Appendix A

Supplemental Material

Appendix A Supplemental Material

A.1 List of Preparers

Table A-1.
Lead NEPA and CEQA Agencies

Preparers	Agency	Participation
Jeff Sutton	Tehama-Colusa Canal Authority	Lead CEQA Agency Project Manager
Adam Nickels	Reclamation	Manager, Resource Management

Table A-2.
Consultants

Name	Qualifications	Background/Expertise	Participation
CDM Smith			
Anusha Kashyap	M.S. Environmental Engineering 11 years experience	Environmental Engineer	Project Technical Lead
Laura Campagna	B.S. Environmental Studies: Natural Resource Management and Conservation 7 years experience	Water Resources Planner	Deliverable Support, Primary Author: Air Quality, and Green House Gas Emissions

Name	Qualifications	Background/Expertise	Participation
Abbie Woodruff, AICP	M.S. Urban and Environmental Planning 7 years experience	Water Resources Planner	Primary Author: Hydrology and Water Quality, Groundwater and Cumulative Impacts
Jenna Quan	B.S. Ecology and Evolution 1 year experience	Environmental Planner	Deliverable Support, Primary Author: Biological Resources
Greta Gledhill	B.S. Environmental Policy Analysis and Planning 1 year experience	Environmental Planner	Deliverable Support, Primary Author: Agriculture and Forest Resources
Sam Bankston	B.S. Aquatic Biology 10 years experience	Environmental Scientist	Technical Review: Biological Resources
Brian Heywood, PE	M.S. Environmental Engineering 25 years experience	Environmental Engineer	Technical Review: Groundwater
Jeremy Gilbride	B.S. Chemical Engineering 8 years experience	Chemical Engineer	Technical Review: Air Quality and Greenhouse Gas Emissions

Key:
AICP = American Institute of Certified Planners
P.E. = Professional Engineer

A.2 Acronyms

AF	acre-feet
APCD	Air Pollution Control District
AQAP	Air Quality Attainment Plan
AQMD	Air Quality Management District
ATCM	Airborne Toxic Control Measure
BMO	basin management objective
CAAQS	California Ambient Air Quality Standard
CARB	California Air Resources Board

CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQ	Council of Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CVHM	Central Valley Hydrologic Model
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
dB	decibel
dBA	A-weighted decibel
dbh	diameter at breast height
DWR	California Department of Water Resources
EA	Environmental Assessment
eGRID	Emissions & Generation Resource Integrated Database
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
ESA	Endangered Species Acts
ETAW	evapotranspiration of applied water
GAMA	Groundwater Ambient Monitoring and Assessment
GGS	giant gartersnake
GHG	greenhouse gas
GIS	geographic information system
GMP	Groundwater Management Plan
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWP	global warming potential
HCP	Habitat Conservation Plan
ID	Irrigation District
IS	Initial Study
ITA	Indian Trust Asset
L_{dn}	day-night average sound level
MAF	million acre-feet
MCL	maximum contaminant level
mg/L	milligrams per liter
MUD	Municipal Utility District

MWC	Mutual Water Company
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standard
NCCP	Natural Community Conservation Plan
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOx	nitrogen oxides
NSVPA	Northern Sacramento Valley Planning Area
O_3	ozone
PM_{10}	inhalable particulate matter
$PM_{2.5}$	fine particulate matter
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
ROD	Record of Decision
SGMA	Sustainable Groundwater Management Act
SIP	state implementation plan
SLDMWA	San Luis & Delta-Mendota Water Authority
SRA	State Responsibility Area
SWP	State Water Project
SWRCB	State Water Resources Control Board
TCCA	Tehama-Colusa Canal Authority
TCR	The Climate Registry
TDS	total dissolved solids
USC	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WY	water year

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Appendix B
Special Status Wildlife Species with Potential to Occur

Special-Status Species With Potential to Occur						
Common Name Scientific Name	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential For Impact**
Invertebrates						
California Freshwater shrimp *Syncaris pacifica*	**E**	**E**	Found in 16 stream segements within Marin, Sonoma and Napa counties	Inhabits small, perennial coastal streams with exposed live roots of trees such as alder and willow along undercut banks with overhanging woody debris or stream vegetation.	December to early May	None. No CNDDB occurences have been documented within the Seller Service Area. In addition, no impacts to coastal streams are anticipated.
Conservancy fairy shrimp *Branchinecta conservation*	**E**	--	Northern two-thirds of the Central Valley. It ranges from Vina Plains of Tehama County; Sacramento NWR in Glenn County; Jepson Prairie Preserve and surrounding area east of Travis Air Force Base, Solano County; Mapes Ranch west of Modesto, Stanislaus County.	Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grass or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat occurs within the project area. No impacts to vernal pool or other habitats occupied by this species are anticipated. The species is not likely to occur to occur in crop fields and canals due to lack of suitable habitat.
Crotch's bumble bee *Bombus crotchii*	--	**CE**	Species occurs primarily in the foothills in California and is currently most abundant in southern California.	Inhabits grasslands and shrublands and requires a hot and dry environment. Prefers certain plant species as a food source including milkweeds, dusty maidens, lupines, and poppies.	February through October	None. Although a few occurrences have been documented within the Seller Service Area, no impacts on grasslands or shrublands would occur. The species is not likely to occur in crop fields and canals owing to a lack of suitable habitat.
Monarch butterfly *Danaus plexippus*	**C**	--	Found throughout North America wherever suitable habitat exists. Overwinter along the coast in California.	Requires the presence of milkweed and flowering plants. Adult monarchs feed on the nectar of many flowers during breeding and migration, but they can only lay eggs on milkweed plants. Typical roosting plants include eucalyptus, Monterey pines, and Monterey cypress trees.	Spring and Summer	None. No CNDDB occurrences have been documented within the Seller Service Area. In addition, no impacts on milkweed or flowering plants are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential For Impact**
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	**T,X**	--	Central Valley and surrounding foothills below 3,000 feet elevation.	Dependent on elderberry shrubs (host plant) as a food source. Potential habitat is shrubs with stems 1 inch in diameter within Central Valley.	Year round for host plant and exit holes; March-June for adults	None. Occurrences have been documented within the Seller Service Area. However, elderberry shrubs will not be impacted, therefore no impact to beetles will occur.
Vernal pool fairy shrimp *Branchinecta lynchi*	**T,X**	--	Endemic to the Central Valley, Central Coast Mountains, and South Coast Mountains of California. It ranges from the Stillwater Plain in Shasta County through most of the length of the Central Valley to Paisley in Tulare County, and along the central Coast Range from northern Solano County to Pinnacles National Monument in San Benito County. Disjunct populations were also reported to occur in San Luis Obispo County, Santa Barbara County, and Riverside County.	Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grassed or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented in the Seller Service areas. Crop fields and canals are not likely to support this species due to lack of suitable habitat. The project is not expected to impact vernal pools or natural wetlands.Therefore, no impacts to the species are expected.
Vernal pool tadpole shrimp *Lepidurus packardi*	**E,X**	--	Endemic to the Central Valley of California, with the majority of the populations occurring in the Sacramento Valley. This species has also been reported from the Sacramento River Delta to the east side of San Francisco Bay, and from a few scattered localities in the San Joaquin Valley from San Joaquin County to Madera County	Found in a variety of natural and artificial seasonally ponded habitat types including: vernal pools, swales, ephemeral drainages, stock ponds, reservoirs, ditches, backhoe pits, and ruts caused by vehicular activities.	Has been collected from early December to early May.	None. Occurrences have been documented in the Seller Service area. Suitable habitat is present in the project area. Crop fields and canals are not likely to support this species due to lack of suitable habitat. The project is not expected to impact vernal pools or natural wetlands. Therefore, no impacts to the species are expected.

