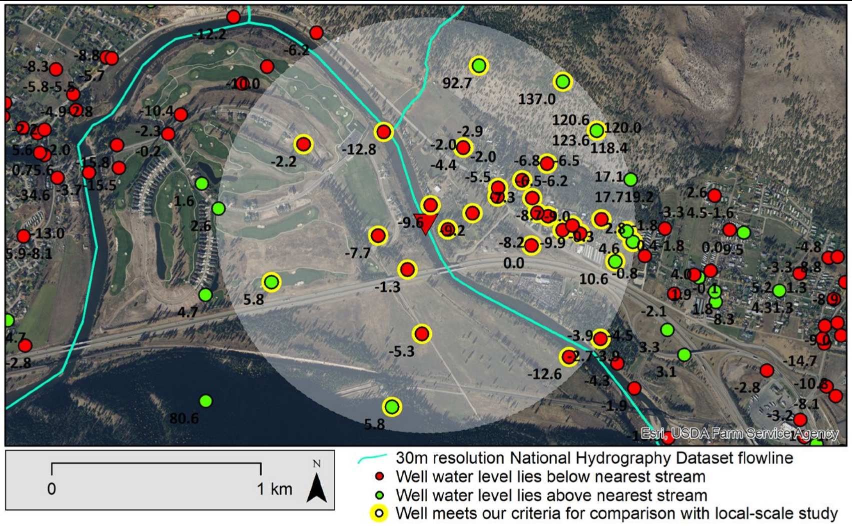


Clear Creek (i.e, local-scale study L36) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Shallow alluvium comprised sands and gravels. A clay-rich aquitard separates the shallow unconfined alluvium from the underlying Ogallala Group, itself comprised largely of unconsolidated materials (silts, sands and gravels) and semi-consolidated sandstones and siltstones (based on description in ref. [66]).

n=3 of n=5 wells (60%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L37</td><td>Clark Fork</td><td>Montana</td><td>Downstream of Milltown Dam</td><td>Losing</td><td>Piezometric measurements and model</td><td>Ref. [70]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



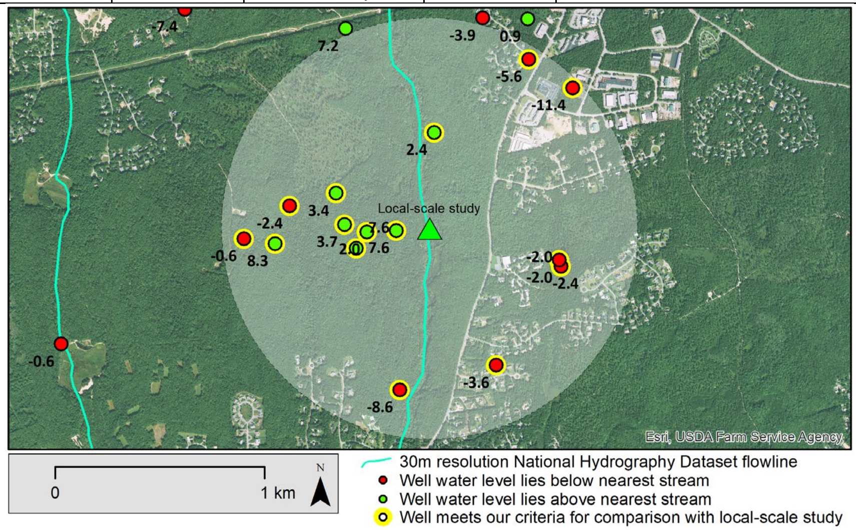
Clark Fork (i.e, local-scale study L37) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Precambrian metasedimentary bedrock (e.g., quartzite, limestone) overlain by Quaternary-aged alluvial deposits. Alluvium comprised of coarse grained sediments (sands, gravels, boulders) with some clay-rich lenses.

n=52 of n=79 wells (60%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L42	Quashnet River	Massachusetts	approximate location of site "C" in study	Gaining	Distributed temperature sensors, seepage meters	Ref. [75]

30 m DEM and hydro-graphy

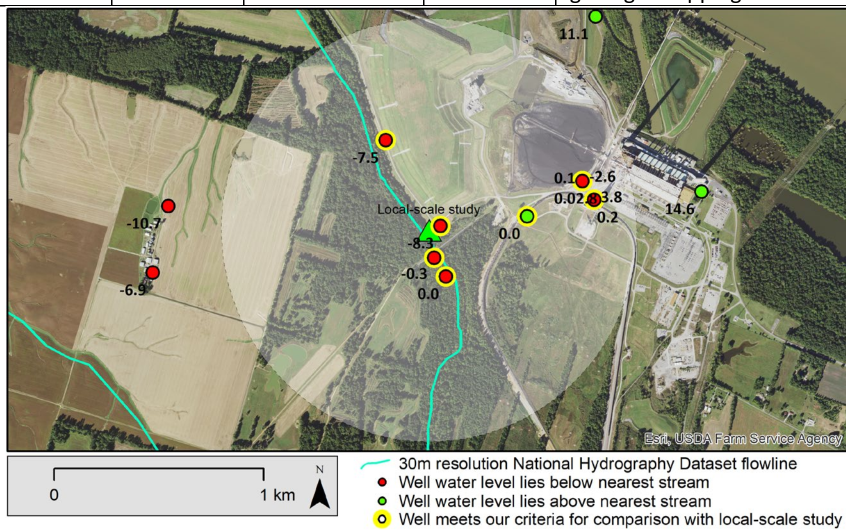


Quashnet River (i.e, local-scale study L42) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

Local geology (based on reference(s) above): Unconsolidated sandy substrate (i.e., "relatively uniform and permeable sandy substrate" quote ref. [75]).

n=9 of n=17 wells (53%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L43</td><td>Little Bayou Creek</td><td>Kentucky</td><td>Between LBC-6 and LBC-4</td><td>Gaining</td><td>Stream- and spring-flow measurements, spring temperature measurements, temperature profiling along the stream-bed, and geologic mapping</td><td>Refs. [15,51]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">


Little Bayou Creek (i.e, local-scale study L43) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.
</td><td>Local geology (based on reference(s) above): Unconsolidated silts and sands (“upper Metropolis Formation and loess” quote ref. [15]). Clay-rich patches exist where sandy substrate does not. In places the “Mounds Gravel” formation exists, itself comprised of cobble and gravel sized particles intermingled with sand (ref. [15]).

n=11 of n=22 wells (50%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

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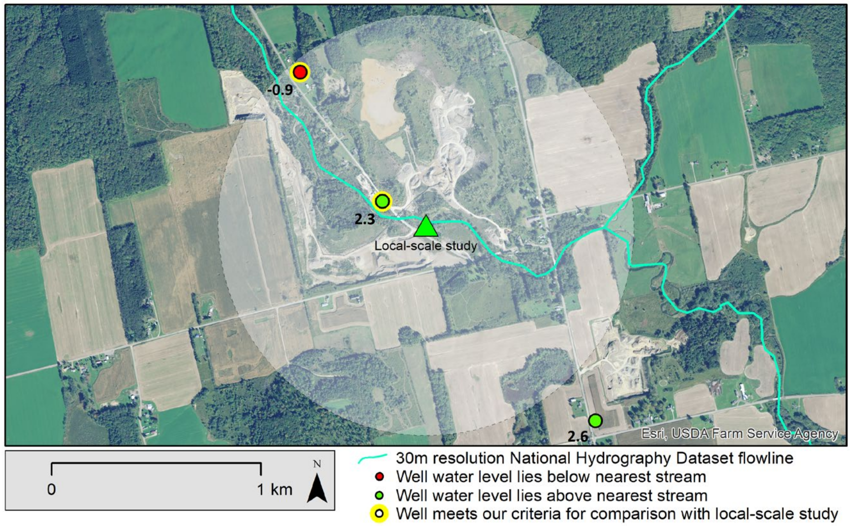
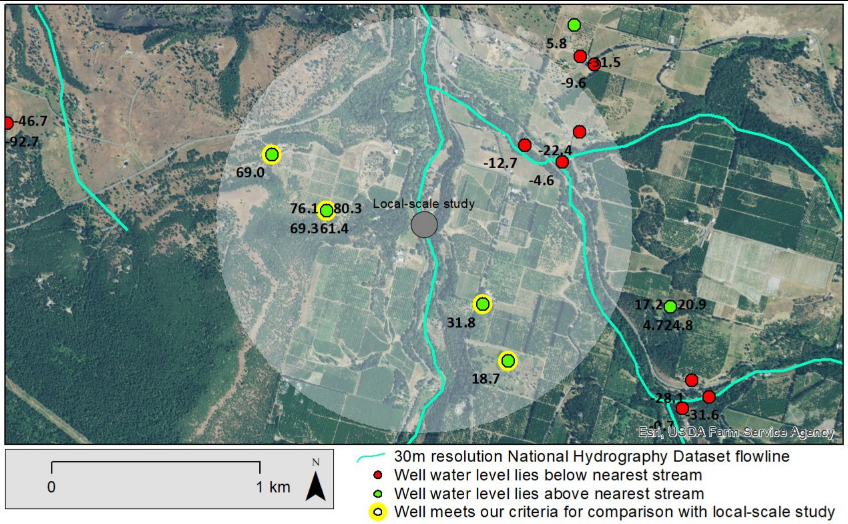
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L44</td><td>Elton Creek</td><td>New York</td><td>near Lafarge Aggregates</td><td>Gaining</td><td>Piezometric measurements</td><td>Refs. [76,77]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



Elton Creek (i.e, local-scale study L44) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Glacial deposits comprised of gravels, sands, silts and clays. Groundwater discharge zones are frequently focused to specific areas, driven by the presence of gravel-rich layers with high hydraulic conductivities (ref. [77]).

n=1 of n=2 wells (50%) are indicative of losing stream conditions*

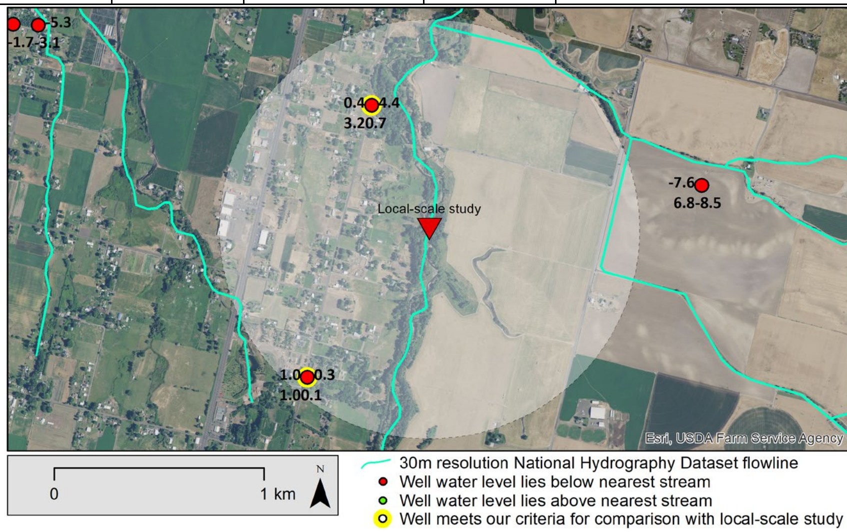
*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L45</td><td>Mosier Creek</td><td>Washington</td><td></td><td>Gaining and losing</td><td>Well water levels</td><td>Ref. [78]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">


Mosier Creek (i.e, local-scale study L45) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The grey circle is the location (sometimes approximate) of a local-scale study (see reference above) where it was unclear whether gaining or losing conditions dominate.
</td><td>
Local geology (based on reference(s) above): Recent alluvium comprised of gravels, sands, silts and clays dominate river corridor. Deposits from outbursts of Glacial Lake Missoula also exist, and consist of silts, sands and gravels. Volcanic deposits (Pliocene, Miocene) overlie Columbia River Flood Basalts.

n=0 of n=9 wells (0%) are indicative of losing stream conditions*

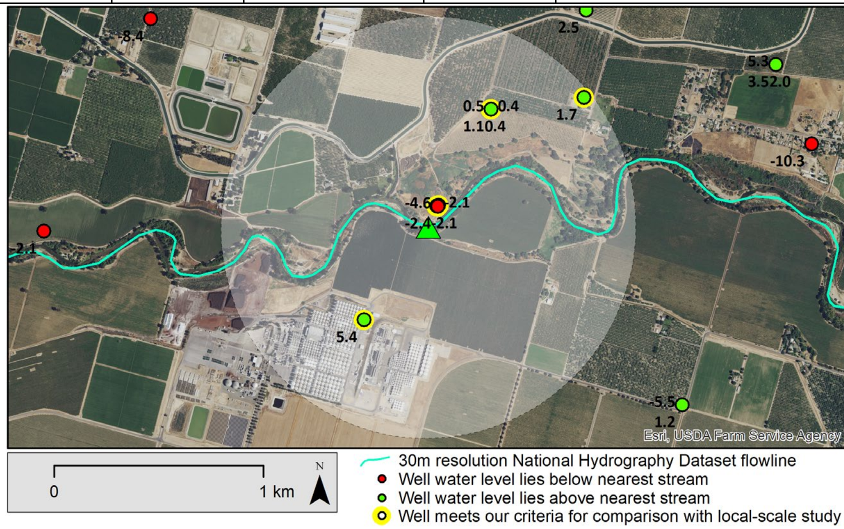
*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.
</td></tr>
</table>

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L48</td><td>Walla Walla River</td><td>Oregon</td><td>Umatilla County near Bier Lane and Summers Lane</td><td>Losing</td><td>Distributed temperature sensors, piezometers</td><td>Ref. [80]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">


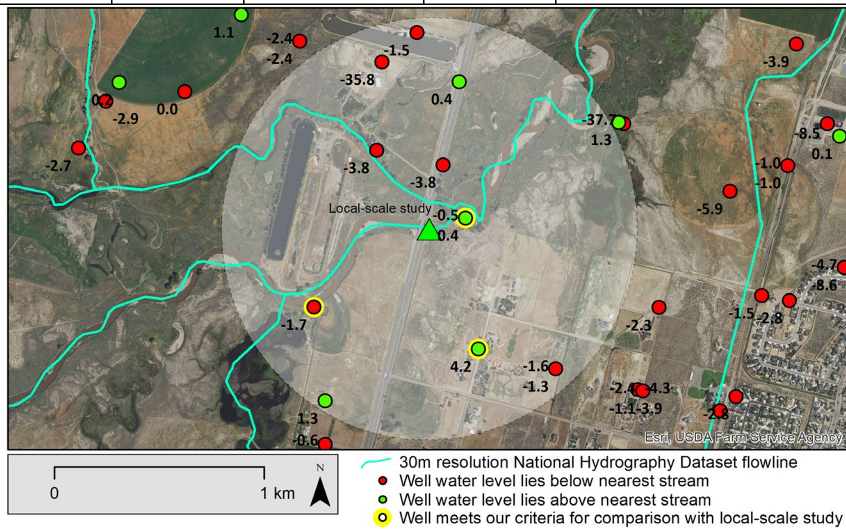
Walla Walla River (i.e, local-scale study L48) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.
</td><td>Local geology (based on reference(s) above): Columbia River Flood Basalts are the dominant bedrock lithology; these deposits exist ~60 m below the land surface in the study area (ref. [80]). Alluvial sediments overlie these basalts, and are comprised of clays, silts, sands, gravels and even larger particles.

n=98 of n=116 wells (85%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L51	Merced River	California	Merced County	Gaining	Groundwater levels data	Ref. [82]
30 m DEM and hydro-graphy	 **Merced River (i.e, local-scale study L51) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Unconsolidated Quaternary-aged alluvium deposited during the Tertiary and Quaternary. **n=8 of n=14 wells (57%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

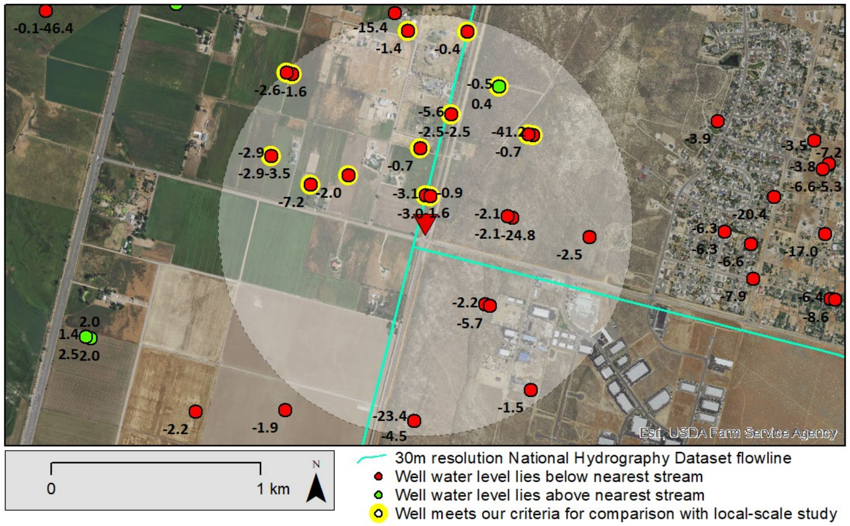
<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L53</td><td>Carson River</td><td>Nevada</td><td>S-1</td><td>Gaining</td><td>Streambed temperature measurements</td><td>Ref. [83]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

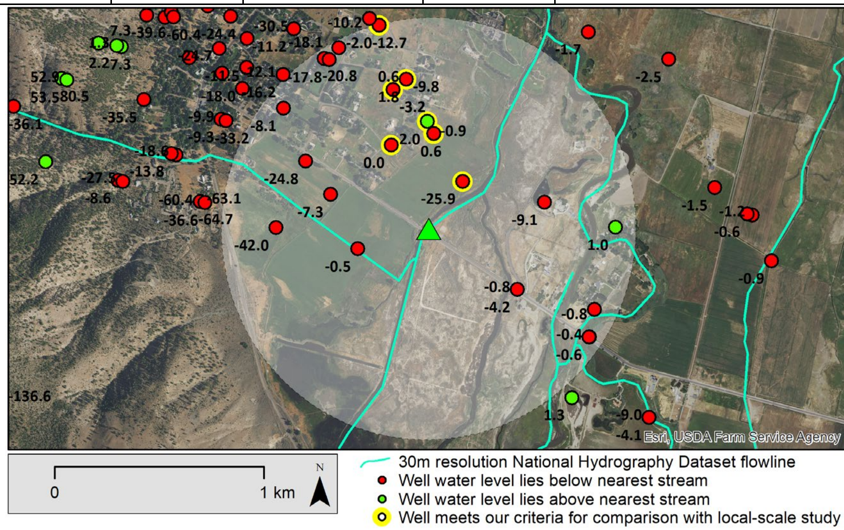


Carson River (i.e, local-scale study L53) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as “well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks.” (text in speech marks quoted from ref. [83]).

n=2 of n=4 wells (50%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

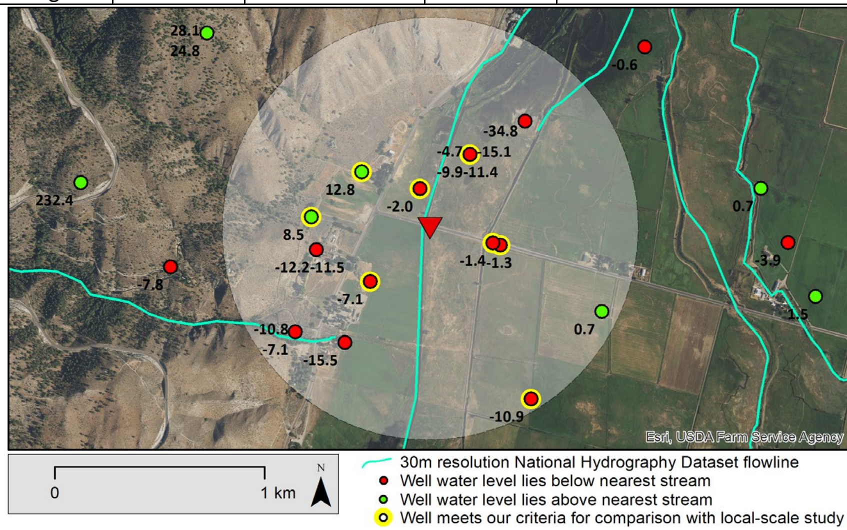
#	River	State	Site	Status	Methods	Reference
L55	Heyburn Ditch	Nevada	ST-5	Losing	Streambed temperature measurements	Ref. [83]
30 m DEM and hydro-graphy	 **Heyburn Ditch (i.e, local-scale study L55) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as “well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks.” (text in speech marks quoted from ref. [83]). **n=21 of n=22 wells (95%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L57</td><td>Unnamed Ditch</td><td>Nevada</td><td>ST-13a-c</td><td>Gaining</td><td>Streambed temperature measurements</td><td>Ref. [83]</td></tr>
<tr><td>30 m DEM and hydrography</td><td colspan="5">


Unnamed ditch (i.e, local-scale study L57) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as “well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks.” (text in speech marks quoted from ref. [83]).