Common Name **Scientific Name**	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential For Impact**
Amphibians						
California Red-legged frog *Rana draytonii*	**T**	**SSC**	Through the Central Valley and coastal regions of central and southern California	Found mostly near ponds in humid forests, woodlands, grasslands, coastal scrub, and streamsides with plant cover. Frequently found in woods adajcent to streams.	Year round	None. No CNDDB occurences have been documented in the Seller Service Area. The project is not expected to impact suitable habitat for the species. Therefore, no impacts on the species are expected.
California tiger salamander *Ambystoma californiense*	**T, X**	**T, WL**	Found in annual grassland habitat, grassy understories of valley-foothill hardwood habitats, and uncommonly along stream courses in valley-foothill riparian habitats. Occurs from near Petaluma, Sonoma Co., east through the Central Valley to Yolo and Sacramento Counties and south to Tulare Co.; and from the vicinity of San Francisco Bay south to Santa Barbara County.	Lives in vacant or mammal-occupied burrows, occasionally other underground retreats, throughout most of the year, in grassland, savanna, or open woodland habitats. Lays eggs on submerged stems and leaves, usually in shallow ephemeral or semi permanent pools and ponds that fill during heavy winter rains, sometimes in permanent ponds; breeding takes place in fish free pools and ponds.	Migrates up to about 2 km between terrestrial habitat and breeding pond. Migrations may occur from November through April.	None. Occurrences have been documented within the Seller Service Areas. Suitable habitat may occur within the project area, but will not be impacted by the project. Cropland idling has the potential to improve habitat for the species.
Foothill yellow-legged frog (Feather River DPS) *Rana boylii*	**PT**	**T, SSC**	This species is known from the Pacific drainages from Oregon to the upper San Gabriel River, Los Angeles County, California, including the coast ranges and Sierra Nevada foothills in the United States.	This species inhabits partially shaded, rocky streams at low to moderate elevations, in areas of chaparral, open woodland, and forest.	Year round	None. Occurrences have been documented within the Seller Service Area. Suitable habitat is present within the project area. However, the project is not expected to impact any suitable rocky stream and woodland habitats. No impact to the species is expected.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Western spadefoot *Spea hammondii*	--	SSC	This species occurs in the Central Valley and bordering foothills of California and along the Coast Ranges into northwestern Baja California, Mexico.	Lowlands to foothills, grasslands, open chaparral, pine-oak woodlands. Prefers shortgrass plains, sandy or gravelly soil. It is fossorial and breeds in temporary rain pools and slow-moving streams that do not contain bullfrogs, fish, or crayfish.	Year round. Usually in underground burrows most of year, but will travel several meters on rainy nights. Movement is rarely extensive.	None. Occurrences have been documented from Seller Service Areas. Suitable habitat is present in the project area. The project will not impact suitable upland habitat types. The species is not likely to occur in crop fields or canals due to the presence of predatory fish, bullfrogs etc. Cropland idling has the potential to improve habitat for the species.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Reptiles						
Giant garter snake *Thamnophis gigas*	**T**	**T**	Sacramento and San Joaquin Valleys from Butte County in the north to Kern County in the south.	Primarily associated with marshes, sloughs, and irrigation ditches. Generally absent in larger rivers.	Year round	High. In recent years, there have been multiple occurrences of this species in the Seller Service Area. Suitable habitat is present within the Seller Service Areas. Suitable habitat in the Seller Service Area is intermittent based on normal variation in cropping. Impacts may include reduction in suitable aquatic habitat within the Seller Service Area. Conservation measures are in place to maintain aquatic habitat corridors within irrigation ditches.
Western pond turtle/ Pacific pond turtle *Actinemys marmorata*	**--**	**SSC**	Ranged from extreme western Washington and British Columbia to northern Baja California, mostly to the west of the Cascade-Sierra crest.	The western pond turtle occupies a wide variety of wetland habitats including rivers and streams (both permanent and intermittent), lakes, ponds, reservoirs, permanent and ephemeral shallow wetlands, abandoned gravel pits, stock ponds, and sewage treatment.	Year round	High. Suitable habitat occurs within the project area. Pond turtles may occur in ditches, canals, rice fields, etc. In recent years, there have been numerous occurrence of this species in the Seller Service Area. Impacts may include reduction in suitable aquatic habitat within the Seller Service Area. Conservation measures are in place to maintain aquatic habitat corridors within irrigation ditches.
Birds						
Aleutian Cackling Goose *Branta hutchinsii leucopareia*	**D**	**WL**	Northern San Joaquin Valley, the delta of central California, and the Humboldt Bay area	Lakes, marshes and fields, often foraging in open prairies and farm fields	Wintering in California from mid-October to mid-April	None. Suitable foraging habitat is located within the Seller Service Area, however there are no recent CNDDB occurrences within the Seller Service Area. No impacts to the species is anticipated.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
American peregrine falcon *Falco peregrinus anatum*	**D, MNBMC**	**D, FP**	Throughout California.	Breeds in woodland, forest and coastal habitats on protected cliffs and ledges. Riparian areas and coastal and inland wetlands are important habitats yearlong especially during the non-breeding season.	Year round	None. Crop fields may provide suitable foraging habitat for the species, but birds could relocate to other habitat areas in the vicinity. No nesting habitat will be affected by the project.
Bald eagle *Haliaeetus leucocephalus*	**D, BGEPA**	**E, FP**	Throughout California.	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance.	Year round	None. Occurrences have been documented within the Seller Service Area and both areas provide suitable habitat. No impacts to suitable nesting habitat are anticipated. Crop fields represent marginal foraging habitat. Birds would be able to relocate to other suitable habitat areas in the vicinity if fields were fallowed. Environmental commitments limit the amount of land that can be fallowed in a given county.
Bank swallow *Riparia riparia*	**--**	**T**	A neotropical migrant found primarily in riparian and other lowland habitats in California west of the deserts during the spring-fall period. Breeding population in California occurs along banks of the Sacramento and Feather rivers in the northern Central Valley.	Requires vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, lakes, and the ocean for nesting. Feeds primarily over grassland, shrub land, savannah, and open riparian areas during breeding season and over grassland, brushland, wetlands, and cropland during migration.	March-mid-September	None. Known within the Seller Service Areas. No suitable nesting habitat (i.e. cliffs along rivers) will be affected from small changes in river flow. There is potential that the project would reduce the area of cropland habitat used for foraging during migration (wetlands and croplands) due to changes in water application. However, fallow cropland would still providing suitable foraging habitat, and birds could forage at other croplands in the vicinity.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Black tern *Chlidonias niger*	--	SSC	Common spring and summer visitor to fresh emergent wetlands of California.	Uses fresh emergent wetlands, lakes, ponds, moist grasslands, and agricultural fields. In migration, some take coastal routes and forage offshore.	April-September	Moderate. No occurrences have been documented within either the Buyer or Seller Service Areas. However, suitable habitat is present within the project area (i.e. rice fields) and the project area is within the known range for the species. Water transfers could reduce suitable habitat for the species within the Seller Service Area. Conservation strategies are in place that would reduce potential impacts to this species to negligible.
Burrowing owl *Athene cunicularia*	--	SSC	Central and southern coastal habitats, Central Valley, Great Basin, and deserts.	Open annual grasslands or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Dependent upon burrowing mammals (especially California ground squirrel) for burrows.	Year round	None. Occurrences have been documented within Seller Service Area. Suitable habitat occurs within the project area. Agricultural ditches may be suitable habitat for burrowing owl burrow and nesting activity. Water transfers would not affect the suitability of habitat for burrowing owl in the project area.
California black rail *Laterallus jamaicensis coturniculus*	--	T, FP	Pacific coast of California, along the lower Colorado River. During breeding season, the species can be found north of San Francisco	Tidal marshes and freshwater marshes, inhabit the drier portions of wetlands with vegetation dominated by fine-stemmed bulrush or grasses.	Year round	None. There are CNDDB records within Sacramento, Sutter, and Yolo counties. However, suitable habitat is unlikely to be impacted by water transfers.
California Condor *Gymnogyps californianus*	E	E, FP	Commonly found along the coast between San Francisco and Los Angeles, as well as in the southern portion of the Sierra Nevada mountain range. Not typically found north of San Francisco.	Condor nest sites are typically located in cliff caves in the mountains. Some condors nest in large cavities in the trunks of giant sequoia redwood trees. Condors predominately forage in open terrain of foothill grassland and oak savanna habitats where they feed on carrion.	Year round	None. No occurrences have been documented within the Seller Service Area. Suitable habitat does not occur within the project area. Transfers are not expected to impact any suitable habitat.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
California Ridgway's rail (formerly California clapper rail) *Rallus obsoletus obsoletus*	**E**	**E**	Common locally around San Francisco, Monterey, and Morro bay.	Found in salt-water and brackish marshes traversed by tidal sloughs. The bird is associated with abundant growths of pickle weed, but feeds on mud-bottomed sloughs.	Year round. Non-migratory in coastal wetlands. Juveniles may disperse to freshwater wetlands late summer and autumn.	None. No occurrences have been documented within the Seller Service Area. Suitable habitat does not occur within the project area. Transfers are not expected to impact any suitable habitat (i.e. salt-water marshes).
California least tern *Sterna antillarum browni*	**E**	**E, FP**	Nests along the coast from San Francisco Bay south to northern Baja California. Migratory in California. Breeding colonies in Southern California near marine and estuarine shores. In SF Bay found near salt ponds and estuarine shores.	Breeds on bare or sparsely vegetated, flat substrates, sand beaches, alkali flats, landfills or paved areas. Feeds in shallow, estuarine waters.	Late April in southern California to mid-May in northern California. Winters south of California. Absent from mid-October to late April.	None. No occurrences have been documented in the Seller Service Area. Suitable habitat is not found within the project area. No impacts are expected to suitable foraging or breeding habitat (i.e. sand beaches, alkali flats).
Cooper's hawk *Accipiter cooperii*	--	**WL**	Throughout California	Frequents landscapes where wooded areas occur in patches and groves. Often uses patchy woodlands and edges with snags for perching. Dense stands with moderate crown-depths used for nesting.	Year round	None. Occurrences have been documented in Seller Service Area. Suitable habitat occurs within the project area. No potential impacts to preferred foraging or nesting habitat are anticipated.
Double-crested cormorant *Phalacrocorax auritus*	--	**WL**	Along the entire coast of California and on inland lakes, in fresh, salt and estuarine waters. Uncommon from San Luis Obispo County south and very rare to the north. Common on Colorado River reservoirs and common in the Central Valley.	Open water with offshore rocks, islands, steep cliffs, dead branches of trees, wharfs, jetties, or even transmission lines. Requires undisturbed nest-sites beside water, on islands or mainland. Uses wide rock ledges on cliffs; rugged slopes; and live or dead trees, especially tall ones. Found on inland lakes, fresh, and estuarine waters.	Year round along coastal regions. Winters inland.	None. No occurrences have been documented within the project area. No negative impacts to foraging or breeding habitat are expected.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Ferruginous hawk *Buteo regalis*	--	WL	Winter resident and migrant at lower elevations and open grasslands in Modoc Plateau, Central Valley, and Coast ranges. Common winter resident of grassland and agriculture areas in southwestern California. Casual in northeast in summer.	Found in open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon-juniper habitats.	Migratory. Present in CA from Sept. to mid-April.	None. Occurrences have been documented in Sacramento County. Suitable habitat occurs within the project area. No potential impacts to preferred habitat are anticipated.
Golden eagle *Aquila chrysaetos*	BGEPA	FP, WL	Throughout California	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance.	Year round	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat occurs within the project area. No impacts to nesting habitat are expected.
Grasshopper sparrow *Ammodramus savannarum*	--	SSC	Throughout California's coastline and central valley	Breeds in open grasslands, prairies, hayfields, and pastures, typically with some bare gound.	Year round	None. There are CNDDB records of this species in Sacramento and Yolo counties. This species is unlikely to breed within dense crop fields, and therefore is unlikely to be affected by water transfers.
Greater sandhill crane *Grus canadensis tabida*	--	T, FP	Breeds only in Siskiyou, Modoc and Lassen counties and in Sierra Valley, Plumas and Sierra counties. Winters primarily in the Sacramento and San Joaquin valleys from Tehama south to Kings Counties.	In summer, this race occurs in and near wet meadow, shallow lacustrine, and fresh emergent wetland habitats. Frequents annual and perennial grassland habitats, moist croplands with rice or corn stubble, and open, emergent wetlands. It prefers relatively treeless plains.	Migration southward is September-October and northward is March-April.	Moderate. No occurrences have been documented within the project area, but occurrences have been recorded in Butte and Sutter Counties. Suitable foraging and winter roosting habitat is present within the project area (i.e. rice fields). Water transfers could reduce suitable habitat for the species within the Seller Service Area. Conservation strategies are in place for this species and birds will have other suitable wintering sites available.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Least bell's vireo *Vireo bellii pusillus*	**E**	**E**	California to northern Baja.	Inhabits low, dense riparian growth along water or along dry parts of intermittent streams. Typically associated with willow, cottonwood, baccharis, wild blackberry, or mesquite in desert localities.	March-August	None. One occurrence has been documented in the Seller Service Area. Suitable habitat may occur within the project action area. The project is not expected to impact any suitable willow or dense riparian habitat due to small changes in river flow, therefore no impacts to the species are anticipated.