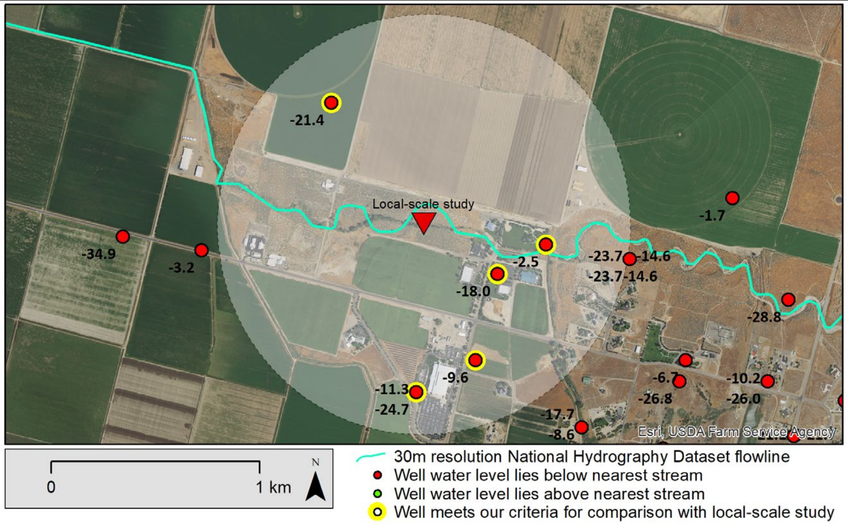
n=12 of n=16 wells (75%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L66	Brockliss Slough	Nevada	ST-16	Losing	Streambed temperature measurements	Ref. [83]
30 m DEM and hydro-graphy	 **Brockliss Slough (i.e, local-scale study L66) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as "well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks." (text in speech marks quoted from ref. [83]). **n=9 of n=11 wells (82%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

#	River	State	Site	Status	Methods	Reference
L67	Buckeye Creek	Nevada	ST-24	Losing	Streambed temperature measurements	Ref. [83]

30 m DEM and hydro-graphy



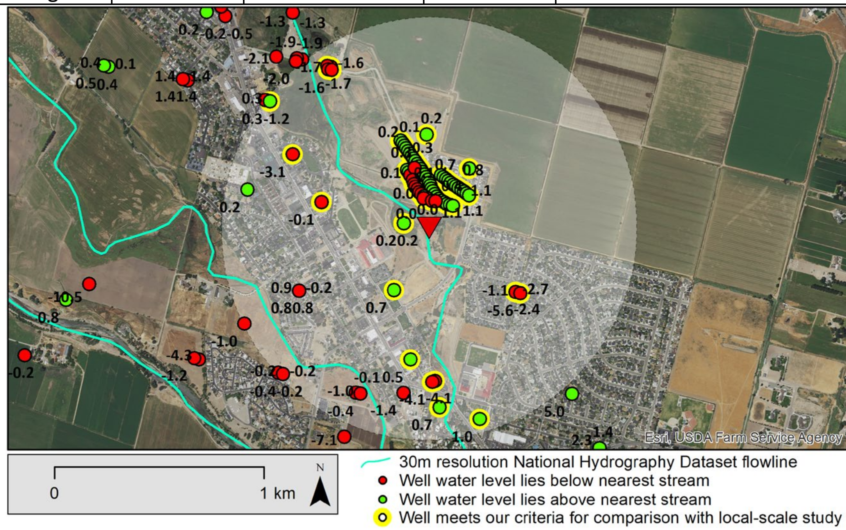
Buckeye Creek (i.e, local-scale study L67) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as “well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks.” (text in speech marks quoted from ref. [83]).

n=6 of n=6 wells (100%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L68</td><td>Martin Slough</td><td>Nevada</td><td>ST-25</td><td>Losing</td><td>Streambed temperature measurements</td><td>Ref. [83]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">



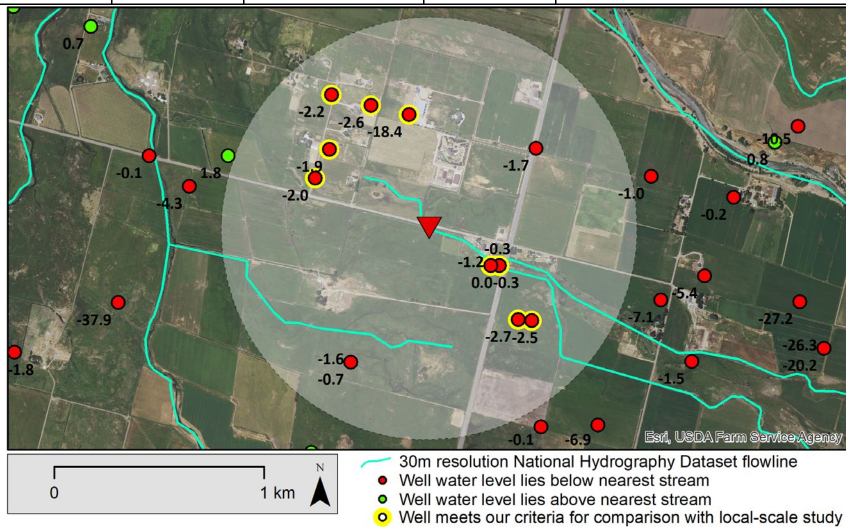
Martin Slough (i.e, local-scale study L68) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as “well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks.” (text in speech marks quoted from ref. [83]).

n=29 of n=82 wells (35%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L71	Henningson Slough	Nevada	ST-28a-b	Losing	Streambed temperature measurements	Ref. [83]

30 m DEM and hydro-graphy

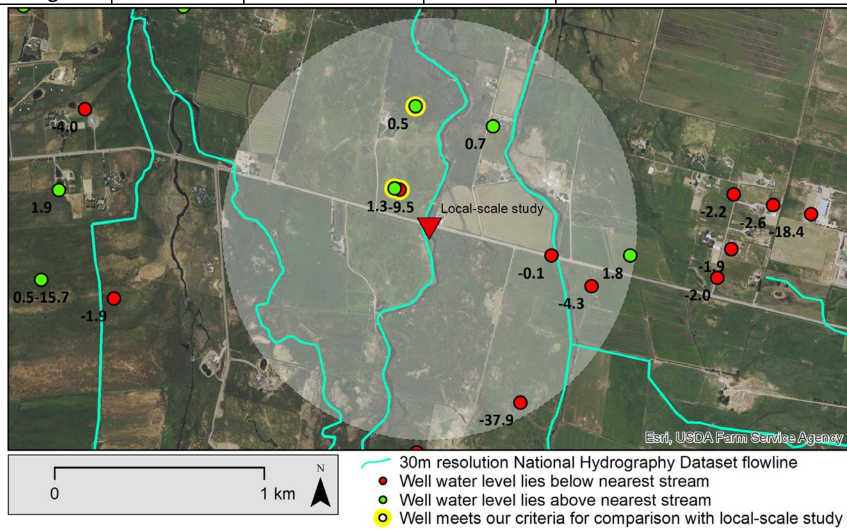


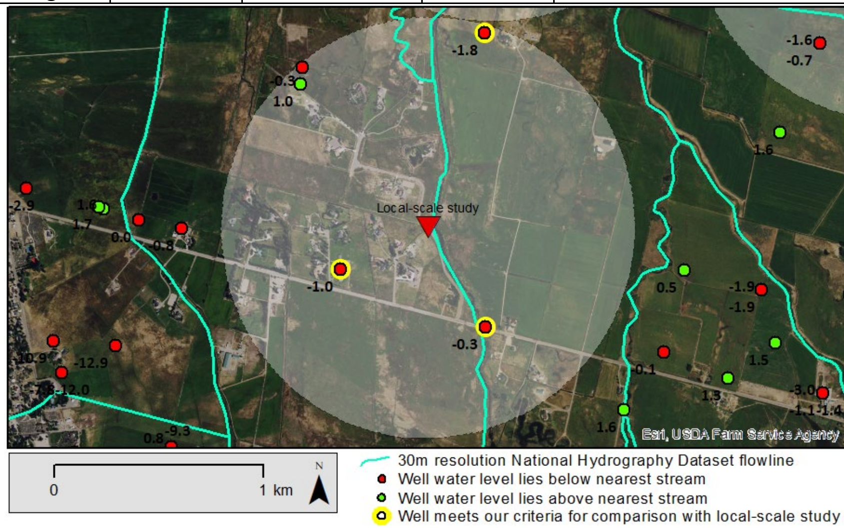
Henningson Slough (i.e, local-scale study L71) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as "well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks." (text in speech marks quoted from ref. [83]).

n=16 of n=16 wells (100%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

#	River	State	Site	Status	Methods	Reference
L72	Brockliss Slough	Nevada	ST-30	Losing	Streambed temperature measurements	Ref. [83]
30 m DEM and hydro-graphy	 **Brockliss Slough (i.e, local-scale study L72) map (above):** Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.					**Local geology (based on reference(s) above):** Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as "well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks." (text in speech marks quoted from ref. [83]). **n=1 of n=3 wells (33%) are indicative of losing stream conditions*** *calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L74</td><td>Brockliss Slough</td><td>Nevada</td><td>ST-33</td><td>Losing</td><td>Streambed temperature measurements</td><td>Ref. [83]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">

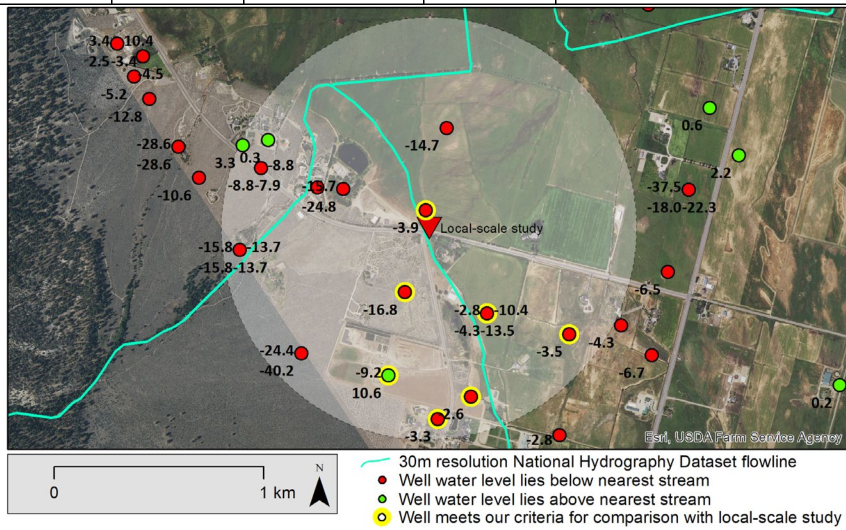
Brockliss Slough (i.e, local-scale study L74) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td><td>Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as “well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks.” (text in speech marks quoted from ref. [83]).

n=3 of n=3 wells (100%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

#	River	State	Site	Status	Methods	Reference
L75	Fredericks-burg Ditch	Nevada	ST-34	Losing	Streambed temperature measurements	Ref. [83]

30 m DEM and hydro-graphy

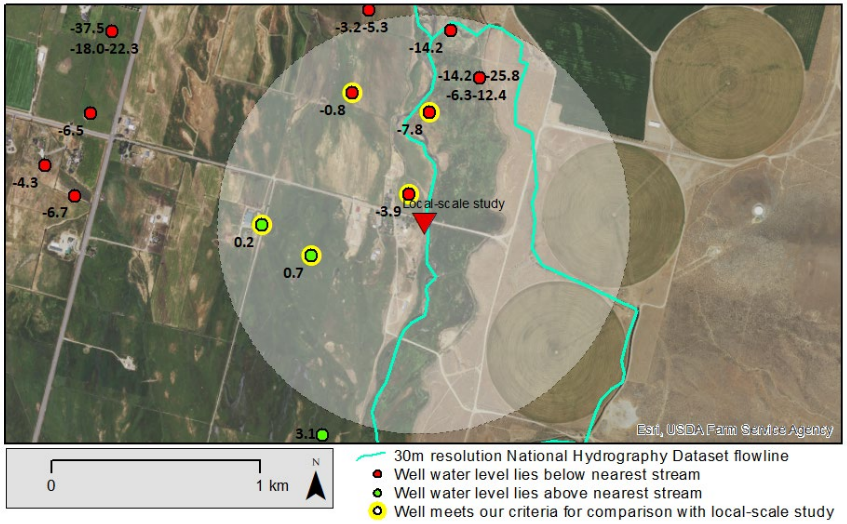


Fredericksburg Ditch (i.e, local-scale study L75) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.

Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as "well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks." (text in speech marks quoted from ref. [83]).

n=10 of n=11 wells (91%) are indicative of losing stream conditions*

*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.

<table>
<tr><th>#</th><th>River</th><th>State</th><th>Site</th><th>Status</th><th>Methods</th><th>Reference</th></tr>
<tr><td>L76</td><td>Carson River</td><td>Nevada</td><td>ST-35</td><td>Losing</td><td>Streambed temperature measurements</td><td>Ref. [83]</td></tr>
<tr><td>30 m DEM and hydro-graphy</td><td colspan="5">


Carson River (i.e, local-scale study L76) map (above): Labels represent median well water elevation (in m) relative to the nearest point on the nearest stream surface. Negative values (red circles) are consistent with a hydraulic gradient from the stream to the aquifer (suggesting a losing stream); positive values (green circles) are consistent with a hydraulic gradient from the aquifer to the stream (suggesting a gaining stream). The transparent white shaded circle shows a 1 km radius around the local-scale study. The light green lines are 30 m resolution National Hydrography Dataset flowlines. The triangle is the location (sometimes approximate) of a local-scale study (see reference above); a downward-pointing red triangle indicates the local-scale study has identified a losing river whereas an upward-pointing green triangle indicates the local-scale study has identified a gaining river.</td>
<td>Local geology (based on reference(s) above): Unconsolidated Quaternary-aged alluvium spans the study area. These sediments are described as “well-sorted sand and gravel, interbedded with fine-grained silt and clay from overbank flood deposits. Unconsolidated sediments deposited by tributary streams are coarse- to fine-grained, poorly sorted deposits, which form alluvial fans at the base of the mountain blocks.” (text in speech marks quoted from ref. [83]).

n=3 of n=5 wells (60%) are indicative of losing stream conditions*

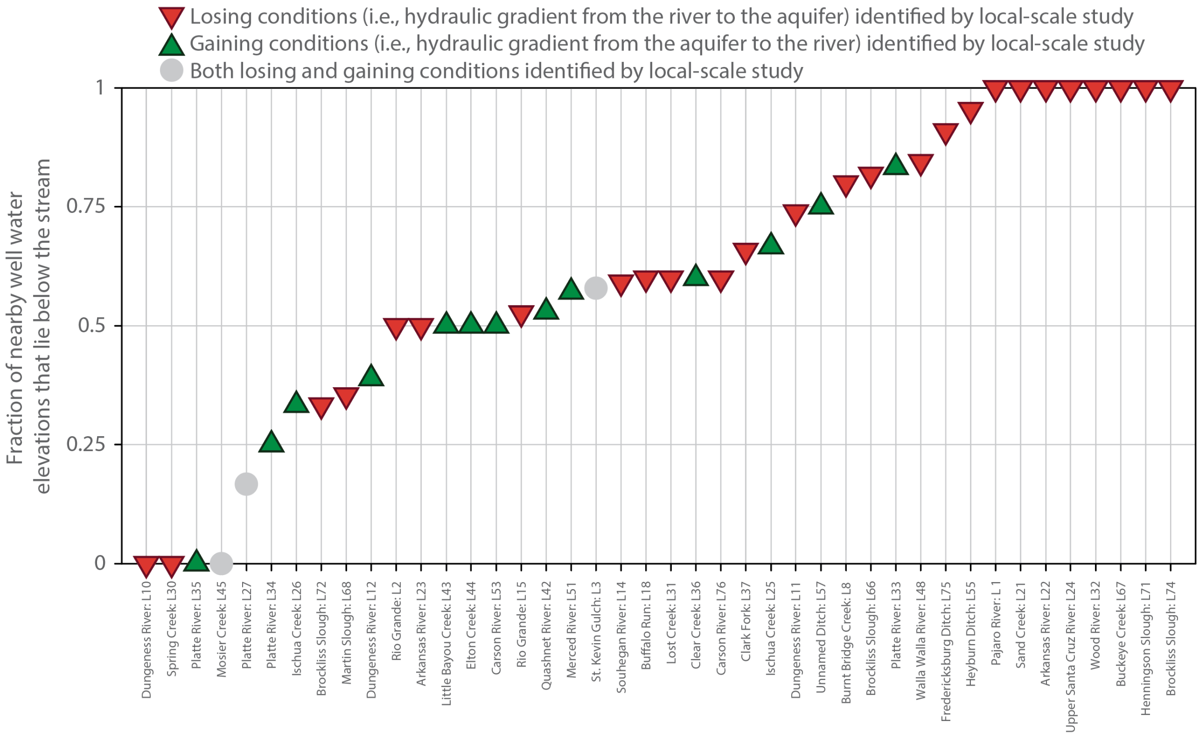
*calculated as the number of wells with water levels below the study stream, as a fraction of all wells meeting the following criteria: a) located no more than one kilometer from the local-scale study, b) located closer to the study stream than to any other flowline in the 30 m resolution National Hydrography Dataset, and c) with a total well depth that is no more than 100 m.</td></tr>
</table>

Here we summarize our comparisons of local-scale studies and the fraction of wells with water levels that lie below the estimated surface elevations of the streams that these local-scale studies investigated (suggesting losing conditions). These comparisons demonstrate that our well water level data are generally consistent with the findings of these local-scale studies, although not in every case (Supplementary Tables 3 and 4; Supplementary Figure 3).

Supplementary Table 3. Summary of our comparison of local-scale studies and well water levels

Site	River	Status described in local-scale study	Number of wells near the local-scale study river with water levels that lie below the studied stream	Total wells nearby the study river	Fraction of wells with water levels below the stream
L1	Pajaro River	Losing	5	5	1.00
L2	Rio Grande	Losing	2	4	0.50
L3	St. Kevin Gulch	Gaining and losing reaches	11	19	0.58
L8	Burnt Bridge Creek	Losing	4	5	0.80
L10	Dungeness River	Losing	0	6	0.00
L11	Dungeness River	Losing	34	46	0.74
L12	Dungeness River	Gaining	14	36	0.39
L14	Souhegan River	Losing	13	22	0.59
L15	Rio Grande	Losing	10	19	0.53
L18	Buffalo Run	Losing	3	5	0.60
L21	Sand Creek	Losing	5	5	1.00
L22	Arkansas River (west Kansas)	Losing	3	3	1.00
L23	Arkansas River (central Kansas)	Losing	2	4	0.50
L24	Upper Santa Cruz River **	Losing	7	7	1.00
L25	Ischua Creek	Gaining	2	3	0.67
L26	Ischua Creek	Gaining	1	3	0.33
L27	Platte River	Gaining and losing (different sides of the river)	2	12	0.17
L30	Spring Creek	Losing	0	6	0.00
L31	Lost Creek	Losing	3	5	0.60
L32	Wood River	Losing	53	53	1.00
L33	Platte River	Gaining	20	24	0.83
L34	Platte River	Gaining	1	4	0.25
L35	Platte River	Gaining	0	7	0.00
L36	Clear Creek	Gaining	3	5	0.60

Site	River	Status described in local-scale study	Number of wells near the local-scale study river with water levels that lie below the studied stream	Total wells nearby the study river	Fraction of wells with water levels below the stream
L37	Clark Fork	Losing	52	79	0.66
L42	Quashnet River	Gaining	9	17	0.53
L43	Little Bayou Creek	Gaining	11	22	0.50
L44	Elton Creek	Gaining	1	2	0.50
L45	Mosier Creek	Gaining and losing	0	9	0.00
L48	Walla Walla River	Losing	98	116	0.84
L51	Merced River	Gaining	8	14	0.57
L53	Carson River	Gaining	2	4	0.50
L55	Heyburn Ditch	Losing	21	22	0.95
L57	Unnamed Ditch	Gaining	12	16	0.75
L66	Brockliss Slough	Losing	9	11	0.82
L67	Buckeye Creek	Losing	6	6	1.00
L68	Martin Slough	Losing	29	82	0.35
L71	Henningson Slough	Losing	16	16	1.00
L72	Brockliss Slough	Losing	1	3	0.33
L74	Brockliss Slough	Losing	3	3	1.00
L75	Fredericksburg Ditch	Losing	10	11	0.91
L76	Carson River	Losing	3	5	0.60



Supplementary Figure 3. Well water levels presented in this study, compared to previous local-scale studies that have identified stream reaches as gaining (i.e., net hydraulic gradient from the aquifer to the stream) or losing (i.e., net hydraulic gradient from the stream to the aquifer). Each symbol represents one location where a previous study has identified aquifer-stream exchanges; the locations, local-scale geologic conditions, and methodologies of these studies are tabulated in Supplementary Table 2. The colour of the symbol signifies the findings of previous research. Upward-pointing green triangles indicate studies that have found hydraulic gradients from the aquifer toward the river (gaining conditions), downward-pointing red triangles indicate studies that have found hydraulic gradients from the river toward the aquifer (losing conditions), and grey circles indicate studies that have found both losing and gaining conditions. The position of each point in the vertical dimension corresponds to the fraction of well water levels (i.e., those in Figure 2 of the main text) that lie below the study river, are within 1 km of the local-scale study's location, and are closer to the study river than to any other flowline in the National Hydrography Dataset (30 m resolution). If locations with >50% and ≤50% of well water levels below the stream elevation (the top and bottom halves of the plot) are assumed to represent losing and gaining conditions, respectively, this classification agrees with the findings of the local-scale studies 69% of the time (27 out of 39 cases, not counting the three studies that found both gaining and losing conditions). However, the overall incidence of losing streams among the local-scale studies (26 out of 39 cases, or 67%, again not counting the three studies with ambiguous results) is nearly identical to the overall incidence of losing streams inferred from groundwater levels (27 of 42 cases, or 64%, including the three sites with unclear results in the local-scale studies). This comparison suggests that our groundwater level analysis yields unbiased estimates of the overall prevalence of gaining and losing streams.

We test for consistency (or lack of consistency) between our well water level elevations and 39 local-scale studies that have (i) identified a stream as either gaining or losing (i.e., excluding cases where the local-scale study yielded ambiguous results), and (ii) where sufficient well water level data exist for comparison (Supplementary Table 4). We consider our well water level data to be broadly consistent with findings of local-scale studies if either:

i) More than half (>50%) of wells that are located nearby (<1 km away from) the local-scale study, and are closer to the local-scale study stream than any other stream (as determined by the National Hydrography Dataset: 30 m resolution), have a median water level elevation that lies below the nearby stream ***and*** the local-scale study indicates the stream is losing, or

ii) At least half (≥50%) of wells that are located nearby (<1 km away from) the local-scale study, and are closer to the local-scale study stream than any other stream (as determined by the National Hydrography Dataset: 30 m resolution), have a median water level elevation that lies above the nearby stream ***and*** the local-scale study indicates the stream is gaining.

Among the 39 local-scale studies for which we can perform this test, (i.e., those stating "gaining" or "losing" in Supplementary Table 3, and depicted as triangles in Supplementary Figure 3), we find that the well water level data are consistent with the local-scale study findings in 27 of these cases (69%; see cells with green text in Supplementary Table 4).

Among the 26 locations where well water levels suggest losing conditions, 20 (or 77%) have local-scale studies that also found losing conditions (Supplementary Table 4; center column). However, among the 13 locations where well water levels suggest gaining conditions, only 7 (or 54%) have local-scale studies that also found gaining conditions (Supplementary Table 4; rightmost column).

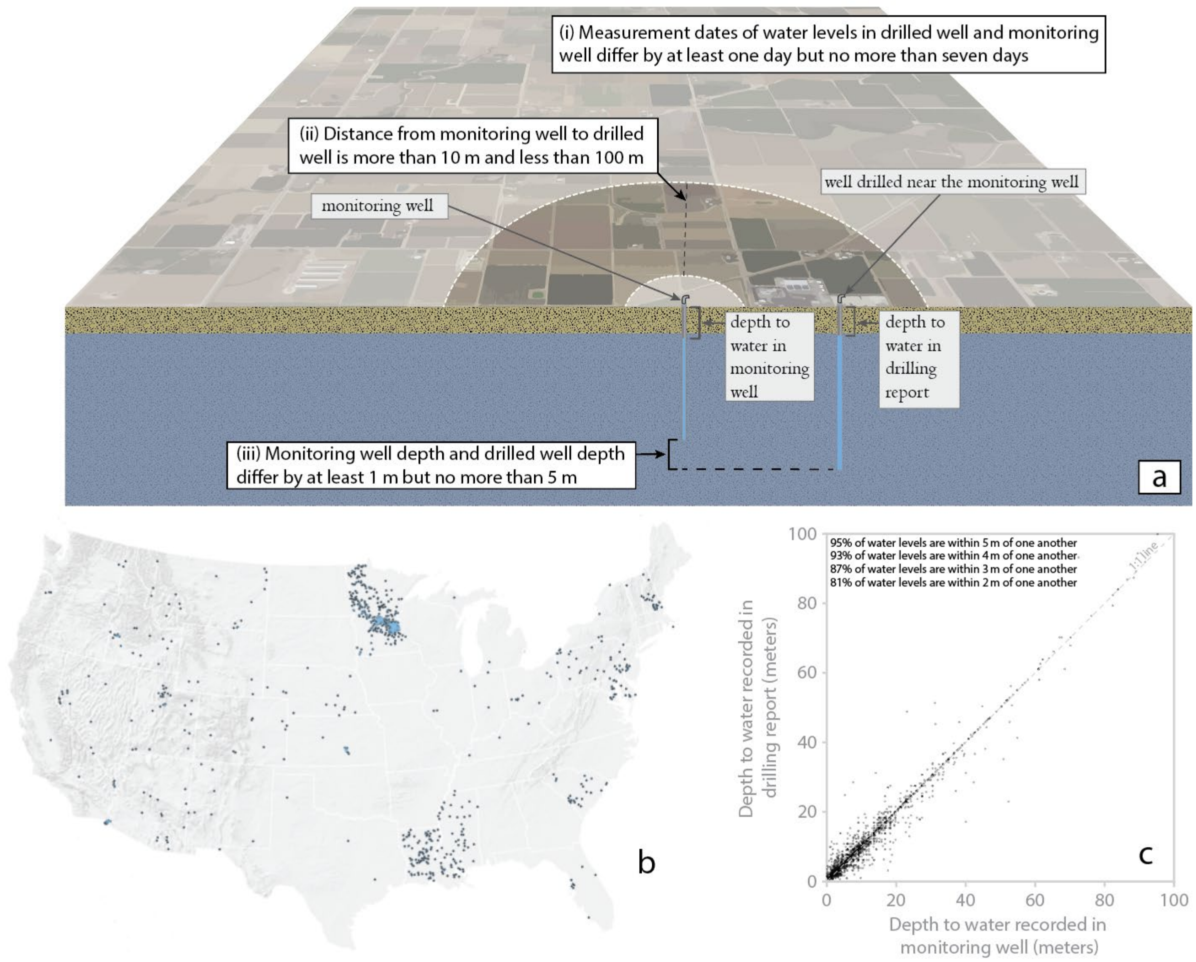
Supplementary Table 4. Comparison of local-scale results and well water levels

Condition identified in local-scale study	*Local-scale study locations where more than 50% of wells have water levels that lie below the study stream (consistent with losing conditions)*	*Local-scale study locations where 50% or less of wells have water levels that lie above the study stream (consistent with gaining conditions)*
Gaining conditions *determined by local-scale study*	**n=6** ***different*** *results between local-scale studies and well water levels*	**n=7** ***consistent*** *results between local-scale studies and well water levels*
Losing conditions *determined by local-scale study*	**n=20** ***consistent*** *results between local-scale studies and well water levels*	**n=6** ***different*** *results between local-scale studies and well water levels*

S3. Datasets and data processing

Our analyses are based on well water levels measured in monitoring wells or recorded in drilling reports (Supplementary Figures 4-7; see Methods in main text). A comparison of well water level measurements from drilling reports with nearby monitoring well water levels suggests that drilling report water levels capture aquifer conditions (refs. [26,28]; Supplementary Figure 4).

The measured well levels were then compared to the stream networks of the medium-resolution National Hydrography Dataset (NHDPlusV2; ref. [29]). The NHDPlusV2 dataset provides stream centerlines for rivers across the United States (Supplementary Figure 5b) together with consistent digital topography based on the National Elevation Dataset (NED) at a resolution of 30 m by 30 m (Supplementary Figure 5c). In order to determine if the elevation of the water level in a well lies above or below the streamwater surface (Supplementary Figures 5d-f), we additionally require an estimate of each stream's bank height in order to apply a correction (see Supplementary Figure 5g and Methods in the main text).



Supplementary Figure 4. Comparison of water level measurements made in monitoring wells versus those recorded in reports of nearby well drilling. (a) Schematic depicting the comparison of water level measurements in a monitoring well and a nearby drilled well. We compare drilling report and monitoring well water levels if all of the following conditions are met: (i) water level measurements in a drilled well and a monitoring well were made more than one day apart and also less than one week apart (i.e., more than 1 day but less than 7 days separate the monitoring well water level measurement from the drilling report date), (ii) locations of the drilled well and the monitoring well differ by more than 10 m but less than 100 m (i.e., more than 10 m but less than 100 m separate the monitoring well's x,y location from the drilled well's x,y location), and (iii) the monitoring well depth and the drilled well depth differ by at least one meter but also differ by no more than five meters. For each of these three criteria, we set minimum values (e.g., well depths that differ by at least 1 m) to reduce the likelihood that the record of drilling of the monitoring well (recorded in the well drilling database) is compared against water levels recorded in the monitoring well database (thus guarding against the possibility that the two wells being compared are in fact the same well recorded in two different databases). (b) Locations of pairs of monitoring wells and drilled wells meeting our criteria for analyses (n=1,979 pairs of one monitoring well and one drilled well; each black dot represents one well pair). (c) Comparison of water level measurements recorded in a monitoring well (y-axis values) versus a drilling report (x-axis values). The strong correspondence (87% of comparisons have water levels the differ by less than 3 m; see the dashed 1:1 line) demonstrates that the driller report data capture similar water levels to monitoring wells, increasing our confidence that the water level data recorded in drilling reports captures actual hydrogeologic conditions. Not all measurements are shown, as the x- and y-axes are truncated at 100 m (98.5% of data are shown).

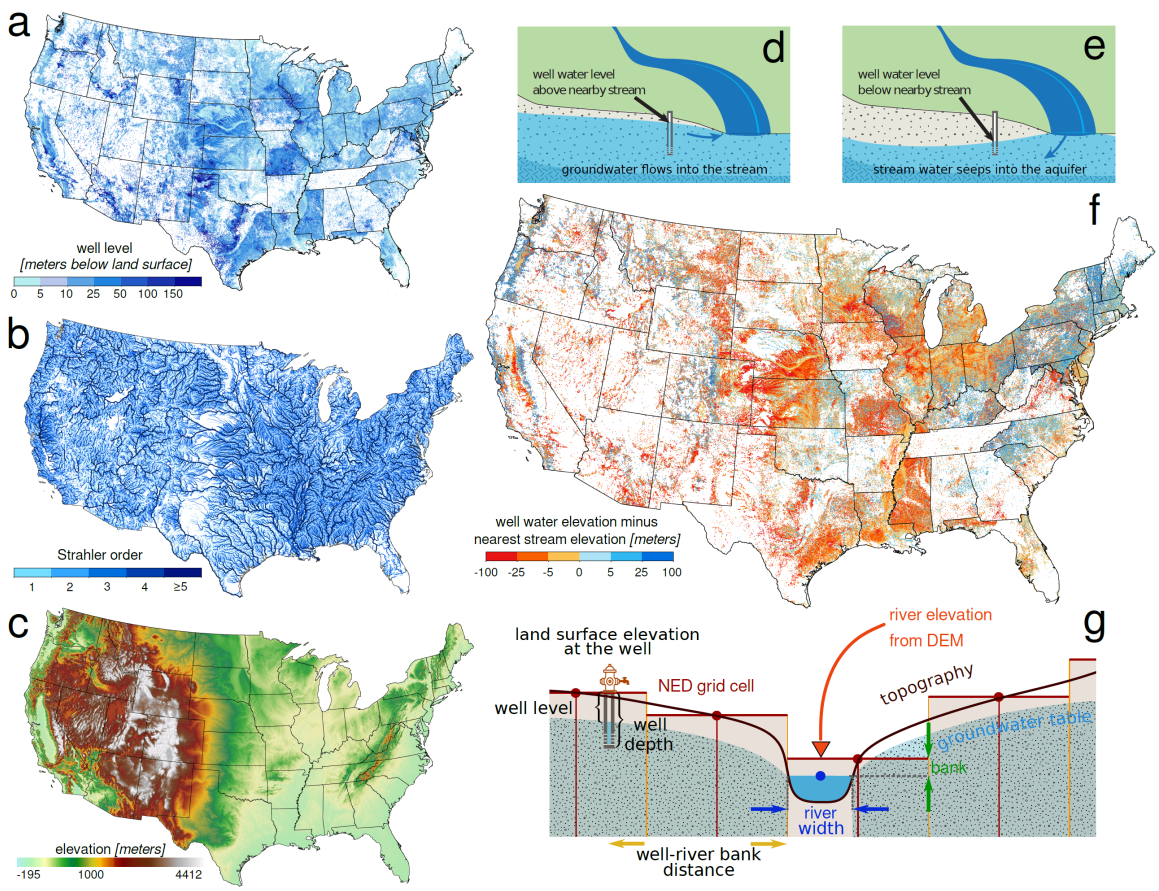
Supplementary Table 5. Here we summarize groundwater well completion data sources and provide hyperlinks to organizations that we contacted to request access to primary datasets and/or from which we downloaded data

State	Webpage	Permission to repost data for entire state?	Further info.
Arizona	http://www.azwater.gov/azdwr/gis/	—	ref. [26]
California	https://www.idwr.idaho.gov/wells/research.html	Yes	ref. [26]
Colorado	https://dwr.state.co.us/Tools/WellPermits	Yes	ref. [26]
Idaho	https://www.idwr.idaho.gov/wells/research.html	Yes	ref. [26]
Kansas	http://www.kgs.ku.edu/Magellan/WaterWell/index.html	—	ref. [26]
Montana	http://mbmggwic.mtech.edu/	Yes	ref. [26]
Nebraska	http://nednr.nebraska.gov/dynamic/wells/Menu.aspx	—	ref. [26]
Nevada	http://water.nv.gov/mapping.aspx?mapping=Well%20Drilling%20and%20Dam%20Data	Yes	ref. [26]
New Mexico	http://geospatialdata-ose.opendata.arcgis.com/	—	ref. [26]
North Dakota	http://www.swc.nd.gov/info_edu/map_data_resources/mapservices.html	—	ref. [26]
Oklahoma	http://www.owrb.ok.gov/maps/PMG/owrbdata_GW.html	Yes	ref. [26]
Oregon	http://apps.wrd.state.or.us/apps/gw/well_log/Default.aspx	—	ref. [26]
South Dakota	https://apps.sd.gov/nr68welllogs/	—	ref. [26]
Texas	https://www.twdb.texas.gov/mapping/gisdata.asp	Yes	ref. [26]
Utah	https://www.waterrights.utah.gov/wellinfo/wellsearch.asp	Yes	ref. [26]
Washington	https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx	Yes	ref. [26]
Wyoming	https://sites.google.com/a/wyo.gov/seo/documents-data/maps-and-spatial-data	—	ref. [26]
Arkansas	https://wise.er.usgs.gov/driller_db/	—	ref. [85]
Louisiana	http://www.sonris.com/	—	ref. [85]
Ohio	https://apps.ohiodnr.gov/water/maptechs/wellogs/appNEW/	—	ref. [85]
Pennsylvania	https://www.dcnr.pa.gov/Conservation/Water/Groundwater/PAGroundwaterInformationSystem/Pages/default.aspx	—	ref. [85]
Alabama	http://www.gsa.state.al.us/inter/staff	—	ref. [27]
Alaska**	http://dnr.alaska.gov/mlw/water/hydro/components/regional-offices.cfm	—	ref. [27]
Delaware	https://data.delaware.gov/Energy-and-Environment/Well-Permits/2655-qn8j	—	ref. [27]
Florida: St. Johns River Water Management District	http://www.sjrwmd.com/	—	ref. [27]
Florida: Northwest Florida Water Management District	https://www.nwfwater.com/Permits/Well-Permits/Setbacks-Fees-Maps/Well-Data-from-Submitted-Completion-Reports	—	ref. [27]
Florida: Suwannee River	http://www.mysuwanneeriver.com/Directory.aspx?did=30	—	ref. [27]

State	Webpage	Permission to repost data for entire state?	Further info.
Water Management District			
Florida: Southwest Florida Water Management District	https://data-swfwmd.opendata.arcgis.com/datasets/well-construction-permits	—	ref. [27]
Florida: South Florida Water Management District*	https://www.sfwmd.gov/doing-business-with-us/permits/well-construction	—	ref. [27]
Hawaii**	https://www.higp.hawaii.edu/hggrc/projects/hawaii-state-waterwells/	—	ref. [27]
Illinois	http://www.isgs.illinois.edu/ilwater	—	ref. [27]
Indiana	https://www.in.gov/dnr/water/3595.htm	—	ref. [27]
Iowa	https://geodata.iowa.gov/dataset/geologic-sampling-points-iowa	—	ref. [27]
Kentucky	http://www.uky.edu/KGS/water/research/gwreposit.htm	Yes	ref. [27]
Maine	http://www.maine.gov/dacf/mgs/pubs/digital/well.htm	—	ref. [27]
Maryland	https://mde.maryland.gov/programs/Water/water_supply/Pages/Permitting.aspx	—	ref. [27]
Massachusetts	https://www.mass.gov/service-details/well-database	—	ref. [27]
Michigan	http://www.mcgi.state.mi.us/mgdl/ground_water/Wellogic_Complete_Statewide_Wells/Wells_Complete.zip	—	ref. [27]
Minnesota	https://www.mngeo.state.mn.us/chouse/ground_water/gis_data.html	—	ref. [27]
Mississippi	https://www.mdeq.ms.gov/about-mdeq/contact-mdeq/staff-directory/	Yes	ref. [27]
Missouri	http://www.msdis.missouri.edu/index.html	—	ref. [27]
New Hampshire	http://www.des.nh.gov/organization/commissioner/gsu/wwip/index.htm	—	ref. [27]
New Jersey	https://www.state.nj.us/dep/watersupply/a_allocat.html	—	ref. [27]
New York	https://www.dec.ny.gov/lands/33317.html	—	ref. [27]
North Carolina	https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/ground-water-protection/well-program	—	ref. [27]
Rhode Island	https://health.ri.gov/	—	ref. [27]
South Carolina	http://www.dnr.sc.gov/water/hydro/staff.html	Yes	ref. [27]
Tennessee	http://tdec.tn.gov/org-charts/Home/Department/drinkingwater	—	ref. [27]
Vermont	http://anrgeodata.vermont.gov/datasets?q=wells	—	ref. [27]
Virginia	http://deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterProtectionSteeringCommittee/WellheadProtection.aspx	—	ref. [27]
Wisconsin	https://dnr.wisconsin.gov/	—	ref. [27]