Merlin *Falco columbarius*	--	**WL**	Occurs in most of the western half of California below 3,900 ft. Rare in Mojave Desert and Channel Islands.	Frequents coastlines, open grasslands, savannahs, woodlands, lakes, wetlands, edges, and early successional stages. Ranges from annual grasslands to ponderosa pine and montane hardwood-conifer habitats.	Winter migrant from September-May	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in project area. Foraging habitat may be altered, but Transfers would not decrease suitability. No negative impacts are anticipated.
Mountain plover *Charadrius montanus*	--	**SSC**	Found in Central Valley from Sutter and Yuba counties southward, foothill valleys west of San Joaquin Valley, Imperial Valley, plowed fields of Los Angeles and western San Bernardino County, and central Colorado river valley. Does not breed in California.	Found in short grasslands, freshly plowed fields, newly sprouting grain fields, and sod farms. Prefers grazed areas and areas with burrowing rodents.	Winter resident Sept. - March.	None. Occurrences have been documented in Seller Service Area. Suitable habitat occurs within the project area. Foraging habitat may be affected, but Transfers would not reduce suitability and individuals can relocate to other habitats within the area.
Northern goshawk *Accipiter gentilis*	--	**SSC**	Throughout California	Nests in mature and old-growth forests with a majority of closed canopy.	Year round	None. There are two CNDDB occurrences in Glenn County. Suitable habitat is not present in the project area (i.e. old-growth forests). Water transfers would not affect this species.
Northern harrier *Circus cyaneus*	--	**SSC**	Throughout lowland California, concentrated in the Central Valley and coastal valleys.	Breeds in annual grasslands and wetlands. Prefers marshes and grasslands for foraging and nesting. Also uses agricultural fields for nesting and foraging, although nests may be destroyed by agricultural activities.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in project area. Foraging and breeding habitat may be affected, but fallow fields would still represent suitable habitat. Birds can relocate to other habitats within the area.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Northern spotted owl *Strix occidentalis caurina*	**T,X**	**T**	Distributed through the Cascade Range, coastal ranges, and as far south as Marin County.	Associated with forests characterized by dense canopy closer of mature and old-growth tree, abundant logs, and live trees with broken tops.	Year round	None. There are no occurrences of this species in the Seller Service Area. In addition, suitable habitat for the species is not present in the project area. This species will not be impacted by water transfers.
Osprey *Pandion haliaetus*	--	**WL**	Northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County.	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats.	Year round	None. Occurrences have been documented in Seller Service Area. Suitable habitat occurs within the project area. Water transfers would be subject to flow requirements. Therefore no impacts to foraging area expected. No impacts to nesting sites are anticipated.
Prairie falcon *Falco mexicanus*	--	**WL**	Found from southeastern deserts northwest throughout Central Valley and inner Coast Ranges and Sierra Nevada. Mostly absent from northern coastal fog belt. Not found in upper elevation of Sierra Nevada.	Inhabits dry, open level or hilly terrain. Breeds on cliffs, forages far afield. Annual grassland to alpine meadows, but primarily perennial grasslands, rangeland, agricultural fields and desert scrub.	Permanent resident. Northern migrants winter in California. Upslope in summer, down slope in winter.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present within the project area. Foraging habitat (i.e. agricultural fields) may be altered, but Transfers would not reduce suitability.
Purple martin *Progne subis*	--	**SSC**	In south, found on the coast and interior mountain ranges. Absent from higher desert regions. In north, found on coast and inland to Modoc and Lassen counties. Absent from higher slopes of Sierra Nevada. Current breeding populations are known from western Santa Clara and Alameda counties, and western Placer County.	Inhabits woodlands, low elevation coniferous forest of Douglas-fir, ponderosa pine and Monterey pine. Uses open habitats during migration, including grassland, wet meadows, and fresh emergent wetlands.	Summer resident throughout California.	Low. CNDDB occurrences have been documented in Sacramento County. This species is restricted to fairly limited nesting sites with suitable cavities free of brood parasites. When wetlands are unavailable, rice fields may represent relatively high quality foraging habitat. This habitat may be slightly reduced by Transfers, but the species can relocate to other suitable habitat in the vicinity. Crop idling limitations are in place in the environmental commitments.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	--	SSC	Resident and summer visitor in San Francisco Bay area. Winter south along coast to San Diego county. Found in No. CA in summer months.	Found in fresh and salt water marshes. Requires thick, continuous cover to water surface for foraging and tall grasses, tulle and willows for nesting.	Year-round in southern California and San Francisco Bay, Summer resident in northern California.	None. Occurrences have been documented in the Seller Service area and suitable habitat may be present in the project area. Not known from rice fields. Water transfers would not affect suitable breeding or foraging habitat.
Song sparrow ("Modesto" population) Melospiza melodia	--	SSC	Distributed through the Central Valley from Butte to Stanislaus counties	Enormous variety of open habitats, including tidal marshes, arctic grasslands, desert scrub, chapparral agricultural fields, forest edges, and deciduous woodlands.	Year round. Breeds from mid-March to early August	None. Occurrences have been documents in the Seller Service area and suitable habitat may be present, i.e. agricultural fields. This species has a wide range of suitable habitat and therefore birds can relocate to other habitats within the area.
Suisun song sparrow *Melospiz melodia maxillaris*	--	SSC	Endemic, restrict to Suisun Marsh from Carquinez Strait east to the confluence of the Sacramento and San Joaquin rivers near Antioch. Highest numbers near Benicia State Park and Martinez shoreline.	Resident of brackish-water marshes. Inhabits cattails, tulles, sedges, and salicornia.	Year round. Non-migratory. Breeds early March to July.	None. Occurrences have been documented in Sacramento County and suitable habitat may be present in the project area. However, no impacts are expected to brackish-water marshes.
Swainson’s hawk *Buteo swainsoni*	MNBMC	T	Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley.	Nests in mature trees, including valley oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain and row crop fields.	Spring and Summer; small wintering population in the Delta	None. CNDDB occurrences have been documented within both the Seller Service Area. Suitable habitat is present within the project area. The project may alter the composition of foraging habitat in the Seller Service Areas, but these areas would still be suitable for the species, and additional habitats in the vicinity would be available. No impacts to riparian breeding habitat are expected from small changes in river flow.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Tricolored blackbird *Agelaius tricolor*	--	T, SSC	A resident in California found throughout the Central Valley and in coastal districts from Sonoma County south.	Breeds near fresh water, preferably in emergent wetlands with tall, dense cattails or tules, but also in thickets of willow, blackberry, wild rose, tall herbs. Feeds in grassland and cropland habitats.	Year round	Moderate. In recent years, CNDDB occurrences have been documented in the Seller Service Area. Suitable habitat is present within the project area. Foraging habitat may be affected by the project. Environmental commitments limit cropland idling and birds can relocate to other adjacent foraging habitats within the area.
Western snowy plover *Charadrius alexandrinus nivosus*	T	SSC	Along the west coast states, with inland nesting taking place at the Salton Sea, Mono Lake, and at isolated sites on the shores of alkali lakes in northeastern California, in the Central Valley, and southeastern deserts.	Nests, feeds, and takes cover on sandy or gravelly beaches along the coast, on estuarine salt ponds, alkali lakes, and at the Salton Sea.	Migration is from July-March (some year round populations).	None. There is a CNDDB occurrence in Yolo County, however this species is not likely to occur in rice fields. Suitable habitat may occur within the project area. However, Transfers are not expected to impact any suitable breeding or foraging habitat (i.e. sandy beaches or estuarine salt ponds).
Western yellow-billed cuckoo *Coccyzus americanus*	T,X	E	Uncommon to rare summer resident in scattered locations throughout California. Breeding population along Colorado river, Sacramento and Owen Valley, along South Fork of Kern River, Santa Ana River and Amargosa River. May be present along San Luis Rey River.	Deciduous riparian thickets or forests with dense, low-level or understory foliage, and which abut on slow-moving watercourses, backwaters, or seeps. Willow almost always a dominant component of the vegetation. In Sacramento Valley, also utilizes adjacent orchards, especially of walnut. Nests in sites with some willows, dense low-level or understory foliage, high humidity, and wooded foraging spaces.	Summer migration is from June-September.	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present within the project area. However this species is not likely to occur in crop fields due to lack of suitable foraging and roosting habitat (i.e. dense riparian thickets). No impacts are anticipated to riparian breeding habitat due to small changes in river flow.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
White-faced ibis *Plegadis chihi*	--	**WL**	Uncommon summer resident in sections of southern California, a rare visitor in the Central Valley, and is more widespread in migration.	Feeds in fresh emergent wetlands, shallow lacustrine waters, muddy grounds of wet meadows, and irrigated or flooded pastures and croplands. Nests in dense, fresh emergent wetlands.	Present in California from April-October.	Low. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. Low potential impact to foraging habitat in the Seller Service Area. No potential impacts are expected to roosting habitat. Can relocate to other habitats within the area. Environmental committments would limit acreage of allowable cropland idling.
White-tailed kite *Elanus leucurus*	**MNBMC**	**FP**	Central Valley, coastal valleys, San Francisco Bay area, and low foothills of Sierra Nevada.	Savanna, open woodlands, marshes, partially cleared lands and cultivated fields, mostly in lowland situations (Tropical to Temperate zones).	Year round	None. CNDDB occurrences have been documented in the Seller Service Area. Suitable habitat is present within the project area. Foraging habitat may be altered, but will still be suitable for the species. No potential impacts to breeding habitat are anticipated.
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	--	**SSC**	Breeds in deep-water, emergent wetlands throughout nonforested regions of western North America.	Breed and roost in freshwater wetlands with dense, emergent vegetation such as cattails. They often forage in fields, typically wintering in large, open agricultural areas.	Year round	Low. Suitable habitat is present within the project area. Foraging habitat may be affected by the project. Environmental commitments limit cropland idling and birds can relocate to other adjacent foraging habitats within the area.
Mammals						
American badger *Taxidea taxus*	--	**SSC**	Throughout California.	Found in dry, open stages of most shrub, forest, and herbaceous habitats with friable soils.	Year round. Permanent resident except in North Coast area.	None. Occurrences have been documented in Seller Service Area and suitable habitat is present within the project area. Suitable habitats are not expected to be impacted.
Marysville California kangaroo rat *Dipodomys californicus eximius*	--	**SSC**	Known only from the Sutter Buttes area in Sutter County	Friable soils in chaparral and valley & foothill grasslands	Year round.	None. There are two occurrences of this species in Sutter County. Suitable habitat is not present within the project area. The species is not likely to be impacted by water transfers.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Pallid bat *Antrozous pallidus*	--	SSC	Throughout California, except for high Sierra Nevada from Shasta to Kern counties, northwestern corner of state from Del Norte & western Siskiyou county. To northern Mendocino County.	Found in deserts, grasslands, scrublands, woodlands and forests. Most common in open, dry habitats with rocky areas for roosting.	Year round.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat may occur within the project area. No impacts would occur to suitable habitat.
Riparian brush rabbit *Sylvilagus bachmani riparius*	E	E	Isolated populations on Caswell Memorial State Park on the Stanislaus River and along an overflow channel of the San Joaquin River.	Riparian thickets	Year round	None. No CNDDB records of this species have been documented in the project area. Suitable habitat is present in the project area, however, no potential impacts are expected to suitable habitat (i.e. riparian thickets).
Salt-marsh harvest mouse *Reithrodontomys raviventris*	E	E, FP	Found in San Francisco Bay and its tributaries.	Found in saline emergent wetlands. Pickle weed is the primary habitat for the species. Requires higher grassland areas for flood escape.	Year round.	None. One CNDDB occurrence has been documented in the Seller Service Area and suitable habitat may be present in the project area. Transfers would not impact saline wetlands and salt marshes.
San Joaquin kit fox *Vulpes macrotis mutica*	E	T	Found only in the Central Valley area of California. Kit foxes currently inhabit suitable habitat in the San Joaquin valley and in surrounding foothills of the Coast Ranges, Sierra Nevada, and Tehachapi Mountains; from southern Kern County north to Contra Costa, Alameda, and San Joaquin counties on the west; and near La Grange, Stanislaus County on the east.	Found in annual grasslands or grassy open stages of vegetation dominated by scattered brush, shrubs, and scrub. Build dens for cover. Some agricultural areas may support these foxes.	Year round (mostly nocturnal, but often active during daytime in cool weather)	None. No occurrences have been documented within the Seller Service Area. Suitable habitat, i.e. agricultural fields is present within the project area. However due to the lack of local occurrences, the proposed project is not likely to impact this species.