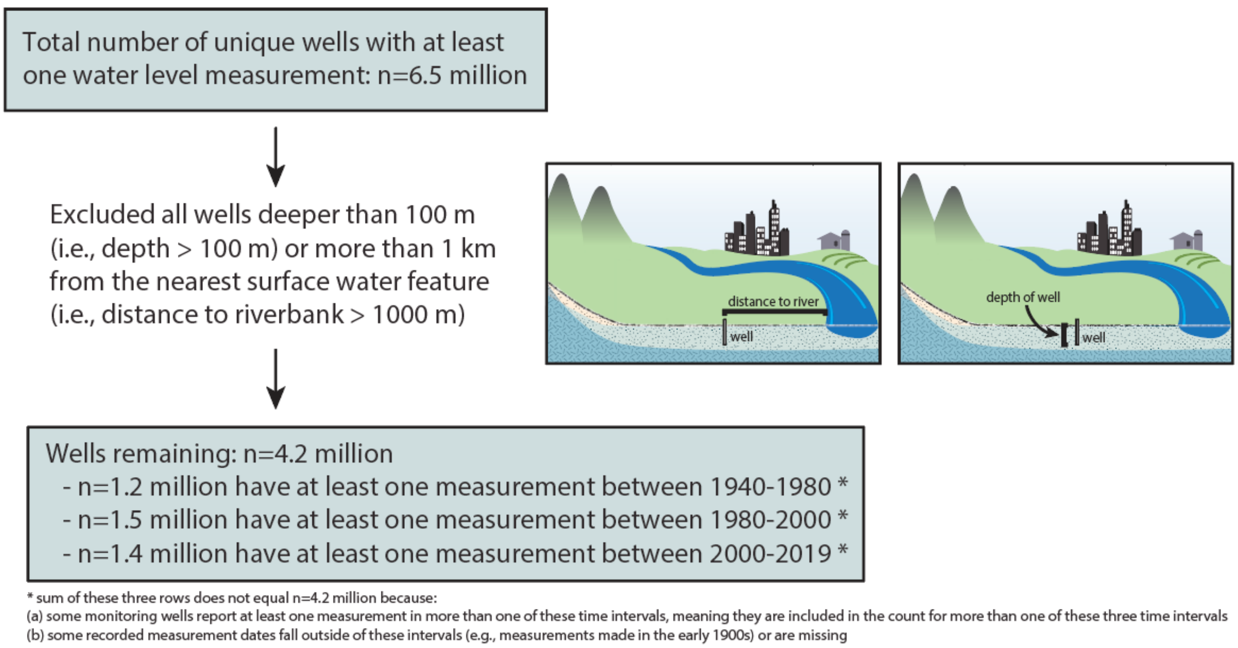
* data compiled county-by-county; for details see SI of ref. [27]

** Hawaii and Alaska are not included in our main analyses, which focus on the contiguous United States

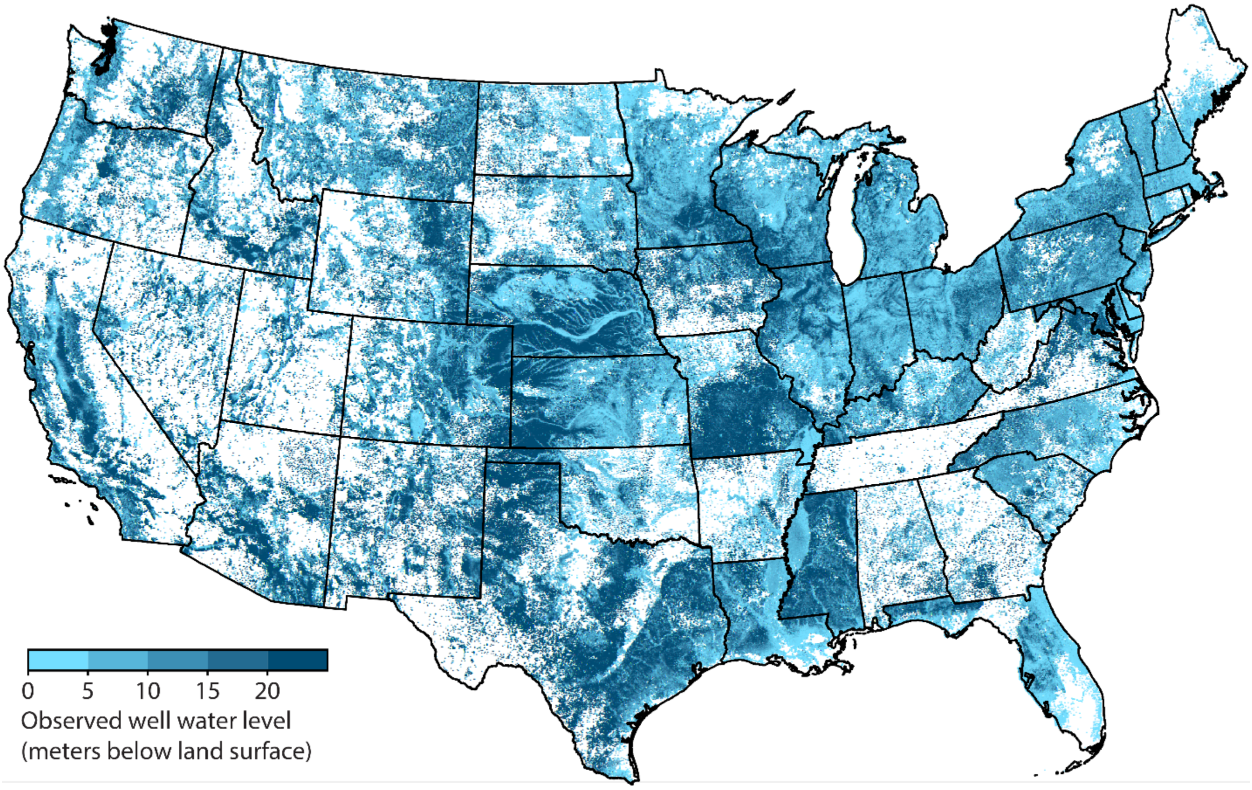


Supplementary Figure 5. Data analyzed to compare well water levels and stream elevations. (a) Recorded depth to water in 6.5 million wells. This map shows our entire well data set, including water level measurements that were excluded from our analyses because they were made in wells deeper than 100 m or more than 1 km from the nearest stream. Where we have more than one water level measurement for a single well, the median is shown. (b) The National Hydrography Dataset's 30 m resolution flowline network (darker shades of blue represent higher stream orders). (c) The National Elevation Dataset's 30 m resolution land surface elevation for the contiguous United States, which was used to calculate the elevation of the well water levels as well as the elevations of the streams. (d) Schematic of a location where the water table lies above the nearest stream (potentially gaining stream). (e) Schematic of a location where the well water level lies below the nearest stream (potentially losing stream). (f) Comparison of the elevations of well water levels and the elevation of the nearest point on the nearest stream (adjusting for the height of the streambank, see panel g). (g) Schematic cross section of a stream corridor where the water table lies above the stream. Labels depict different geospatial data (from left to right) (i) "well level" represents the depth below the land surface to the water level measured in the well; (ii) "well depth" represents the depth of the well in which a water level measurement was made; (iii) "NED grid cell" represents an example of a National Elevation Dataset (NED) grid cell (data accompany ref. [29]), which in this schematic shows that the NED may be too coarse to capture the narrow stream channel; (iv) "well-river bank distance" represents the distance from the well to the bank of the stream; wells more than 1 km (or 250 m; see Supplementary Section S4.1) from the nearest streambank were excluded from our analysis; (v) "river width" represents the width of the river (as estimated by ref. [43]); (vi) "river elevation from DEM" indicates the elevation of the river (blue) as represented by the digital elevation model (DEM); in this case, we highlight that the elevation captured by the digital elevation model may overestimate the actual elevation of the stream surface, because part of the grid cell overlaps with the streambank (see right side of horizontal dark red line as it transitions from overlying the stream to overlying the adjacent land); (vii) "bank" represents the bankfull height recorded in the National Hydrography Dataset (ref. [29]); we adjusted the stream surface elevations captured by the digital elevation dataset using these bank height values.

Of the n=6.5 million unique wells for which at least one well water level measurement was available (Supplementary Figure 7), n=4.2 million unique wells met the following criteria for inclusion in our analysis: (i) they have depths no deeper than 100 m, *and* (ii) they have recorded locations that are within 1 km of the bank of a National Hydrography Dataset (version "NHDPlusV2") surface water feature. Because the NHDPlusV2 dataset only provides the locations of the centerlines of streams, we subtract half the estimated width of each river to estimate the distance from each well to the streambank (Supplementary Figure 6; main text Figure 2). The estimated widths of each surface water feature (i.e., each NHDPlusV2 flowline) are from ref. [43].



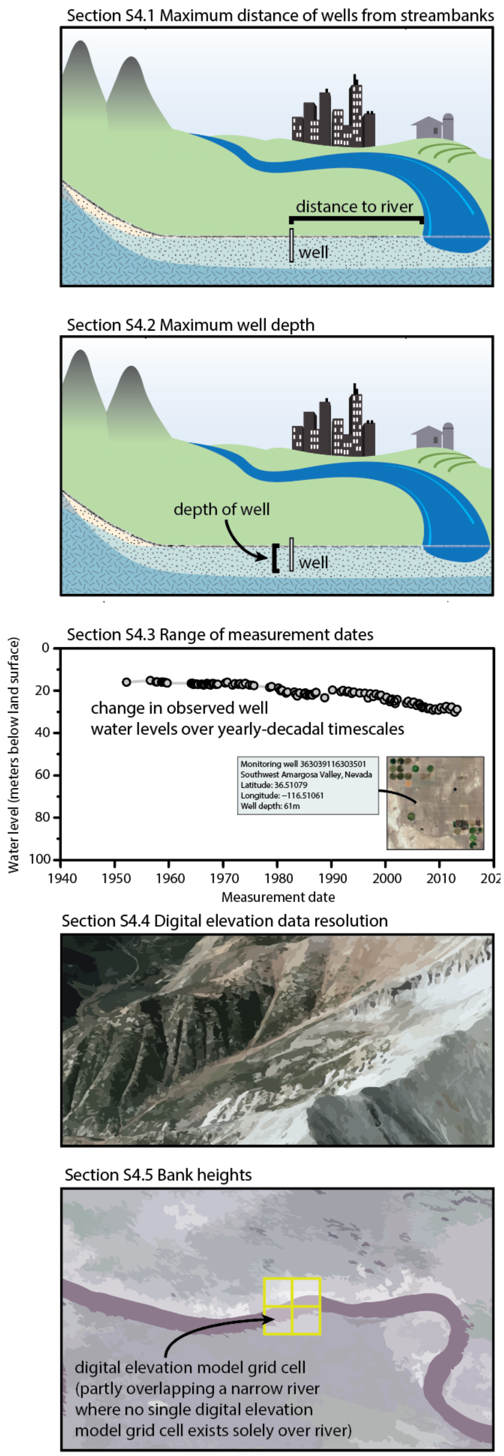
Supplementary Figure 6. Schematic detailing how well water level data were processed. Specifically, the schematic shows how the original database (consisting of ~6.5 million unique wells with at least one well water level measurement) was reduced to include only those wells with depths no deeper than 100 m and also no more than 1 km from the nearest National Hydrography Dataset streambank. For wells where we have more than one measurement (e.g., a time series of water level measurements in monitoring wells), we analyzed the median well water level (evaluated for a given time interval, see Supplementary Section S4.3).



Supplementary Figure 7. Well water levels across the contiguous USA. Each point represents one well, and its colour on this map represents the water level in that well relative to the topographic surface. For monitoring wells with more than one water level measurement, we present the median of the available measurements. Well water levels are often shallower—that is, closer to the land surface—near many major rivers, across much of Florida and in the northeast USA (light blue points). Well water levels are often deeper—that is, farther below the land surface—across much of the western USA, including regions where groundwater reserves have been depleted (e.g., High Plains in western Texas and southwestern Kansas; southern portion of California's Central Valley).

S4. Sensitivity analyses

This supplementary information section presents sensitivity analyses that evaluate the robustness of our findings, as summarized in Supplementary Figure 8.



Supplementary Figure 8. Schematic of five sensitivity analyses that are detailed in Supplementary Sections S4.1-S4.5. Each panel represents one sensitivity analysis. The images are schematics of scenarios we identified as potentially impactful to our main results.

4.1. Sensitivity analysis: Maximum distance of wells from streambanks

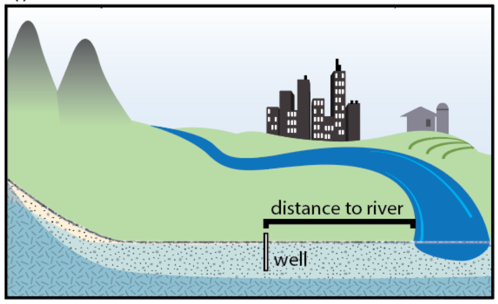
We evaluated the sensitivity of our results to the maximum distance from each well to its nearest streambank (beyond which the well was deemed unlikely to be useful for assessing aquifer-stream connectivity). The distance from each well to the nearest streambank was estimated by (i) calculating the horizontal distance from each well to the nearest surface water feature polyline (from ref. [29]), and (ii) subtracting one-half of the estimated stream width (estimated by ref. [43]) for that stream segment (under the implicit assumption that National Hydrography Dataset polylines approximate stream centerlines).

We show that as the maximum threshold distance from a well to the nearest streambank is reduced, the fraction of wells consistent with a losing stream (i.e., well water level lower than nearest stream elevation) tends to increase (see Supplementary Table 6). Our finding meets intuition: systematically excluding a greater number of wells drilled farther from a stream also tends to exclude more wells that are located where land surfaces are high relative to stream surfaces. Because water tables often represent a subdued version of topography in many areas, excluding wells at higher elevations also systematically excludes areas with higher water tables.

The proportions of well water levels that lie below the nearest stream range from 64% to 75% among the sensitivity analysis thresholds (within 250 m, 500 m, 750 m or 1 km of the nearest stream), highlighting that our first main finding—that the majority of well water levels lie below nearby stream surfaces, demonstrating widespread potential for losing streams where wells are close by—remains robust to the threshold distance we apply to determine which wells are included in our analysis.

Supplementary Table 6. How the maximum distance from wells to their nearest rivers affects the fraction of well water level elevations that lie below the nearest river (suggesting losing conditions)

(i) Maximum distance of wells to nearest river



Threshold well distance from nearest river (determined by the distance from a well to the nearest National Hydrography Dataset feature minus half of the estimated river width)	Fraction of all well water levels that lie below the elevation of the nearest river***
Excluding wells >250 m from riverbank	75% (n=1,218,336, of n=1,630,026 wells) *
Excluding wells >500 m from riverbank	68% (n=1,948,634 of n=2,853,972 wells) *
Excluding wells >750 m from riverbank	65% (n=2,396,734 of n=3,667,256 wells) *
Excluding wells more >1000 m from riverbank**	64% (n=2,667,323 of n=4,174,218 wells) *

* we only consider wells with depths of no more than 100 m. All results presented here derive from our analysis using the 30 m digital elevation data (as river width data were available only for this spatial resolution)

** value presented in the main text

*** calculated as: (well water level elevation − river elevation from digital elevation data + bank height)

4.2. Sensitivity analysis: Maximum depth of wells

This subsection evaluates how our results vary when considering shallower versus deeper wells. We test the sensitivity of our results to the maximum depth of wells in two ways:

(1) using only well water level measurements derived from wells no deeper than the 25th percentile, median, and 75th percentile well depth in each county, as determined after our initial data exclusion steps (see Supplementary Figure 10 for workflow and Supplementary Table 7 for results);
(2) using only well water level measurements derived from wells no deeper than 25 m, 50 m, 75 m and 100 m (Supplementary Table 8).

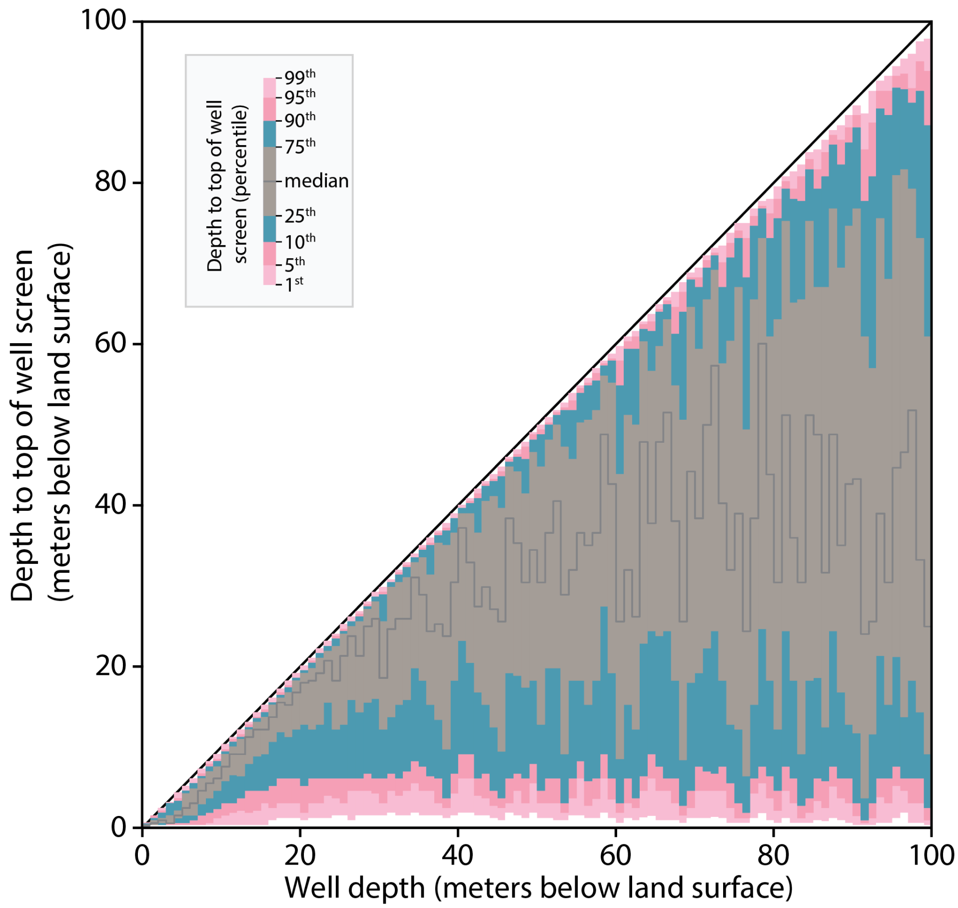
We analyze depths of the wells rather than their screened intervals because the latter are unavailable for many of the wells in our dataset. We emphasize that the total well depth represents the maximum depth at which perforations exist in a given well, but many production wells in our database have screened intervals that are substantially shallower than their bottoms (see Supplementary Figure 9).

In general, inclusion of deeper wells tends to increase the fraction of [well water level elevation minus nearest stream surface elevation + bank height] values that are consistent with potentially losing streams (Supplementary Tables 7 and 8). This relationship—greater proportions of well water elevations below nearby stream surfaces among deeper wells—likely arises in part because of the prevalence of downward-oriented vertical hydraulic gradients, which lead to deeper water levels in deeper wells (see ref. [27]).

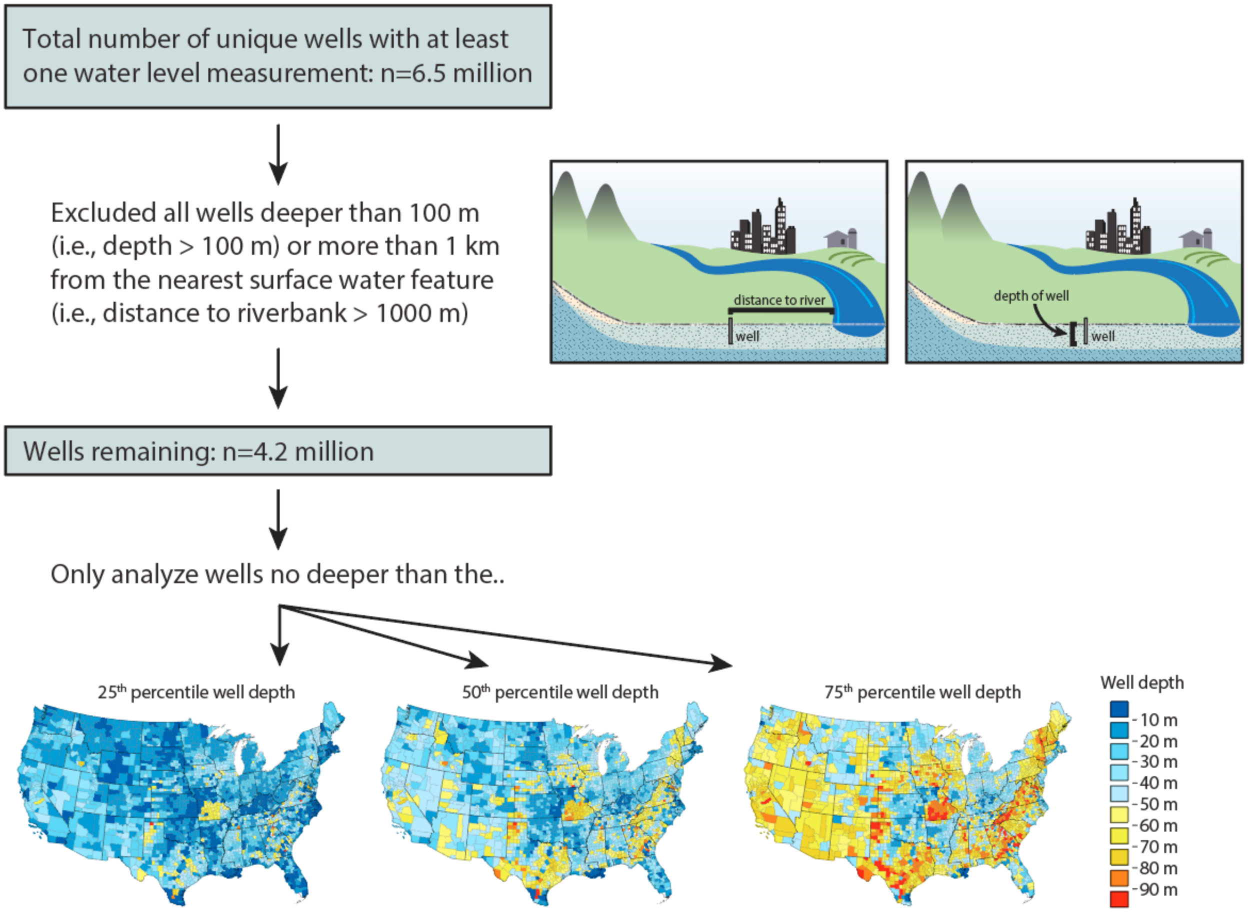
The fractions of well water levels that lie below the nearest stream range from 52% to 64% among these different well depth thresholds (i.e., including only wells with depths that are shallower than the lower quartile, median and upper quartile, or shallower than 25 m, 50 m, 75 m and 100 m; Supplementary Tables 7 and 8), demonstrating that our first main finding—that the majority of well water levels lie below nearby stream surfaces—remains robust to the threshold (i.e., maximum) well depth we use to exclude deeper wells from our analysis.

We also re-ran our explanatory variable analysis (i.e., Figure 4 of main text) for each of the sensitivity analyses presented in Supplementary Tables 7 and 8. All of these sensitivity analyses (Supplementary Table 9) yield similar Spearman rank correlation coefficients between the fractions of wells with water levels that lie below nearby streams in each county and (i) county-average precipitation divided by potential evapotranspiration, (ii) county-average groundwater withdrawals, or (iii) county-average topographic slope. The similarities in these rank correlations demonstrate that our second main finding—that wells with water levels below the nearest stream tend to be more prevalent where (i) climate is more arid, (ii) groundwater pumping rates are higher, and (iii) topography is flatter—is largely insensitive to the maximum depth of wells considered in our analysis.

Our examination of two regional-scale aquifer systems (for which three-dimensional hydrostratigraphic data are available) suggests that the well depth thresholds in our sensitivity analyses (i.e., 25 m to 100 m well depth thresholds) encompass the most common depths at which these aquifer systems transition from unconfined to confined conditions (Supplementary Table 10).

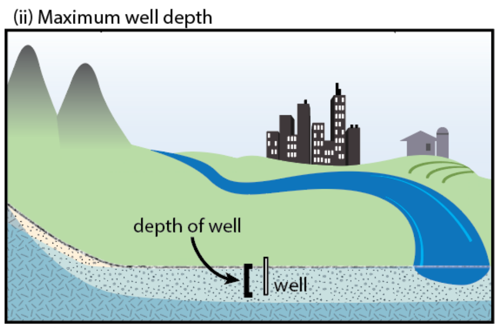


Supplementary Figure 9. Total recorded well depths (x-axis values; expressed in meters below land surface), compared to the recorded depth to the top of the uppermost perforated interval (y-axis values; expressed in meters below land surface). The diagonal black line marks a 1:1 relationship. Shaded areas mark the percentiles of depths to the top of the shallowest perforations (see legend in upper left corner): dark grey represents the 25th-75th percentile range, light blue represents the 10th-25th percentile range and the 75th-90th percentile range, dark pink represents the 5th-10th percentile range and the 90th-95th percentile range, and light pink represents the 1st-5th percentile range and the 95th-99th percentile range (percentiles determined by binning the x-axis well depths into 1 m intervals), and the dark grey line represents the median. We lack screen interval data for many well completion reports; therefore, we use well depth data (which are more widely available than well screen interval data) in the sensitivity analyses described in Supplementary Section S4.2. Our comparison of the total depth of wells (x-axis) and the depth to the top of their perforations (y-axis) demonstrates that many wells (among those for which we have screen interval data) have perforated intervals that begin at considerably shallower depths than the total depth of the well. For example, half of wells that have total depths between 99 m and 100 m have tops of perforated intervals (or bottoms of casings) within 25 m of the land surface. Therefore, the depth thresholds presented in our sensitivity analyses in Supplementary Section S4.2 will be deeper than the shallowest screened intervals in many of these wells. We emphasize that not all of our well completion datasets record well screen interval data; in some cases, the depth to the bottom of the well casing was analyzed, which will underestimate the depth to the top of the well screen for some wells (see refs. [26,27]).



Supplementary Figure 10. Schematic detailing how water level data were excluded on the basis of county-level well depth percentiles (specifically, lower-quartile, median and upper-quartile depths of wells in each county). The schematic shows how the wells in the original database (consisting of ~6.5 million unique wells with at least one well water level measurement) were selected on the basis of their depth (no deeper than 100 m) and location (no more than 1 km from the nearest stream). Next (i.e., beneath text box that reads "Wells remaining: n=4.2 million"), we excluded wells deeper than (i) the lower-quartile well depth as quantified at the county scale (lower-left map), (ii) the median well depth as quantified at the county scale (lower-center map), or (iii) the upper-quartile well depth as quantified at the county scale (lower-right map). These three exclusion criteria (three lowermost arrows on figure above) represent the various rows in Supplementary Table 7 below.

Supplementary Table 7. Effect of well depth on the fraction of well water elevations that lie below the nearest stream (suggesting losing conditions)



Threshold well depth (i.e., any wells with depths deeper than this threshold are excluded from analysis)	Fraction of all well water levels that lie below the elevation of the nearest stream***
Excluding wells deeper than the county's lower-quartile well depth	52% (n=564,973 of n=1,090,061) *
Excluding wells deeper than the county's median well depth	57% (n=1,212,672 of n=2,133,445) *
Excluding wells deeper than the county's upper-quartile well depth	61% (n=1,921,362 of n=3,166,434) *
Excluding wells deeper than 100 m**	64% (n=2,667,323 of n=4,174,218 wells) *

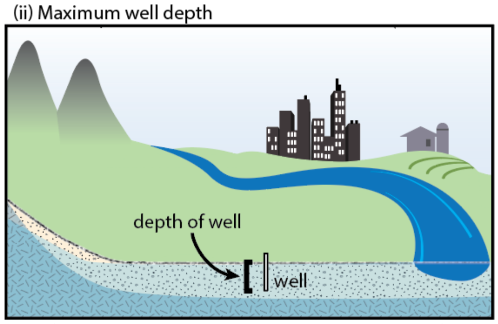
* we only consider wells located no more than 1 km from the nearest NHD polyline. All results presented here derive from our analysis using the 30 m digital elevation data (as stream width data were available only for this spatial resolution)

** value presented in the main text

*** calculated as: (well water level elevation − stream elevation from digital elevation data + bank height)

Supplementary Table 8. Effect of well depth on the fraction of well water elevations that lie below the nearest stream (suggesting losing conditions)

(ii) Maximum well depth



Threshold well depth (i.e., any wells with depths deeper than this threshold are excluded from analysis)	Fraction of all well water levels that lie below the elevation of the nearest stream***
Excluding wells deeper than 25 m	54% (n=847,843 of n=1,579,404 wells) *
Excluding wells deeper than 50 m	60% (n=1,783,840 of n=2,967,991 wells) *
Excluding wells deeper than 75 m	63% (n=2,330,762 of n=3,719,166 wells) *
Excluding wells deeper than 100 m**	64% (n=2,667,323 of n=4,174,218 wells) *

* we only consider wells located no more than 1 km from the nearest NHD polyline. All results presented here derive from our analysis using the 30 m digital elevation data (as stream width data were available only for this spatial resolution)

** value presented in the main text

*** calculated as: (well water level elevation − stream elevation from digital elevation data + bank height)

Supplementary Table 9. Explanatory variable analysis (e.g., main text Figure 4) repeated with deep wells excluded. Only counties with water level data for at least three wells are considered

Threshold well depth (i.e., any wells with depths deeper than this threshold are excluded from analysis)	Spearman rank correlation of [County-scale fraction of all well water levels that lie below the elevation of the nearest stream] versus the following variables:		
	County-average annual groundwater withdrawals	County-average P/PET**	County-average topographic slope
Excluding wells deeper than the county's lower-quartile well depth	ρ = 0.29	ρ = −0.26	ρ = −0.20
Excluding wells deeper than the county's median well depth	ρ = 0.31	ρ = −0.32	ρ = −0.26
Excluding wells deeper than the county's upper-quartile well depth	ρ = 0.32	ρ = −0.36	ρ = −0.32
Excluding wells deeper than 25 m	ρ = 0.26	ρ = −0.31	ρ = −0.24
Excluding wells deeper than 50 m	ρ = 0.30	ρ = −0.34	ρ = −0.32
Excluding wells deeper than 75 m	ρ = 0.32	ρ = −0.37	ρ = −0.33
Excluding wells deeper than 100 m*	ρ = 0.32	ρ = −0.38	ρ = −0.33

* values presented in main text Figure 4
** precipitation divided by potential evapotranspiration

Three-dimensional hydrogeologic data are required in order to distinguish wells that penetrate confined aquifers from those that are perforated in unconfined aquifers. Although high-resolution three-dimensional hydrogeologic data are not presently available for the contiguous US, they are available for several regional-scale aquifer systems. We completed regional-scale analyses for two of these aquifer systems:

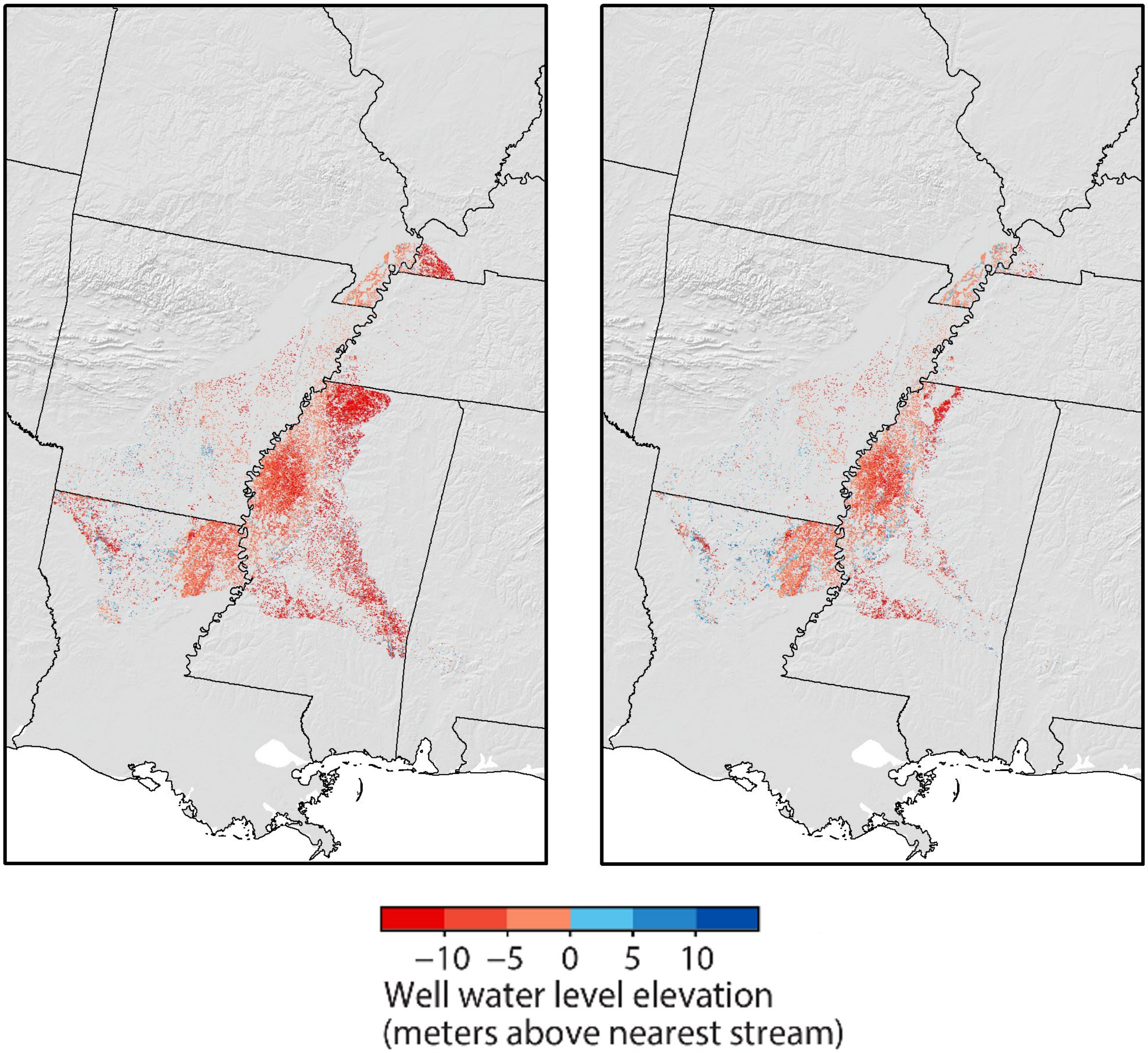
- The Mississippi Embayment (digital geologic data from ref. [86])
- The North Atlantic Coastal Plain (digital geologic data from ref. [87])

In each of these two analyses, we excluded wells that penetrate the top of the uppermost confining unit (Supplementary Figures 11 and 12), and found that the proportion of wells with water levels that lie below the nearest stream is only slightly lower (by 2% or 5%; see blue shaded cells in Supplementary Table 10) than the results we presented in the main text for each aquifer system. This proportion also falls within the fractions of wells with water levels that lie below the nearest stream when we exclude wells deeper than 25 m, 50 m, 75 m, or 100 m (see red shaded cells in Supplementary Table 10). These regional-scale analyses suggest that excluding wells deeper than 25 m, 50 m, 75 m, or 100 m does not produce substantially different results than those obtained when we exclude wells penetrating the top of the uppermost confining unit, at least for the Mississippi Embayment and the North Atlantic Coastal Plain.

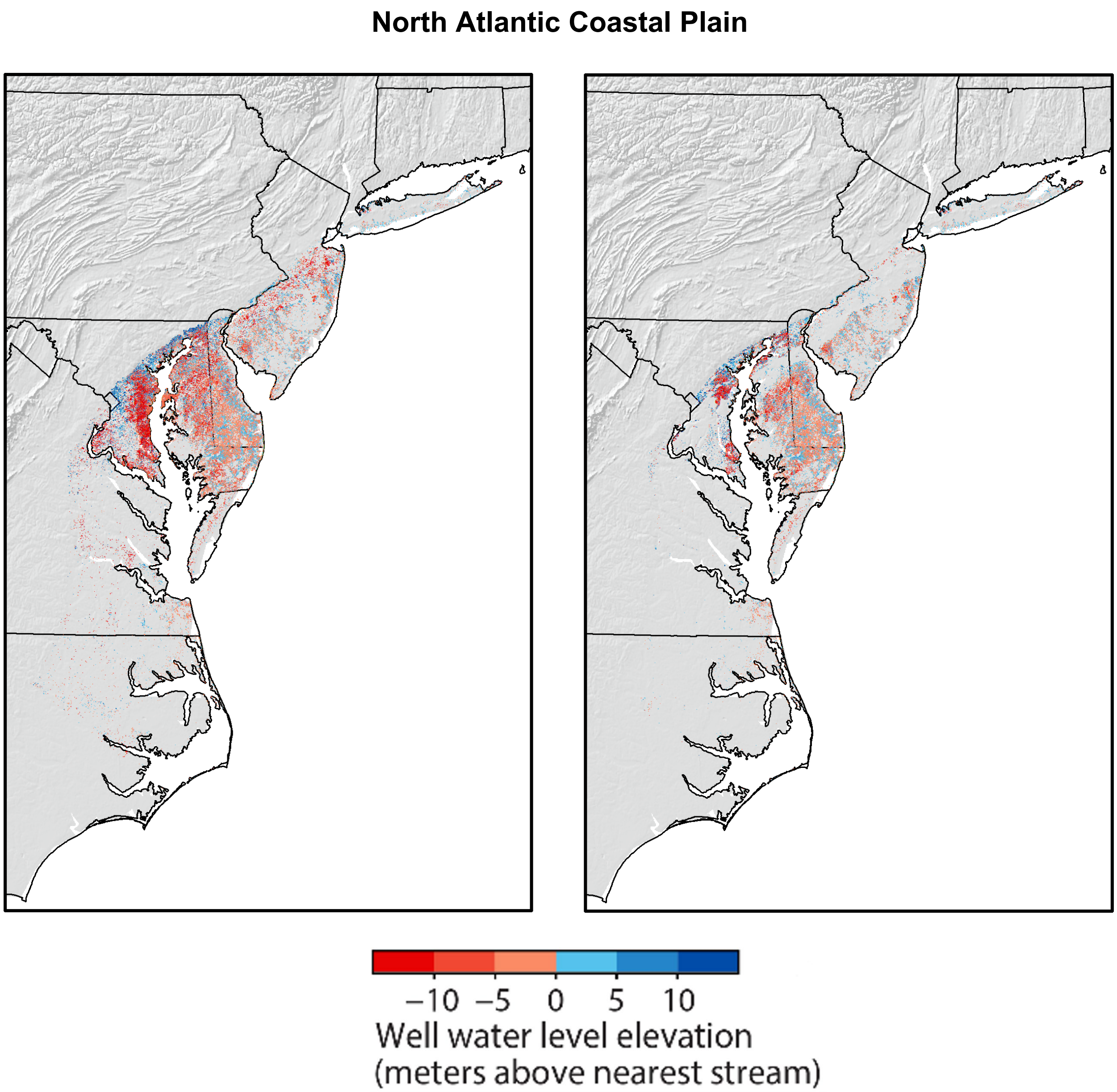
Supplementary Table 10. The prevalence of wells with water levels that lie below the nearest stream if we isolate our analysis only to wells that overlie the uppermost confining unit (blue shaded cells), compared to the prevalence of wells with water levels that lie below the nearest stream if we isolate our analysis only to wells shallower 25 m, 50 m, 75 m, or 100 m (red shaded cells)

Aquifer System	**Mississippi Embayment**	**North Atlantic Coastal Plain**
All wells within 1 km of the nearest stream *and* with a depth of no more than 100 m *and* with bottoms that overlie the top of the uppermost confining unit	**82%** have water levels that lie below the nearest stream	**59%** have water levels that lie below the nearest stream
All wells within 1 km of the nearest stream *and* with a depth of no more than 25 m	**64%** have water levels that lie below the nearest stream	**49%** have water levels that lie below the nearest stream
All wells within 1 km of the nearest stream *and* with a depth of no more than 50 m	**82%** have water levels that lie below the nearest stream	**56%** have water levels that lie below the nearest stream
All wells within 1 km of the nearest stream *and* with a depth of no more than 75 m	**84%** have water levels that lie below the nearest stream	**60%** have water levels that lie below the nearest stream
All wells within 1 km of the nearest stream *and* with a depth of no more than 100 m	**84%** have water levels that lie below the nearest stream	**64%** have water levels that lie below the nearest stream

Mississippi Embayment



Supplementary Figure 11. Comparison of well-water and stream-surface elevations in the Mississippi Embayment Aquifer System. (left panel) Comparison of well-water and stream-surface elevations as presented in the main text (i.e., in main text Figure 2) for all wells within the boundaries of the Mississippi Embayment Aquifer System. (right panel) Comparison of well-water and stream-surface elevations for all wells that are shallower than the top of the uppermost confining unit (as estimated using the digital geological dataset reported by ref. [86]).