Common Name **Scientific Name**	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential For Impact**
Townsend's big-eared bat *Corynorhinus townsendii*	--	**SSC**	Along the California coastline	Habitat associations include coniferous forests, deserts, native prairies, riparian communties, active agricultural areas, and coastal habitat types. Populations centers occuring in areas dominated by exposed, cavity forming rock and/or historic mining districts.	Year round.	None. There are CNDDB records for this species in Yolo and Colusa counties. Appropriate rock formations are not present in the project area and will not be impacts by water tranfsers.
Western mastiff bat *Eumops perotis californicus*	--	**SSC**	Found in southeastern San Joaquin Valley and Coastal ranges from Monterey County southward through southern California and from the coast eastward to Colorado Desert.	Found in open, semi-arid habitats, including conifer and deciduous woodlands, coastal scrub, grasslands, and chaparral. Roost in crevices in cliff faces, high buildings, trees and tunnels.	Year round	None. There is one CNDDB occurrence in the Seller Service Area and suitable habitat is present within the project area. No impacts are anticipated to feeding or roosting habitat.
Western red bat *Lasiurus blossevillii*	--	**SSC**	Occurs from Shasta County to Mexican border, west of Sierra Nevada/Cascade crest and deserts. Winters in western lowlands and coastal regions south of SF bay. Not found in desert areas.	Found in trees 2-40ft above ground, from sea level up through mixed conifer forests. Prefers habitat edges and mosaics with trees. Feeds over a wide variety of habitats including grasslands, scrublands and croplands.	Year round. Migrates in spring (March-May) and autumn (Sept.-Oct). Migrates between summer and winter range	None. Occurrences have been documented in the Seller Service Area and suitable habitat is present within the project area. No impacts to roosting habitat are anticipated. Transfers could alter the configuration of foraging habitat, but would not reduce suitability.
Fish						
Chinook Salmon (Central Valley spring-run ESU) *Oncorhynchus tshawytscha*	**T**	**T**	The Sacramento and San Joaquin Rivers and their tributaries	Cold-water streams with adequate dissolved oxygen for spawning and rearing. Spawning habitat generally consists of clean, loose gravel, in swift, relatively shallow riffles.	Spawning mid-August to early October	None. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Chinook Salmon (Sacramento River winter-run ESU) *Oncorhynchus tshawytscha*	**E**	**E**	Distributed throughout northern California	Cold-water streams with adequate dissolved oxygen for spawning and rearing. Spawning habitat generally consists of clean, loose gravel, in swift, relatively shallow riffles.	Spawning mid-April to mid-August	None. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact
Delta Smelt *Hypomesus transpacificus*	**T,X**	**E**	Restricted to the upper reaches of the San Francisco Bay and Sacramento-San Joaquin Delta Estuary, from San Pablo Bay upstream to Sacramento on the Sacramento River and Mossdale on the San Joaquin River.	This species can tolerate a wide range of salinity and temperatures. Shallow, fresh, or slightly brackish backwater sloughs and edgewaters with good water quality and substrate are used for spawning.	Year round	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.
Eulachon *Thaleichthys pacificus*	**T**	**--**	Found from nothern California to southwest Alaska.	Adults spend most of their life in the ocean and migrate into freshwater to spawn. Most spawning occurs within tidal influence through some spawning areas area located farther upstream of the river mouth. The species is susceptible to poor water quality	Spawning between December and May	None. There are no recent CNDDB occurrences within the Seller Service Area. Suitable spawning habitat is present in the project area. However, flow reductions as a resullt of this project would be low and would not affect this species.
Green sturgeon (Southern DPS) *Acipenser medirostris*	**T**	**--**	Throughout northern and central California; Humboldt Bay, San Francisco Bay and Delta, Monterey Bay, Sacramento, Feather, and Yuba Rivers	Using both freshwater and saltwater habitat, this species spawns in deep pools, in large turbulent freshwater river mainstems.	Spawning Match to July	None. Suitable migration and spawning habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.
Longfin smelt *Spirinchus thaleichthys*	**C**	**T**	Found on the Sacramento and San Joaquin Rivers in the Delta through Suisun Bay and Suisun Marsh, San Pablo Bay, San Francisco Bay, the Gulf of the Farallones, Humboldt Bay, Eel river estuary and other local coastal areas.	Adult longfin smelt migrate into low salinity or freshwater reaches of coastal rivers and tributary streams to spawn. Encounter a wide variety of water temperatures and salinities during their life cycle but are rarely found in water temperatures greater than 71 degrees F.	Spawning in January - March	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.

Common Name **Scientific Name**	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential For Impact**
Sacramento perch *Archoplites interruptus*	**--**	**SSC**	Found in Clear Lake and Alameda Creek/Calaveras Reservoir, as well as in some farm ponds and reservoirs. The species has been introduced through the state including the upper Klamath basin, upper Pit River watershed, Walker River watershed, Mono Lake watershed, and Owens River watershed, and may exist in Sonoma Reservoir in the Russian River watershed.	Inhabit warm reservoirs and ponds where summer temperatures range from 64 to 82 degrees F. Often found in clear water among beds of aquatic vegetation, but can thrive in turbid lakes absent of plants. The species is found along the bottom of inshore regions.	Spawning March through early August	None. There are no recent CNDDB occurrences within the Seller Service Area. Suitable spawning habitat is present in the project area. However, flow reductions as a resullt of this project would be low and would not affect this species.
Sacramento splittail *Pogonichthys macrolepidotus*	**--**	**SSC**	Largely confined to the Delta, Suisun Bay, Suisun Marsh, Napa River, Petaluma River, and other parts of the San Francisco Estuary, while spawning on upstream floodplains and channel edges.	Adapted to estuarine life so thet are tolerant of a wide range of salinities and temperatures. Require a rising hydrograph for upstream migration and flooded vegetation for spawning and rearing areas for their early life history stages.	Year round	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.
Steelhead (California Central Valley DPS) *Oncorhynchus mykiss*	**T**	**--**	Native to streams along the Pacific coast of North America	Populations inhabit small headwater streams, large rivers, lakes, or reservoirs; often in cool clear lakes and cool swift streams with silt-free substrate. Usually requires a gravel riffle for successful spawning.	Year round	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in project area. However, flow reductions as a result of this project would be low and would not affect this species.