Supplementary Figure 12. Comparison of well-water and stream-surface elevations in the North Atlantic Coastal Plain. (left panel) Comparison of well-water and stream-surface elevations as presented in the main text (i.e., in main text Figure 2) for all wells within the boundaries of the North Atlantic Coastal Plain. (right panel) Comparison of well-water and stream-surface elevations for all wells that are shallower than the top of the uppermost confining unit (as estimated using the digital geological dataset ref. [87]).

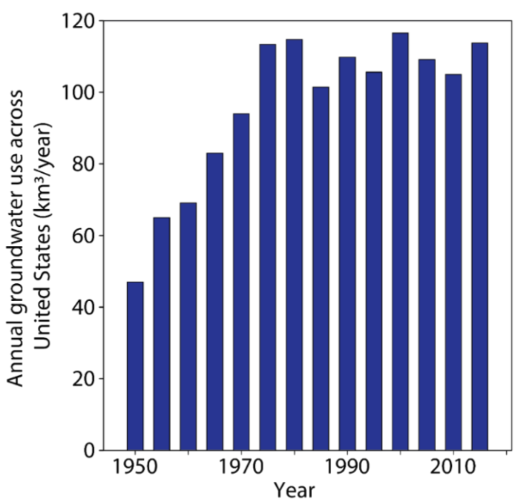
4.3. Sensitivity analysis: Range of measurement dates

This subsection evaluates how our results vary when we focus only on well water levels measured within one of the following time intervals:

(i) 1940-1980
(ii) 1980-2000
(iii) 2000-2019

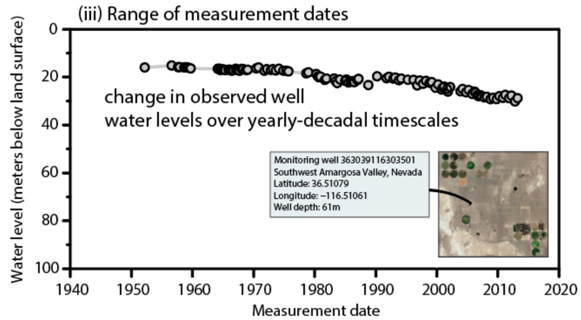
For monitoring wells with more than one water level measurement, we present the median of the available measurements for each given time interval. The spatial distributions of wells with water level data vary among the different time intervals. For example, most driller-report-based water level data postdate the year 2000 for Texas and postdate the year 1990 for Washington.

The fractions of well water levels that lie below the nearest stream vary from 63% to 65% among the three studied time intervals (Supplementary Table 11). This demonstrates that our first main finding—that the majority of well-water levels lie below nearby stream surfaces, demonstrating widespread potential for losing streams where wells are close by—is not highly sensitive to the time period that we study. This conclusion is not entirely counterintuitive; annual groundwater withdrawals for the US (as estimated by the United States Geological Survey; ref. [32]) have been high and relatively constant since the 1970s (Supplementary Figure 13), though cumulative groundwater depletion has increased (see Figure 56 in ref. [88]). Water level declines have been reported in many monitoring wells across the United States (see the recent comprehensive analysis by ref. [89]). Our sensitivity analysis suggests that hydraulic gradients consistent with losing streams have been widespread in many parts of the US for several decades, where wells have been constructed.



Supplementary Figure 13. Estimated annual fresh groundwater pumping for the United States (data from Table 14 in ref. [32]). Estimated annual fresh groundwater withdrawals more than doubled from 1950 to 1975, increasing from ~47 km^3/year in 1950 to ~113 km^3/year in 1975. Estimated annual fresh groundwater withdrawals in the United States plateaued after 1975, varying between 101 km^3/year and 117 km^3/year over the following 40 years.

Supplementary Table 11. How the fraction of well water level elevations that lie below the nearest stream varies across three different time intervals

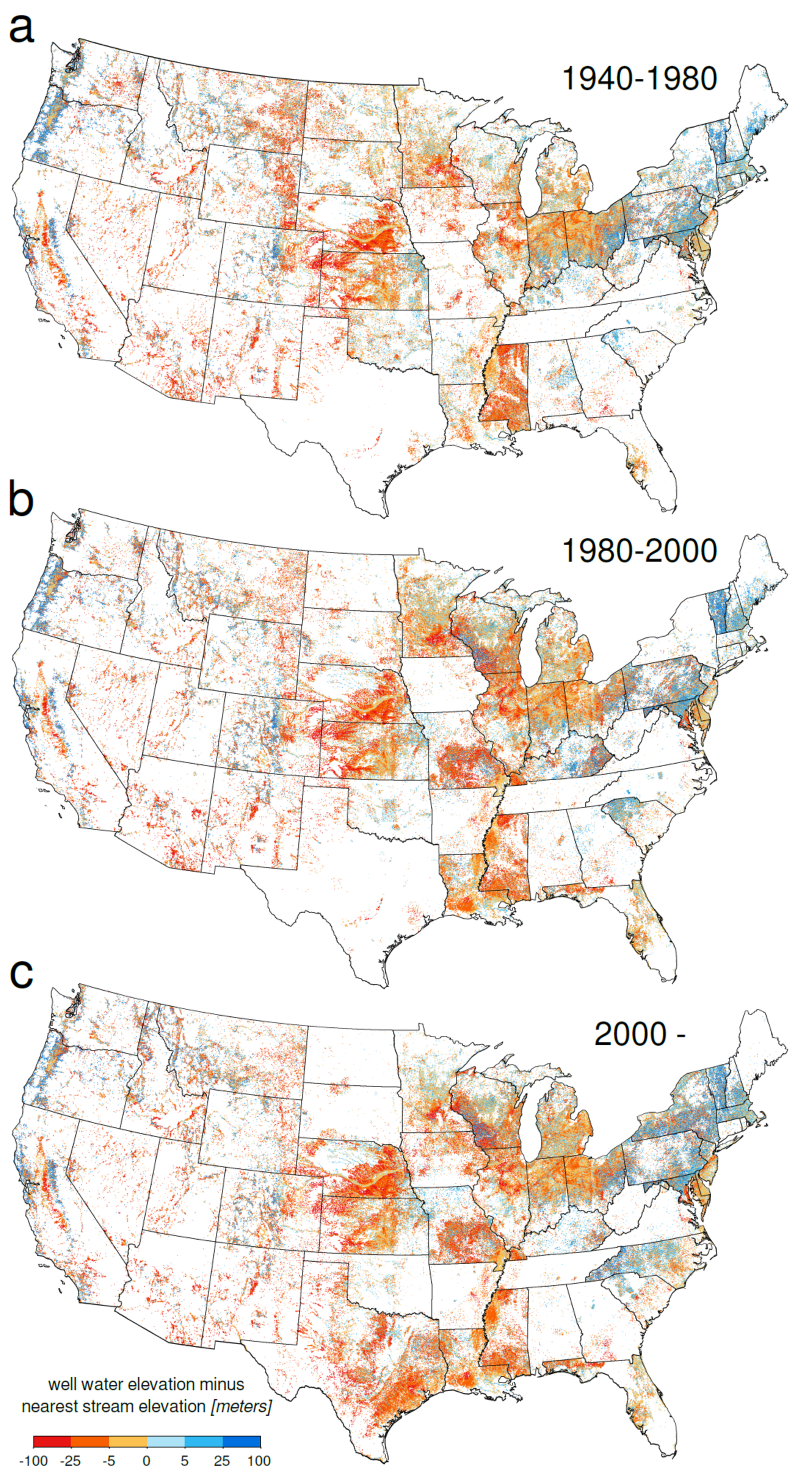


Time interval	Fraction of all well water levels that lie below the elevation of the nearest stream***
1940-1980	63% (n=751,167 of n=1,192,393 wells) *
1980-2000	64% (n=976,379 of n=1,536,517 wells) *
2000-2019	65% (n=891,195 of n=1,362,695 wells) *
**** All measurements**	64% (n=2,667,323 of n=4,174,218 wells) *

* we only consider sites meeting all of the following criteria: (i) well depth is no more than 100 m, (ii) well is no more than 1 km from the nearest National Hydrography Dataset feature. All results presented here derive from our analysis of 30 m digital elevation data (as stream width data were available only for this spatial resolution)

** includes water level measurements that lack a measurement date (meaning the total number of measurements reported here is greater than the sum of the number of measurements reported among the three rows above this). This is the measurement date range used in the main text (i.e., Figure 2 main text)

*** calculated as: (well water level elevation − stream elevation from digital elevation data + bank height)



Supplementary Figure 14. Comparison of well water level and stream surface elevations for three different time intervals: (panel a) 1940-1980, (panel b) 1980-2000, and (panel c) 2000-present. Each map compares the elevations of well water levels and the elevation of the nearest point on the nearest stream (only wells within 1 km of a stream and with a depth of less than 100 m are shown).

4.4. Sensitivity analysis: Spatial resolution of elevation and hydrography data

The elevation data described in the main text have a spatial resolution of 30 m. Although ~10 m resolution digital elevation data are available, they lack the stream width and bankfull height data that we need for our analysis. For that reason, we used ~30 m resolution digital elevation data in the main text. Here, we examine how using ~10 m (instead of ~30 m) hydrography and land surface elevation data would affect our results (but ignoring bank height in both cases, to make this comparison possible).

The fraction of well water levels that lie below the nearest stream changes by only six percent (from 69% to 75%) when we use ~10 m versus ~30 m resolution elevation and hydrography data (Supplementary Table 12). This demonstrates that our first main finding—that the majority of well water levels lie below nearby stream surfaces, implying widespread potential for losing streams where wells are close by—is not highly sensitive to the spatial resolution of the digital elevation data that we analyze.

Supplementary Table 12. Effect of the spatial resolution of digital elevation data on the fraction of well water elevations that lie below the nearest stream (suggesting losing conditions)

(iv) Digital elevation model resolution in valleys

Digital elevation data resolution	Fraction of all well water levels that lie below the elevation of the nearest stream (without correcting for bank height)
Results based on 30 m resolution digital elevation data *	69% (n=2,885,811 of n=4,174,218 wells)
Results based on 10 m resolution digital elevation data [x]	75% (n=3,117,329 of n=4,174,218 wells)

* we only consider sites meeting all of the following criteria: (i) well depth is no more than 100 m deep, and (ii) well is no more than 1 km from the nearest NHD polyline based on the 30 m resolution digital elevation data. These results do not include the adjustment made to account for streambank heights (unlike the values presented in the main text). In order to keep our method consistent for the 30 m and 10 m resolution analyses, we do not adjust for bank height because there is no equivalent bank height product for the 10 m resolution digital elevation and hydrography dataset.

[x] for consistency, we only analyze well water level data for wells that met our criteria for analyses based on the 30 m resolution digital elevation data (i.e., the total number of wells – that is, the text: "..of n=4,174,218 wells"—is consistent for analyses using the 30 m and 10 m resolution digital topography).

4.5. Sensitivity analysis: Bank heights

Elevations obtained from digital topography data may capture streambank elevations rather than stream surface elevations (i.e., overestimating the elevations of stream surfaces). We accounted for this possibility in two ways:

#1) We applied an offset to account for the height of streambanks (streambank height data from ref. [31]). This step was only possible for our analyses using 30 m resolution hydrography (as bank geometry data were not available for the 10 m resolution hydrography). This bank height offset is included in results presented in our main text.

#2) We completed a sensitivity analysis by applying an additional bank height offset. Specifically, we calculated the fraction of well water levels that lie below the nearest stream under two scenarios: (i) bank heights are assumed to be equivalent to those estimated by ref. [31] plus an additional 1 m, and (ii) bank heights are assumed to be equivalent to those estimated by ref. [31] plus an additional 2 m. These scenarios explore how sensitive our results would be to a systematic underestimation of bank heights by ref. [31], if this were the case. The fraction of well water levels that lie below the nearest stream varies from 50% to 64% among these scenarios (Supplementary Table 13). These analyses suggest that our main findings remain robust even in the case that ref. [31] has underestimated bank heights by up to 2 m.

Supplementary Table 13. How the fraction of well water level elevations that lie below the nearest stream would vary if bank heights were underestimated by ref. [31]

Fraction of all well water levels that lie below the elevation of the nearest stream [x] **(no additional bank height offset) ** **	Fraction of all well water levels that lie below the elevation of the nearest stream [x] **(additional 1 m bank height offset)**	Fraction of all well water levels that lie below the elevation of the nearest stream [x] **(additional 2 m bank height offset)**
64% (n=2,667,323 of n=4,174,218 wells)	57% (n=2,382,285 of n=4,174,218 wells)	50% (n=2,101,363 of n=4,174,218 wells)

* for all results presented in this table, we only consider sites meeting all of the following criteria: (i) well depth is no more than 100 m deep, (ii) well is no more than 1 km from the nearest NHD polyline. All results presented here derive from our analysis using the 30 m digital elevation model (as stream width data were available only for this spatial resolution)

** main text results

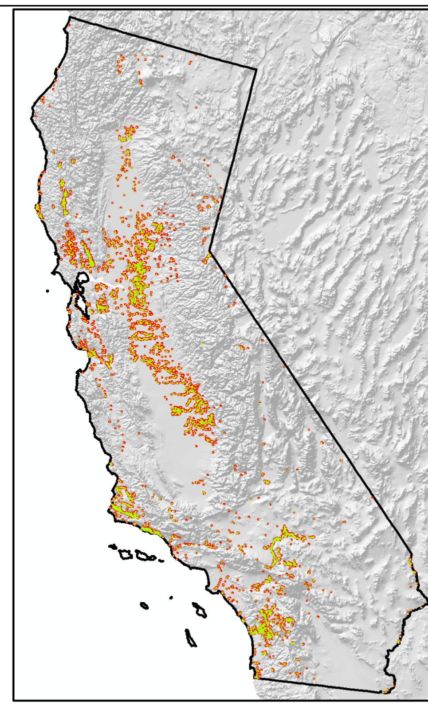
[x] calculated as: (well water level elevation − stream elevation from digital elevation data + bank height) + additional bank height offset

S5. Implications of California's imprecise well location data

The spatial resolution of driller-reported well locations in some areas is poor, especially for wells constructed prior to the widespread adoption of global positioning systems. Further, some state databases (e.g., California) obscure actual well locations; for example, California records well locations as the centroid of township-range-section areas, which have an x,y resolution of about one mile (~1.6 km).

We tested how these imprecisions in the locations of wells could influence our results. To do so, we compared results obtained from driller-reported water levels (for which x,y location data are often relatively poor in their spatial resolution) against monitoring wells (which have more reliable well location data) across California. Specifically, we identified all township-range-section areas where we have at least one monitoring well and at least one driller-reported well that meet our criteria for analysis (shallower than 100 m and within 1 km of the nearest stream). We show that the fractions of well water levels lying below nearby streams are similar for the two datasets: 76% versus 80% for monitoring wells and well drilling reports, respectively (Supplementary Table 14). Readers should note that this comparison is only possible in areas where monitoring wells are present, which tend to be in flatter landscapes in California.

Supplementary Table 14. California well water levels relative to the nearest stream based on co-located (within ~1.6 km) monitoring wells (a) or drilling reports (b)

<table>
<tr><th>Water level data source</th><th>Total number of wells in a township-range-section where at least one monitoring well and at least one well drilling report data point exist</th><th>Fraction of wells with water levels below the nearest stream</th><td rowspan="3">
Map showing locations of monitoring wells (red dots) and driller report wells (green dots) compared in this table</td></tr>
<tr><td>(a) monitoring wells</td><td>n=10,134 wells</td><td>0.80
(n=8,062 of n=10,134 wells)</td></tr>
<tr><td>(b) drilling reports</td><td>n=19,942 wells</td><td>0.76
(n=15,083 of n=19,942 wells)</td></tr>
</table>

California is not the only state where driller-reported well locations are imprecise. To test if our main findings are sensitive to imperfections in the driller-reported well locations, we re-ran our analyses for the contiguous US using only monitoring wells (which have more reliable x,y location data). We find that the fractions of wells with water levels that lie below the nearest stream are similar whether we analyze only monitoring wells or only constructed wells (62% versus 64%; Supplementary Table 15). This demonstrates that our main finding—that many wells have water levels that lie below nearby streams—is not highly sensitive to imprecise well locations in driller reports.