Common Name Scientific Name	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential For Impact

Federal
T = listed as threatened under the federal Endangered Species Act
C = Candidate for listing as threatened or endangered
SC = species of concern; formerly Category 2 candidate for federal listing
BGEPA = Bald and Golden Eagle Protection Act
MNBMC = Fish and Wildlife Service: Migratory Nongame Birds of Management Concern
-- = no designations
X = critical habitat
PX = proposed critical habitat
D = delisted

State
E = listed as endangered under the California Endangered Species Act
T = listed as threatened under the California Endangered Species Act
PT- listed as proposed threatened under Federal Endangered Species Act
CE = candidate endangered under the California Endangered Species Act
FP = fully protected under the California Fish and Game Code
SSC = species of special concern
D= delisted
WL = Watch List
-- = no designations

Sources
California Department of Fish and Wildlife (CDFW) 2022 Special Animals List.
CDFW California Natural Diversity Database (CNDDB) Rarefind 5. Accessed December 2022.

Appendix C
Special Status Plant Species with Potential to Occur

Common Name Scientific name	**Special Status* (F/S/CNPS)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Adobe-lily *Fritillaria pluriflora*	-/-/ 1B	Butte, Colusa, Glenn, Lake, Napa, Solano, Tehama, and Yolo Counties	Often adobe, chaparral, cismontane woodland, and valley/ foothill grassland	February-April	None. There are CNDDB occurrences within the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	-/-/ 1B	Butte, Calaveras, Placer, Sacramento, Tehama, and Yuba Counties.	Valley and foothill grassland (mesic).	March-May	None. There are CNDDB occurrences within the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Alkali milk-vetch *Astragalus tener var. tener*	-/-/ 1B	Central western California including Yolo County.	Subalkaline flats and areas around vernal pools.	March-June	None. There are CNDDB occurrences within the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present (i.e. subalkali flats).
alkai-sink goldfields *Lasthenia chrysantha*	-/-/ 1B	Saccramento and San Joaquin valleys	Vernal pools and wet saline flats	February-April	None. There are CNDDB occurrences within the Seller Service Area. Not likely to occur in crop fields, no suitable habitat is present (i.e. vernal pools).
Anthony Peak lupine *Lupinus antoninus*	-/-/ 1B	Colusa, Lake, Mendocino, Tehama, and Trinity Counties	Rocky lower and upper montane coniferous forest	May-July	None. There are CNDDB occurrences within the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present (i.e. coniferous forest).
Antioch Dunes evening-primrose *Oenothera deltoides* ssp. *howellii*	E,X/E/1B	Found only in Contra Costa and Sacramento Counties.	Occurs in inland dunes.	March-September	None. One CNDDB occurrence recorded in Sacramento County. Not likely to occur in crop fields, no suitable habitat present.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Baker's navarretia *Navarretia leucocephala ssp. bakeri*	-/-/1B	Colusa, Glenn, Lake, Lassen, Mendocino, Marin, Napa, Solano, Sonoma, Sutter, Tehama, and Yolo Counties.	Cismontane woodland, meadows and seeps, vernal pools, valley and foothill grassland, lower montane coniferous forest. Vernal pools and swales, adobe or alkaline soils from 5 - 950m.	April - July	None. The CNDDB contains records of this species within the Seller Service Area. It is very unlikely that Baker's navarretia would establish in rice fields, given the lack of adobe or alkaline soils.
bearded popcornflower *Plagiobothrys hystriculus*	-/-/1B	Napa, Solano, and Yolo Counties.	Vernal pools, valley and foothill grassland in wet sites from 10-50m. This species is only known from a few very limited occurrences at the edges of vernal pools, such as at Jepson Prairie and in the Montezuma Hills.	April - May	None. Previous records of bearded popcorn-flower exist within the Seller Service Area. This species is not expected to occur in rice fields. No vernal pools or grassland habitats would be affected by the proposed Transfers.
bent-flowered fiddleneck *Amsinckia lunaris*	-/-/1B	Alameda, Contra Costa, Colusa, Lake, Marin, Napa, San Benito, Santa Clara, Santa Cruz, San Mateo, Sonoma, and Yolo Counties.	Cismontane woodland, valley and foothill grassland from 50 - 500m.	March - June	None. Has been previously documented within the Buyer Service Area. Although suitable habitat occurs within the area of analysis, none would be affected by the proposed actions.
big-scale balsamroot *Balsamorhiza macrolepis*	-/-/1B	Alameda, Butte, Colusa, El Dorado, Lake, Mariposa, Napa, Placer, Santa Clara, Solano, Sonoma, Tehama, and Tuolumne Counties.	Valley and foothill grassland, cismontane woodland. Sometimes on serpentine. 35 - 1000m	March - June	None. This species has been previously documented within both the Buyer Service Areas. However, it is not expected to occur in rice fields due to lack of suitable habitat.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Boggs Lake hedge-hyssop *Gratiola hetersepela*	-/E/1B	Dispersed throughout the Sacramento and Central Valley. Also in Oregon.	Marsh's, swamps, and vernal pools (clay).	April-August	None. There are CNDDB occurrences within Sacramento County. Suitable habitat is present but has low potential to occur. No effects anticipated from small changes in river flow.
Bolander's horkelia *Horkelia bolanderi*	-/-/1B	Colusa, Lake, and Mendocino counties	The edges and vernally mesic areas of chaparral, lower montane coniferous forest, meadows and seeps, and valley/ foothill grassland.	May-August	None. There is a CNDDB occurrence within Colusa County. However, it is not expected to occur in rice fields due to lack of suitable habitat and no effects are anticipated from small changes in river flow.
Brittlescale *Atriplex depressa*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grassland, alkali meadow, alkali scrub, and vernal pools.	April-October	There are CNDDB occurrences within Glenn, Colusa, and Yolo counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali and vernal pools).
Burke's Goldfields *Lasthenia burkei*	E/E/1B	Lake, Mendocino, Napa, and Sonoma counties	Meadows and seeps (mesic), and vernal pools	April-June	None. Although suitable habitat may be present, no CNDDB occurrences were reported in the Seller Service Area. No effects anticipated from small changes in river flow.
Butte County Meadowfoam *Limnanthes floccosa ssp. californica*	E/E/1B	Butte County	Valley and foothill grassland (mesic) and vernal pools	March-May	None. Suitable habitat is not present and no CNDDB occurrences were reported in the Seller Service Area. No effects anticipated from small changes in river flow.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
California alkali grass *Puccinellia simplex*	-/-/1B	Alameda, Butte, Contra Costa, Colusa, Fresno, Glenn, Kings, Kern, Lake, Los Angeles, Madera, Merced, Napa, San Bernardino, Santa Clara, Santa Cruz, San Luis Obispo, Solano, Stanislaus, Tulare, and Yolo counties	Alkaline, vernally mesic sinks, flats, and lake margins of chenopod scrub, meadows and seeps, valley and foothill grasslands, and vernal pools	March-May	None. CNDDB records exist for the Seller Service Area. However, transfers are not expected to impact suitable habitat for this species.
Cobb Mountain lupine *Lupinus sericatus*	-/-/1B	Colusa, Lake, Napa, and Sonoma Counties	Broadleafed upland forest, chaparral, cismontane woodland, and lower montane coniferous forest	March-June	None. There is a CNDDB occurrence within Colusa County, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. coniferous forest).
Colusa grass *Neostapfia colusana*	T,X/E/1B	Southern Sacramento Valley, and northern San Joaquin Valley.	Vernal pools.	May-August	None. There are a CNDDB occurrences within Glenn, Colusa, and Yolo counties; however, this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Colusa layia *Layia septentrionalis*	-/-/1B	Colusa, Glenn, Lake, Mendocino, Napa, Sonoma, Sutter, Tehama, and Yolo Counties.	Chaparral, cismontane woodland, valley and foothill grassland. Scattered colonies in fields and grassy slopes in sandy or serpentine soil 145 - 1095m asl.	April - May	None. CNDDB records exist for the Seller Service Area. Transfers are not expected to impact suitable habitat for this species given that rice fields do not provide appropriate conditions.
Contra Costa Goldfields *Lasthenia conjugens*	E/-/1B	San Francisco Bay Delta Regions, and scattered coastal areas.	Cismontane woodlands, playas, valley and foothill grasslands, and vernal pools. Often occurs in vernal pools, swales, and low depressions in open grassy areas 1 - 445m asl.	March-June	None. Suitable habitat is not present and no CNDDB occurrences were reported in the Seller Service Area. No effects anticipated from small changes in river flow.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Coulter's goldfields *Lasthenia glabrata ssp. coulteri*	-/-/1B	Colusa, Kern, Los Angeles, Merced, Orange, Riverside, Santa Barbara, San Bernardino, San Diego, San Luis Obispo, Tehama, Tulare, Ventura, and Yolo counties	Marshes and swamps, playas, and vernal pools	February-June	None. CNDDB records exist in Colusa and Glenn counties. Transfers are not expected to impact suitable habitat for this species.
Crampton's tuctoria (Solano grass) *Tuctoria mucronata*	E,X/E/1B	Located only in Yolo and Solano Counties.	Valley and foothill grassland (mesic), and vernal pools.	April-August	None. There are two CNDDB occurrences in Yolo County. Not likely to occur in crop fields, no suitable habitat present.
Deep-scarred cryptantha *Cryptantha excavata*	-/-/1B	Colusa, Lake, Mendocino, and Yolo counties	Sandy and gravelly portions of cismontane woodland	April-May	None. There are CNDDB records of this species within Yolo and Colusa counties. However, it is not expected to occur in rice fields due to lack of suitable habitat and no effects are anticipated from small changes in river flow.
Delta tule pea *Lathyrus jepsonii var. jepsonii*	-/-/1B	Contra Costa, Napa, Sacramento, San Joaquin, Solano, Sonoma and Yolo Counties.	Marshes and swamps (freshwater and brackish)	May-July	None. This species has been previously documented within the Seller Service Area. No impacts to suitable habitat is anticipated.
Diamond-petaled California poppy *Eschscholzia rhombipetala*	-/-/1B	Alameda, Contra Costa, Colusa, San Joaquin, San Luis Obispo, Stanislaus Counties.	Valley and foothill grassland. Alkaline clay slopes and flats. 0 - 975m asl.	March - April	None. This species has been previously documented in Colusa County. No impacts to suitable habitat are anticipated.
Drymaria-like western flax *Hesperolinon drymarioides*	-/-/1B	Colusa, Glenn, Lake, Napa, and Yolo Counties	Serpentinite closed-cone coniferous forest, chaparral, cismontane woodland, and valley and foothill grassland.	May-August	None. There are CNDDB occurrences in Glenn and Colusa counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. coniferous forest).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Dwarf soaproot *Chlorogalum pomeridianum var. minus*	-/-/1B	Alameda, Colusa, Glenn, Lake, Santa Clara, San Luis Obispo, Sonoma, and Tehama Counties	Chaparral (serpentinite)	May-August	None. There are CNDDB records in Glenn and Colusa counties; however not likely to occur in crop fields, no suitable habitat will be impacted.
El Dorado bedstraw *Galium californicum ssp. sierrae*	E/R/1B	El Dorado County	Gabbroic chaparral, cismontane woodland, and lower montane coniferous forest	May-June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Ferris' milk-vetch *Astragalus tener* var. *ferrisae*	-/-/1B	Sacramento Valley.	Subalkaline flats and areas around vernal pools.	March-June	None. Although there are CNDDB occurrences within the Seller Service Area, the species is not likely to occur in crop fields, no suitable habitat will be impacted.
Succulent Owl's-clover (formerly Fleshy Owl's-clover) *Castilleja campestris ssp. succulenta*	T,X/E/1B	Fresno, Madera, Merced, Mariposa, San Joaquin, and Stanislaus Counties	Vernal pools, oftern acidic	March-May	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
green jewelflower *Streptanthus hesperidis*	-/-/1B	Colusa, Glenn, Lake, Napa, Sonoma, and Yolo Counties	Serpentinite, rocky chaparral and cismontane woodlands	May-July	None. There are CNDDB records in Glenn and Yolo counties; however not likely to occur in crop fields, no suitable habitat will be impacted.
Greene's narrow-leaved daisy *Erigeron greenei*	-/-/1B	Colusa, Lake, Napa, and Sonoma Counties	Serpentinite or volcanic chaparral	May-September	None. There are CNDDB records in Colusa County; however not likely to occur in crop fields, no suitable habitat is present.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Greene's tuctoria *Tuctoria greeni*	E/R/1B	Butte, Colusa, Fresno, Glenn, Madera, Merced, Modoc, Shasta, San Joaquin, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	May-July	There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Hairy Orcutt grass *Orcuttia pilosa*	E/E/1B	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento counties.	Vernal pools.	May-September	None. There are CNDDB occurrences within Butte and Glenn counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Hall's harmonia *Harmonia hallii*	-/-/1B	Colusa, Lake, Napa, and Yolo Counties	Serpentinite chaparral	April-June	None. CNDDB records exist for the Seller Service Area. Transfers are not expected to impact suitable habitat for this species.
Hartweg's golden sunburst *Pseudobahia bahiifolia*	E/E/1B	Fresno, Madera, Merced, Stanislaus, Tuolumne, and Yuba counties	Clay and often acidic, cismontane woodland, and valley and foothill grassland	March-April	None. A CNDDB occurrence exists within Sutter County. Transfers are not expected to impact suitable habitat for this species.
Heartscale *Atriplex cordulata*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, alkali meadows, and alkali scrub.	May-October	None. There are CNDDB occurrences within Butte, Colusa, Yolo, and Glenn counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali areas).
Heckard's pepper-grass *Lepidium latipes* var. *heckardii*	-/-/1B	Glenn, Solano, and Yolo Counties.	Valley and foothill grassland alkaline flats.	March-May	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali flats).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Hoover's cryptantha *Cryptantha hooveri*	-/-/1A	Contra Costa, Kern, Madera, Stanislaus Counties.	Valley and foothill grassland in coarse sand up to 150m asl.	April - May	None. There is one CNDDB occurrence within the Seller Service Area. No impacts to suitable habitat for this species are anticipated.
Hoover's spurge *Chamaesyce hooveri*	T/-/ 1B	Scattered in Glenn, Butte, Colusa, Merced, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	July-September	None. There are CNDDB occurrences within Glenn County, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Indian valley brodiaea *Broiaea coronaria* ssp. *rosea*	-/E/3	Scattered in Glenn, Lake, Colusa, and Tehama Counties.	Closed cone coniferous forest, chaparral, valley and foothill grasslands (serpentinite).	May-June	None. There are CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Ione (incl. Irish Hill) Buckwheat *Eriogonum apricum (incl. var. prostratum)*	E/E/1B	Amador and Sacramento Counties	Chaparral	July-October	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Ione Manzanita *Arctostaphylos myrtifolia*	T/-/1B	Amador and Calaveras counties	Acidic, ione soil, clay or sandy chaparral and cismontane woodland	November-March	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Jepson's coyote-thistle *Eryngium jepsonii*	-/-/1B	Alameda, Amador, Calaveras, Contra Costa, Fresno, Napa, San Mateo, Solano, Stanislaus, Tuolumne, and Yolo counties	Clay soils of valley and foothill grassland and vernal pools	April-August	None. The species has been observed within the Seller Service Area. No impacts to suitable habitat for this species are anticipated.
Jepson's leptosiphon *Leptosiphon jepsonii*	-/-/1B	Lake, Napa, Sonoma, and Yolo counties	Usually volcanic soils of chaparral, cismontane woodland, and valley and foothill grassland	March-May	None. The species has been observed within Yolo County. No impacts to suitable habitat for this species are anticipated.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Jepson's milk-vetch *Astragalus rattanii var. jepsonianus*	-/-/1B	Colusa, Glenn, Lake, Napa, Tehama, and Yolo counties.	Chaparral, cismontane woodland, valley and foothill grassland, often serpentinite.	April-June	None. There are CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Keck's checkerbloom *Sidalcea keckii*	E/-/1B	Colusa, Fresno, Merced, Napa, Solano, Tulare, and Yolo counties.	Cismontane woodlands, foothill and valley grasslands (serpentinite).	April-May	None. There are CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Klamath sedge *Carex klamathensis*	-/-/1B	Colusa, Lake, and Tehama counties	Serpentinite chaparral, cismontane woodland, and meadows/ seeps	--	None. There is one CNDDB occurrence within the Seller Service Area. No impacts would occur to suitable habitat.
Konocti manzanita *Arctostaphylos manzanita ssp. elegans*	-/-/1B	Colusa, Glenn, Humbodlt, Lake, Mendocino, Napa, Shasta, Sonoma, Tehama, and Trinity counties	Volcanic soils of chaparral, cismontane woodland, and lower montane coniferous forest	January-July	None. There are CNDDB occurrences within Glenn and Colusa counties, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. coniferous forest).
Large-flowered fiddleneck *Amsinckia grandiflora*	E/E/1B	Alameda, Contra Costa, and San Joaquin Counties.	Cismontane woodland, valley and foothill grassland. Annual grassland in various soils 275 - 550m asl.	April - May	None. There are no CNDDB occurrences within the Seller Service Area. No impacts would occur to suitable habitat.
Layne's Ragwort (Formerly Layne's Butterweed) *Packera layneae*	T/R/1B	El Dorado, Placer, Tuolumne, and Yuba counties	Serpentinite or gabbroic, rocky soils of chaparral and cismontane woodland	April-August	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Legenere *Legenere limosa*	-/-/1B	Sacramento Valley and south of the North Coast Ranges.	Vernal pools.	May-June	None. There are CNDDB occurrences within Sacramento County. Not likely to occur in crop fields, no suitable habitat present (i.e. vernal pools).

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Marsh checkerbloom *Sidalcea oregana* ssp. *hydrophila*	-/-/1B	Glenn, Lake, Mendocino, and Napa Counties.	Meadows and seeps, and riparian forest.	June-August	None. There are CNDDB records of this species within the Seller Service Area. Not likely to establish in crop fields and no effects anticipated from small changes in river flow.
Mason's lilaeopsis *Lilaeopsis masonii*	-/R/1B	Alameda, Contra Costa, Marin, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Freshwater and brackish marshes, riparian scrub. Tidal zones, in muddy or silty soil formed through river deposition or river bank erosion 0 - 10m asl. Populations may be ephemeral, using freshly deposited or exposed	April - November	None. Previous records of this species exist within the Buyer Service Area. This species is not expected to establish within rice fields.
Milo Baker's lupine *Lupinus milo-bakeri*	-/T/1B	Glenn and Mendocino Counties.	Cismontane woodlands, foothill and valley grasslands.	June-September	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat.
Oregon fireweed *Epilobium oreganum*	-/-/1B	Del Norte, El Dorado, Glenn, Humboldt, Mendocino, Nevada, Placer, Shasta, Siskiyou, Tehama, and Trinity counties	Mesic soils of bogs, fens, lower montane coniferous forest, meadows, seeps, and upper montane coniferous forest	June-September	None. CNDDB records of this species exist within Glenn County. Suitable habitat is not present and species is not likely to be impacted by water transfers.
Palmate-bracted bird's-beak *Chloropyron palmatum*	E/E/1B	Found in Glenn and Colusa Counties and within the Central Valley.	Alkali meadow, alkali scrub, valley and grasslands.	May-October	None. CNDDB records of this species exist in the Seller Service Area. Not likely to occur in rice fields; no suitable habitat is present (i.e. alkali areas).
Pappose tarplant *Centromadia parryi ssp. parryi*	-/-/1B	Butte, Colusa, Glenn, Lake, Napa, San Mateo, Solano, Sonoma, and Yolo counties	Often alkaline soils of chaparral, coastal prairie, meadows and seeps, marshes and swamps, and valley and foothill grassland	May-November	None. There are occurrences within Glenn, Colusa, and Yolo counties. This species is not expected to establish within rice fields.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Pincushion navarretia *Navarretia myersii ssp. myersii*	-/-/1B	Amamdor, Calaveras, Merced, Placer, and Sacramento Counties.	Vernal pools (often acidic).	May	None. Previously documented in Sacramento County. No vernal pools would be affected by transfers.
Pine Hill ceanothus *Ceanothus roderickii*	E/R/1B	El Dorado County	Serpentinite or gabbroic soils of chaparral and cismontane woodland	April-June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
Pine Hill flannelbush *Fremonodendron californicum ssp. decumbens*	E/R/1B	El Dorado, Nevada, and Yuba counties	Rocky, Gabbroic or serpentinite soils of chaparral and cismontane woodland	April-July	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.
pink creamsacs *Castilleja rubicundula var. rubicundula*	-/-/1B	Butte, Contra Costa, Colusa, Glenn, Lake, Napa, Santa Clara, and Shasta counties	Serpentinite soils of chapparal, cismontane woodland, meadows and seeps, and valley and foothill grassland habitat	April-June	None. CNDDB records of the species have been documented in Yolo, Colusa, and Glenn counties. The species is not likely to occur within crop fields and is not anticipated to be affected by transfering water.
Porter's navarretia *Navarretia paradoxinota*	-/-/1B	Colusa, Lake, and Napa counties	Serpentinite, openings, vernally mesic, and drainages of meadows and seeps	May-July	None. There is a CNDDB record in Colusa County, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. meadows and seeps)
Recurved larkspur *Delphinium recurvatum*	-/-/1B	Disbursed throughout the Sacramento and Central Valley.	Chenopod scrub, cismontane, valley and foothill grasslands (alkali).	March-June	None. There is a CNDDB occurrence, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. alkali soil).
red-flowered bird's-foot trefoil *Acmispon rubriflorus*	-/-/1B	Colusa, Stanislaus, and Tehama counties	Cismontane woodland and valley and foothill grassland	April-June	None. CNDDB records of this species exist within Colusa County. Suitable habitat is not present and species is not likely to be impacted by water transfers.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Sacramento orcutt grass *Orcuttia viscida*	E,X/E/1B	Valley grasslands and freshwater wetlands.	Vernal pools.	May-June	None. There are CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
saline clover *Trifolium hydrophilum*	-/-/1B	California's Central coast and Bay Area.	Marshes and swamps, valley and foothill grassland, vernal pools. Mesic, alkaline sites 0 - 300m asl.	April - June	None. Records of saline clover exist within the Seller Service Areas. Rice fields may represent marginally suitable habitat for this species, even so this species is unlikely to be affected by water transfers.
San Joaquin spearscale *Atriplex joaquiniana*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, and alkali scrub.	April-September	None. There are CNDDB records within the Seller Service Area, however the species is not likely to occur in crop fields, no suitable habitat present (i.e. alkali soils).
Sanford's arrowhead *Sagittaria sanfordii*	-/-/1B	Central Valley.	Freshwater marshes, shallow streams, and ditches.	May-August	None. There are CNDDB occurrences within the Buyer Service Area. Suitable habitat present in ditches. Not likely to establish in crop fields and no effects anticipated from small changes in river flow.
Sanhedrin Mountain stonecrop *Sedum sanhedrinum*	-/-/1B	Northwestern California and southwestern Oregon.	Rock outcrops and rocky crevices in chaparral, lower montane coniferous forest, and upper montane coniferous forest habitats occuring at 1350-1500 m asl.	May-July	None. There is a CNDDB record in northeastern Colusa County. However, crop fields do not provide suitable habitat for the species.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Scabrid alpine tarplant *Anisocarpus scabridus*	-/-/1B	Colusa, Humboldt, Lake, Mendocino, Shasta, Tehama, and Trinity counties	Metamorphic, rocky soils of upper montane coniferous forest	June-September	None. There is a CNDDB record in Colusa County, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. montane coniferous forest)
Serpentine cryptantha *Cryptantha dissita*	-/-/1B	Colusa, Lake, Mendocino, Napa, Shasta, Siskiyou, and Sonoma counties	Chaparral (serpentinite)	April-June	None. There are CNDDB records in western Colusa County. Howver, the species is not likely to occur in crop fields, because no suitable habitat is present.
Shining navarretia *Navarretia nigelliformis ssp. radians*	-/-/1B	Alameda, Contra Costa, Fresno, Merced, Monterey, San Benito, San Joaquin, and San Luis Obispo Counties.	Cismontane woodland, valley and foothill grassland, and vernal pools 200 - 1000m asl. Known from grassland, and may not necessarily occur in vernal pools.	April - July	None. There are previous CNDDB records of shining navarettia exist for the Seller Service Area. This species is unlikely to establish within rice fields due to lack of suitable habitat (i.e., vernal pools and native grassland)
Showy rancheria clover (Formerly Showy Indian clover) *Trifolium amoenum*	E/-/1B	North Coast Ranges, Central Coast and San Francisco Bay	Valley grassland, wetland-riparian	April - June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields. No impacts to the species is anticipated.
Silky cryptantha *Cryptantha crinita*	-/-/1B	Glenn, Shasta, and Tehama counties	Gravelly streambeds of cismontane woodland, lower montane coniferous forest, riparian forest, riparian woodland, and valley and foothill grassland	April-May	None. There is a previous CNDDB record in Glenn County. The species is not likely to occur in crop fields, no suitable habitat present (i.e. gravelly streambeds).