Supplementary Table 15. Fraction of analyzed wells with water levels that lie below the nearest stream when we isolate our analyses to only monitoring wells or only constructed wells

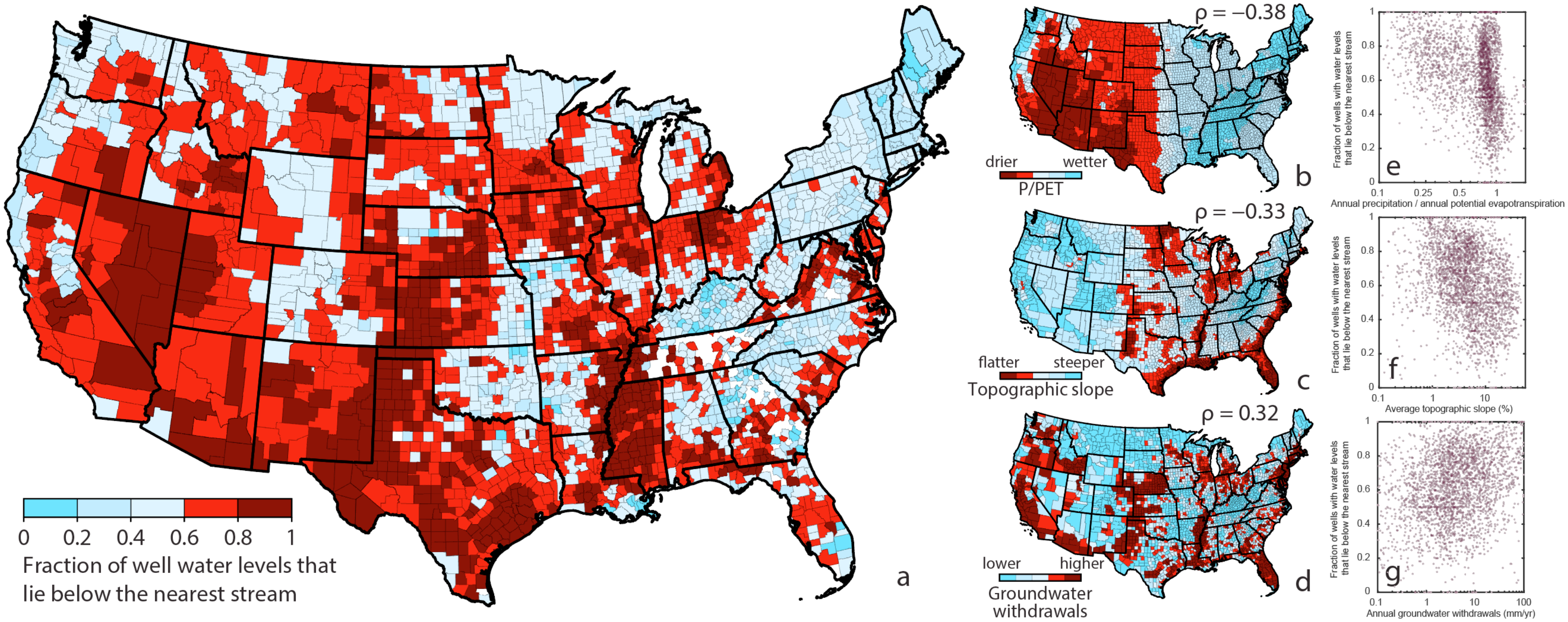
Dataset	**Well water levels that lie below the nearest stream**
All wells	64%
Monitoring wells only	62%
Driller-reported wells only	64%

S6. Supplementary Results

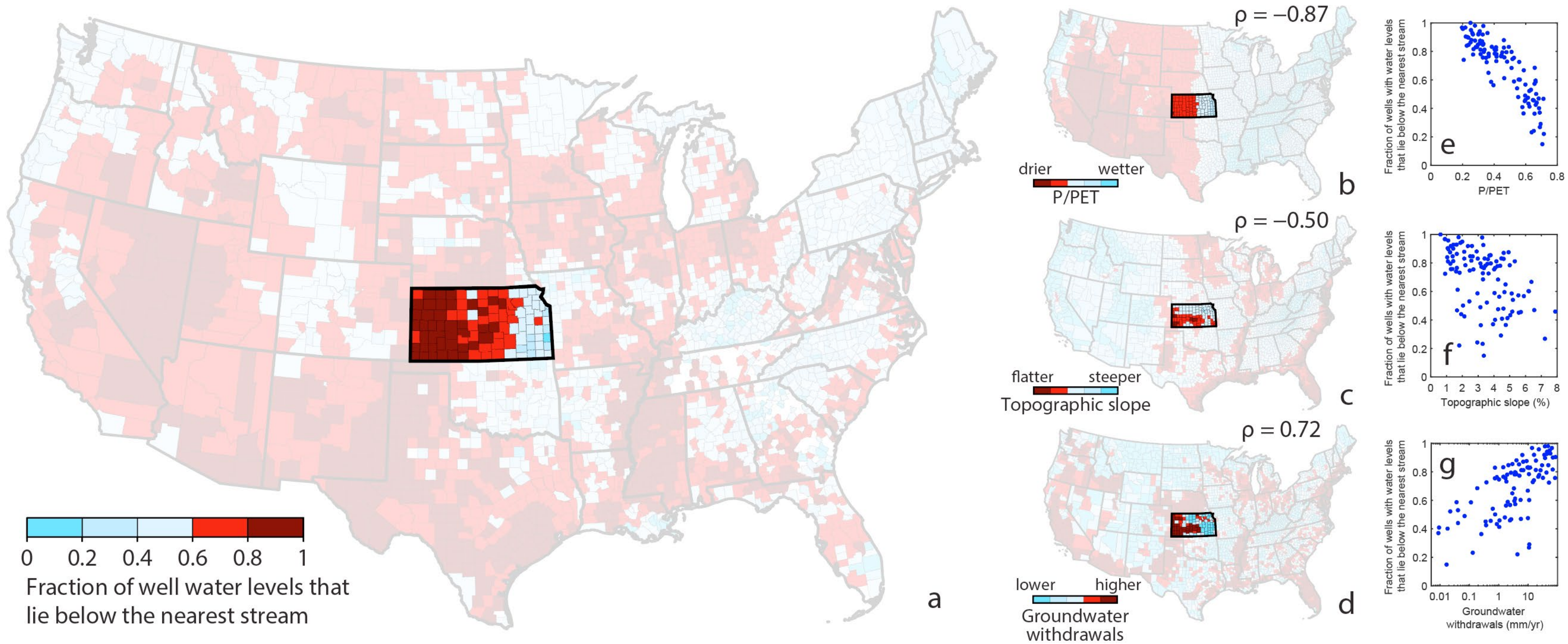
Supplementary Table 16. How the threshold number of well water levels in each county affects the results of our explanatory variable analysis shown in main text Figure 4

Minimum number of wells in a county	Spearman rank correlation coefficient of [County-scale fraction of well water levels that lie below the elevation of the nearest stream] versus the following variables:		
	County-average annual groundwater withdrawals	County-average P/PET**	County-average topographic slope
Excluding counties with fewer than n=3 wells in our database*	ρ = 0.32	ρ = −0.38	ρ = −0.33
Excluding counties with fewer than n=5 wells in our database	ρ = 0.32	ρ = −0.38	ρ = −0.33
Excluding counties with fewer than n=10 wells in our database	ρ = 0.33	ρ = −0.39	ρ = −0.33
Excluding counties with fewer than n=20 wells in our database	ρ = 0.34	ρ = −0.39	ρ = −0.34
Excluding counties with fewer than n=30 wells in our database	ρ = 0.33	ρ = −0.39	ρ = −0.33
Excluding counties with fewer than n=40 wells in our database	ρ = 0.33	ρ = −0.40	ρ = −0.33
Excluding counties with fewer than n=50 wells in our database	ρ = 0.33	ρ = −0.40	ρ = −0.33

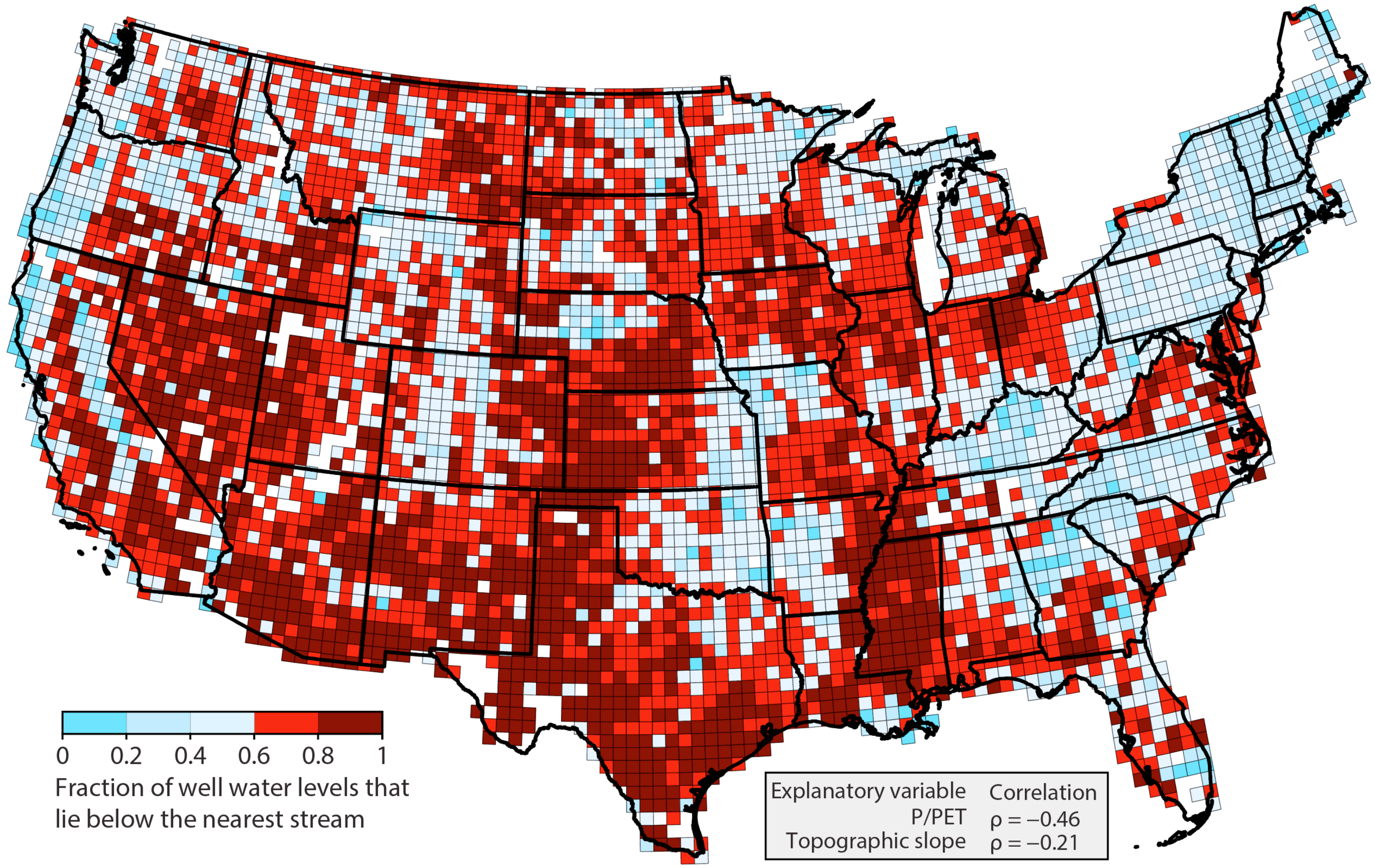
* values shown in main text Figure 4
** precipitation divided by potential evapotranspiration



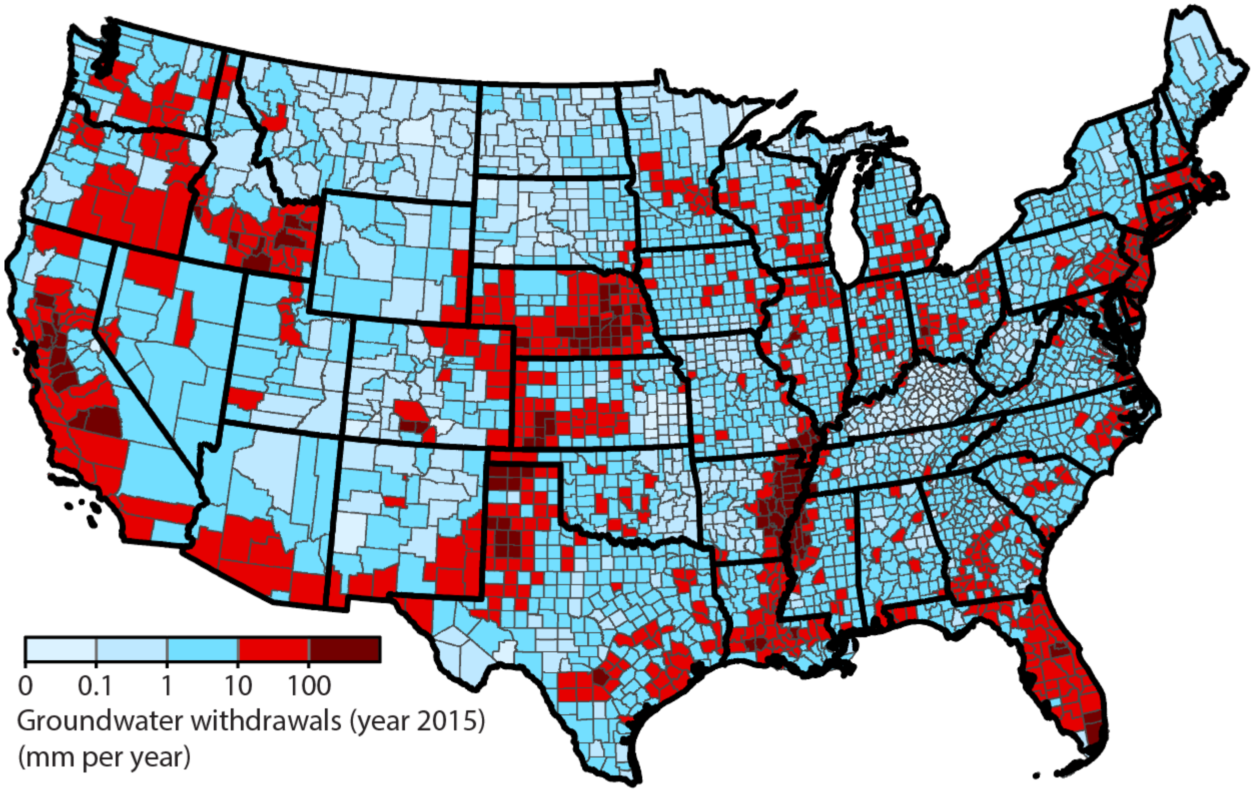
Supplementary Figure 15. The prevalence of losing conditions in relation to climatic aridity, topographic slope and groundwater withdrawals. (a) The fraction of wells with water levels that lie below the nearest stream across US counties. Red and blue shades indicate high and low prevalence of potentially losing conditions. (b-d) County-averaged precipitation divided by potential evapotranspiration[33] (P/PET), topographic slope[29], and annual groundwater withdrawals[32]. Rank correlations between these county-scale data and the prevalence of losing conditions (panel a) are shown above the maps in panels (b-d); all are statistically significant at $p < 0.0001$. (e-g) Cross plots of each explanatory variable (i.e., precipitation divided by potential evapotranspiration, topographic slope, and groundwater pumping) against the fraction of well water levels that lie below the nearest stream. Each point represents one county.



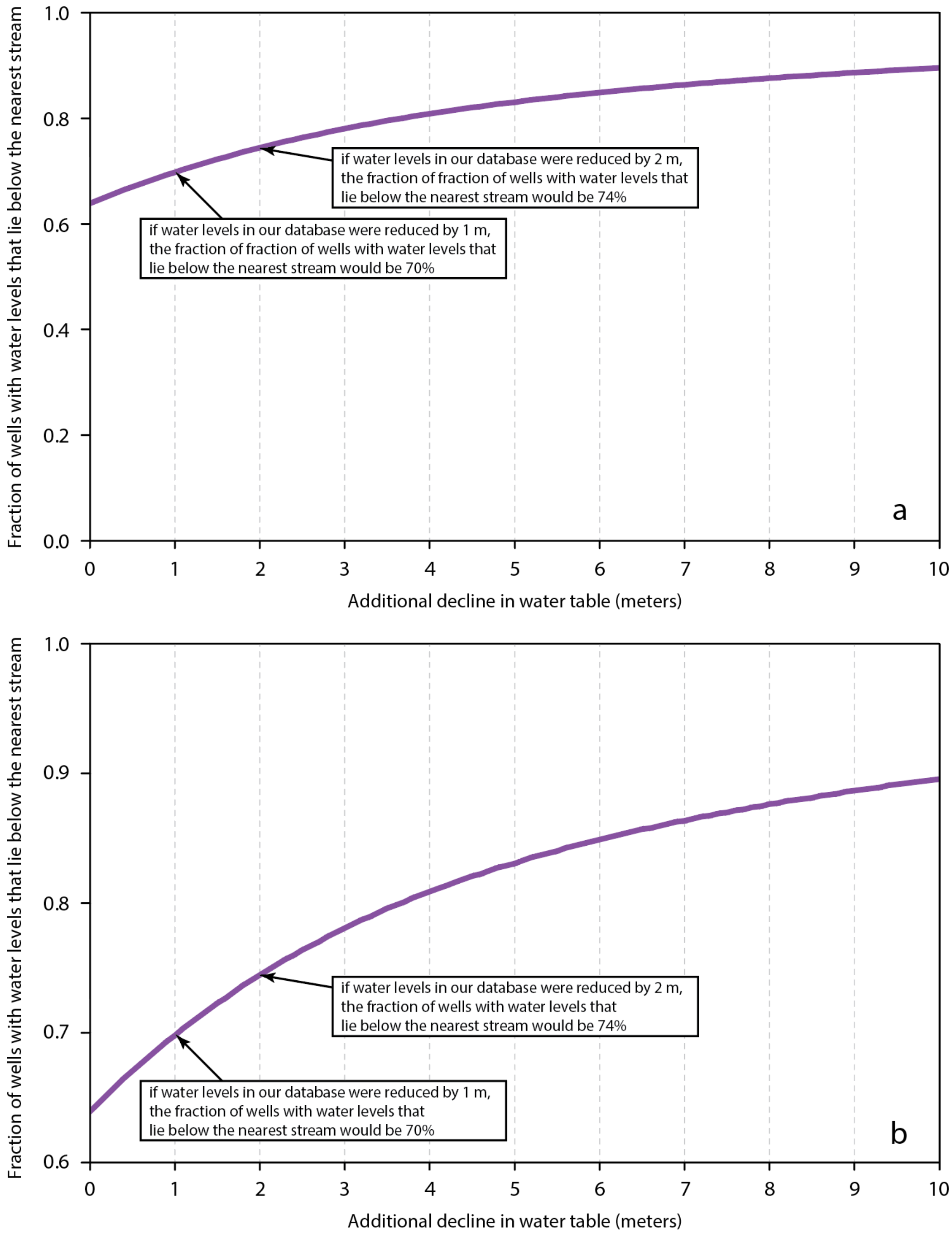
Supplementary Figure 16. The prevalence of losing conditions in relation to climatic aridity, topographic slope and groundwater withdrawals if we isolate our analysis solely to Kansas, where extensive groundwater-use data are available (e.g. ref. [37]). (a) The fraction of wells with water levels that lie below the nearest stream across counties in Kansas. Red and blue shades indicate high and low prevalence of losing conditions. (b-d) County-averaged precipitation divided by potential evapotranspiration[33] (P/PET), topographic slope[29], and annual groundwater withdrawals[32]. Rank correlations between these county-scale data and the prevalence of losing conditions (panel a) for Kansas are shown above the maps in panels (b-d); all are statistically significant at $p < 0.0001$. These rank correlations are stronger than those for the US as a whole (presented in Figure 4 of the main text and Supplementary Figure 15). (e-g) Cross plots of each explanatory variable (i.e., precipitation divided by potential evapotranspiration, topographic slope, groundwater pumping) against the fraction of well water levels that lie below the nearest stream for counties in Kansas. Each point represents one county.



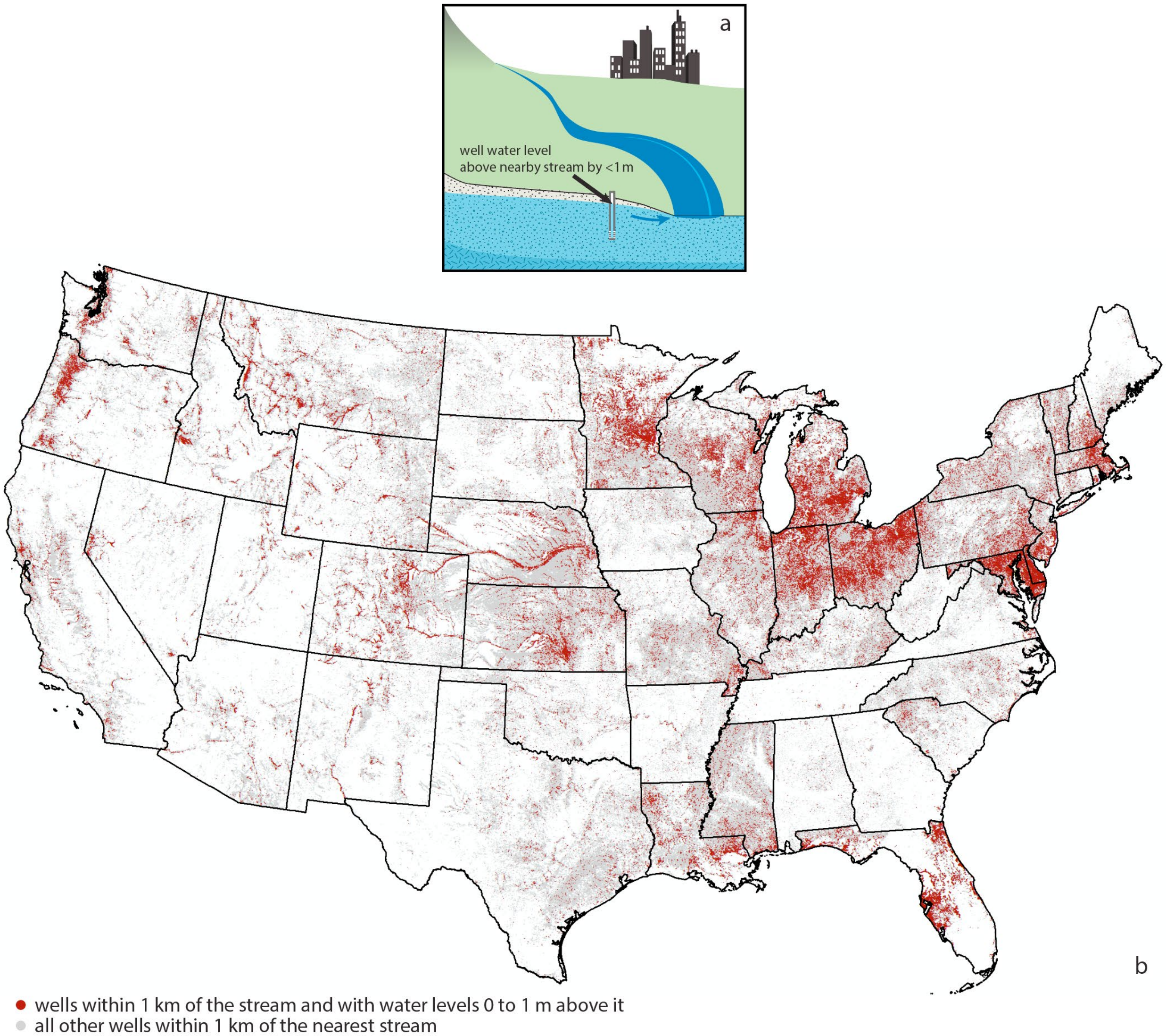
Supplementary Figure 17. The prevalence of losing conditions in relation to climatic aridity and topographic slope for 50 km by 50 km areas (rather than counties) across the United States. Each square area presents the fraction of wells with water levels that lie below the nearest stream; red shades indicate widespread occurrences of well water levels that lie below nearby stream surfaces (only areas with at least n=3 wells are analyzed and shown). The Spearman correlation coefficients (ρ) for topographic slope and precipitation divided by potential evapotranspiration are shown in the grey-shaded text box (e.g., the rank correlation coefficient for precipitation divided by potential evapotranspiration (average in 50 km by 50 km areas) versus the fraction of well water levels that lie below the nearest stream is −0.46).



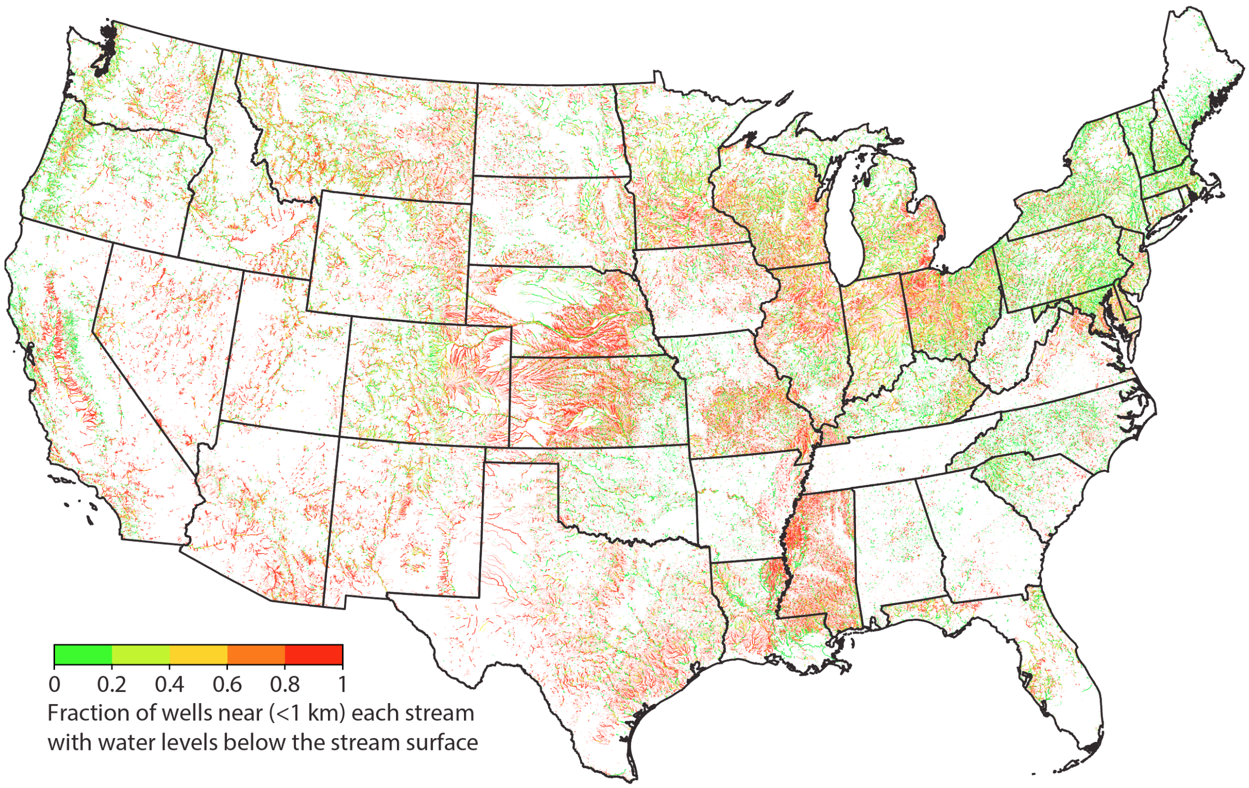
Supplementary Figure 18. Estimated spatial distribution of annual groundwater withdrawals across the United States for 2015 (data from Table 14 of ref. [32]). We have normalized the volumetric pumping rates reported in ref. [32] by county area, and report the resulting groundwater withdrawals in units of mm per year (i.e., colours on the map indicate total annual groundwater withdrawals expressed as a saturated layer of water spread at a constant depth across the entire county). This figure has a colour scale with different threshold values (i.e., different values marking where one colour versus another is displayed) than those in Figure 4d in the main text.



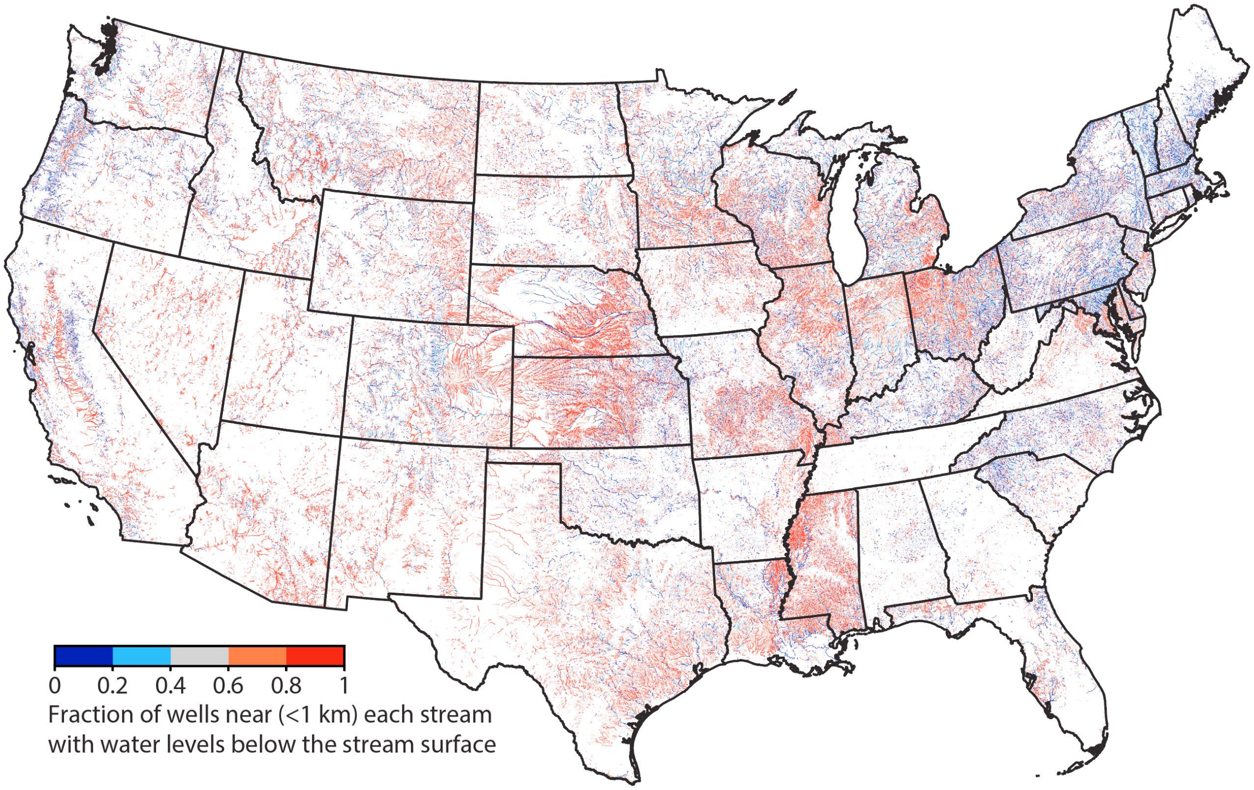
Supplementary Figure 19. How reductions in groundwater levels would increase the prevalence of wells with water levels that lie below the nearest stream. Values on the x-axis represent constant reductions applied to the well water elevations analyzed in the main text. Panel (a) and (b) are identical with the exception of the scaling of the y-axis. This analysis implies that a reduction in the water table of 2 m would increase the fraction of wells with water levels that lie below the nearest stream from 64% to 74% (see rightmost text box in this figure). The locations of wells with water levels that lie above the nearest stream, but by less than 1 m, are shown in Supplementary Figure 20.



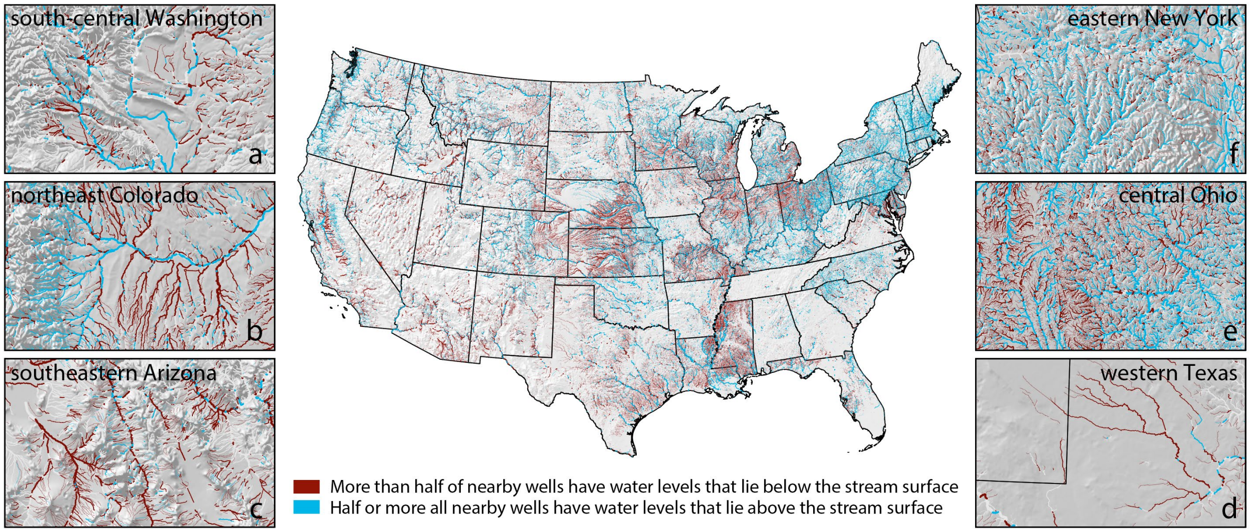
Supplementary Figure 20. The locations of wells with water levels that lie above the nearest stream by less than 1 m. (a) Schematic representing a well with a water level that lies above the nearest stream by less than 1 m. (b) Wells with water levels that lie above the nearest stream by less than 1 m are shown as red points; these wells have depths of less than 100 m and are no more than 1 km from the nearest streambank. Many of these wells are located in the Midwest states, Florida, parts of the Atlantic Coastal Plain, the Willamette Valley of Oregon and alluvial basins (e.g., Montana). Grey points show all other wells with depths of less than 100 m and that are no more than 1 km from the nearest stream.



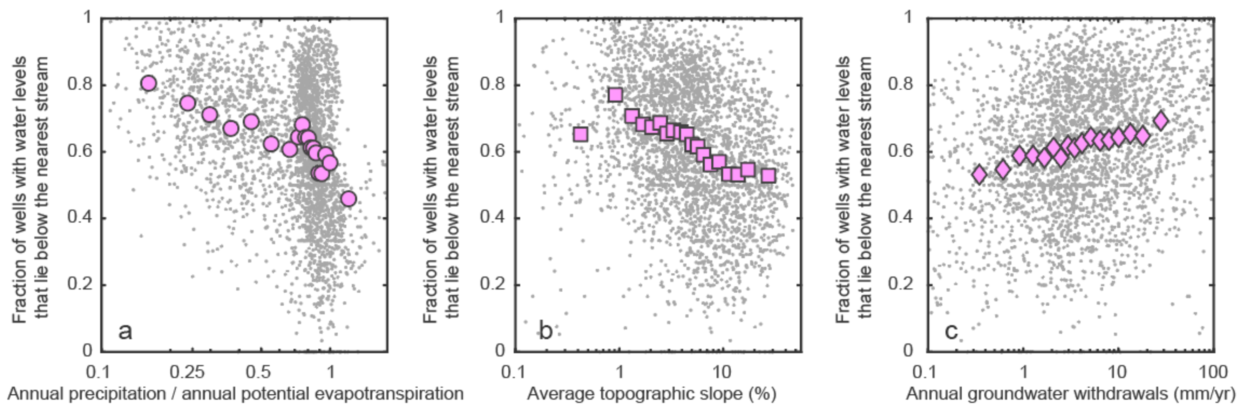
Supplementary Figure 21. Potentially losing versus gaining streams across the contiguous US. Fraction of wells with water levels that lie below the nearest stream surface, calculated for each National Hydrography Dataset segment with at least one nearby (within 1 km) well shallower than 100 m. Each polyline represents one National Hydrography Dataset stream segment. Red colours mark potentially losing stream segments (i.e., those whose surfaces lie above most water levels in nearby wells); green colours mark potentially gaining stream segments (i.e., those whose surfaces lie below most water levels in nearby wells). Potentially losing streams are common in the Great Plains, California's Central Valley, the Mississippi Embayment, and much of the Basin and Range (e.g., Nevada, Arizona). Streams of order three or higher are presented as thicker lines than second-order streams (medium-weight lines) or first-order streams (thinnest lines). Stream segments lacking nearby well water level measurements (i.e., in at least one well within one kilometer of the streambank) are not shown.



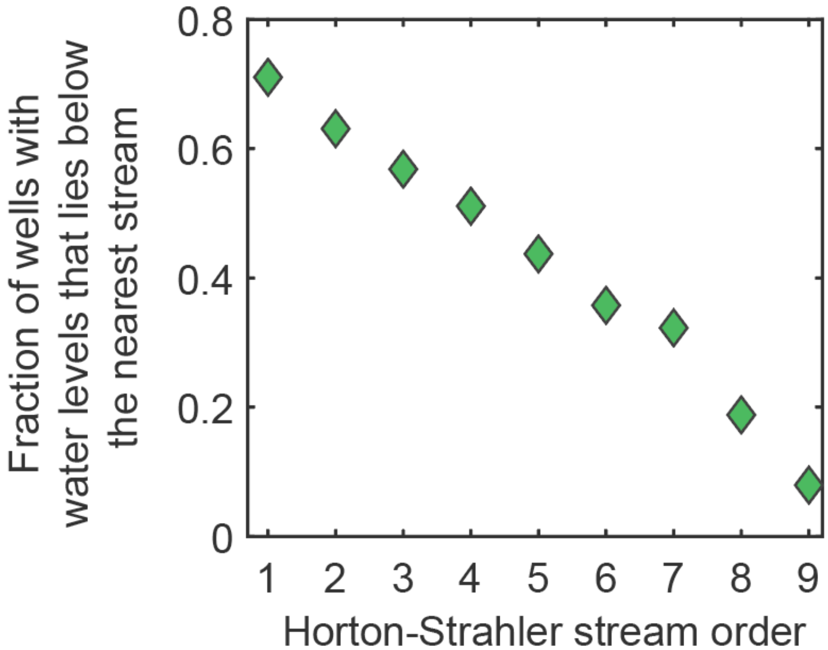
Supplementary Figure 22. Potentially losing versus gaining streams across the contiguous US. Fraction of wells with water levels that lie below the nearest stream surface, calculated for each National Hydrography Dataset segment with at least one nearby (within 1 km) well shallower than 100 m. Each polyline represents one National Hydrography Dataset stream segment. Red colours mark potentially losing stream segments (i.e., those whose surfaces lie above most water levels in nearby wells); blue colours mark potentially gaining stream segments (i.e., those whose surfaces lie below most water levels in nearby wells). Potentially losing streams are common in the Great Plains, California's Central Valley, the Mississippi Embayment, and much of the Basin and Range (e.g., Nevada, Arizona). Streams of order three or higher are presented as thicker lines than second-order streams (medium-weight lines) or first-order streams (thinnest lines). Stream segments lacking nearby well water level measurements (i.e., in at least one well within one kilometer of the streambank) are not shown. This figure shows the same information as Supplementary Figure 21, but uses a different colour scale.



Supplementary Figure 23. Streams lying above and below water levels in nearby wells. We show 581 thousand National Hydrography Dataset stream segments (totaling 2.2 million kilometers) that have at least one nearby well. Blue lines represent National Hydrography Dataset stream segments whose surfaces lie below half or more of nearby (<1 km) well water levels. These potentially gaining streams are prevalent in the northeastern states and in areas with high topographic relief. Red lines represent stream segments whose surfaces lie above more than half of nearby (<1 km) well water levels. These potentially losing streams are common where climate conditions are more arid, where topographic slopes are flatter, and where groundwater pumping rates are higher (e.g., western Texas). Six small maps surrounding the main figure magnify selected regions: (a) south-central Washington, (b) northeastern Colorado, (c) southeastern Arizona, (d) western Texas, (e) central North Carolina, and (f) eastern New York. This figure presents the same data shown in Figure 3 of the main text, but uses a different colour scheme and presents different locations in the mini-maps surrounding the central figure.



Supplementary Figure 24. Scatterplots of each explanatory variable against the fraction of well water levels that lie below the nearest stream. Each grey point represents one county. The large pink symbols represent the mean (average) fraction of wells with water levels that lie below the nearest stream elevation (i.e., average y-axis value) binned at intervals that capture 5% of the data as determined by the x-axis values (i.e., x-axis values have been binned at intervals designed to each contain 5% of the grey points). These plots suggest that wells with water levels below the nearest stream (i.e., corresponding to potentially losing streams) tend to be more prevalent in counties with more arid climate conditions (panel a), flatter topographic slopes (panel b), and higher groundwater withdrawal rates (panel c).



Supplementary Figure 25. Fraction of wells with water levels that lie below the nearest stream, as a function of stream order. Each diamond represents the fraction of wells with water levels that lie below the nearest stream, grouped by stream order. Headwater (i.e., low-order) streams are more likely to be potentially losing (i.e., to have nearby wells with water levels that lie below the stream).

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