Common Name Scientific name	**Special Status* (F/S/CNPS)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Slender Orcutt grass *Orcuttia tenuis*	T,X/E/1B	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento Counties	Vernal pools.	May-July	None. There are CNDDB occurrences, however this species is not likely to occur in crop fields due to lack of suitable habitat (i.e. vernal pools).
Small-flowered calycadenia *Calycadenia micrantha*	-/-/1B	Colusa, Humboldt, Lake, Monterey, Napa, and Trinity counties	Roadsides, rocky, talus, scree and sparsely vegetated areas of chaparral, meadows, and valley and foothill grassland	June-September	None. There is a single CNDDB occurrence in Colusa County. Suitable habitat for this species is not likely to be impacted by water transfers.
Snow Mountain buckwheat *Eriogonum nervulosum*	-/-/1B	Colusa, Glenn, Lake, Napa, Sonoma, and Yolo Counties	Chaparral (serpentinite)	June-September	None. The CNDDB contains records of this species within the Seller Service Area. It is very unlikely that Baker's navarretia would establish in rice fields, given the lack of chaparral.
Snow Mountain willowherb *Epilobium nivium*	-/-/1B	Colusa, Glenn, Lake, Mendocino, Tehama, and Trinity	Rocky chaparral and upper montane coniferous forest	June-October	None. Snow mountain willowherb has been recorded by the CNDDB within the Seller Service Area. No impacts would occur to suitable habitat.
Soft salty bird's beak *Chloropyron molle* ssp. *Molle*	E/R/1B	Contra Costa, Marin, Napa, Sacrmaneto, Solano, and Sonoma counties	Marshes and swamps	June-November	None. There is a single CNDDB occurrence in Sacramento County. Suitable habitat for this species is not likely to be impacted by water transfers.
Stebbins' Morning-glory *Calystegia stebbinsii*	E/E/1B	El Dorado and Nevada counties	Gabbroic and serpentinite soils of chaparral and cismontane woodland	April-June	None. There are no CNDDB records in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Stony Creek spurge *Euphorbia ocellata ssp. rattanii*	-/-/1B	Glenn and Tehama counties	Chaparral, riparian scrub, and valley and foothill grassland	May-October	None. There are multiple CNDDB occurrences in Glenn County. However this species is not likely to occur within crop fields and is not likely to be impacted.
Suisun Marsh aster *Symphyotrichum lentum*	-/-/1B	Contra Costa, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Saline and freshwater marshes and swamps. Most often seen along sloughs with Phragmites, Scirpus, blackberry, Typha, etc. at 0-3m asl.	May - November	None. This species has been previously documented in Sacramento and Yolo counties. This species is not expected to occur within rice fields given its sensitivity to habitat alteration and agricultural amendments. Environmental commitments would require that downstream flows are maintained, such that no impacts are anticipated in the natural habitats for the species.
Tehama County western flax *Hesperolinon tehamense*	-/-/1B	Alameda, Glenn, Lake, Napa, Stanislaus, and Tehama counties	Serpentinite chaparral and cismontane woodland	May-July	None. Previously documented in Glenn County. No chaparral and cismontane woodland habitat would be affected by Transfers.
Three-fingered morning-glory *Calystegia collina ssp. tridactylosa*	-/-/1B	Colusa, Glenn, Lake, Mendocino, and Sonoma counties	Serpentinite, rocky, gravelly, openings of chaparral and Cismontane woodlands.	April-June	None. There is a single occurrence in Colusa County. Not likely to occur in crop fields, no suitable habitat is present.
Tracy's estriastrum *Estriastrum tracyi*	-/R/3	Alameda, Colusa, Fresno, Glenn, Kern, Lake, Modoc, Santa Clara, Shasta, Stanislaus, Tehama, Trinity, Tulare	Foothill areas. Loam and sandy loam soils.	June - July	None. There are CNDDB occurrences within Glenn and Colusa counties, but not within the project area. No impacts to foothill vegetation are expected.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact
Tuolumne button-celery *Eryngium pinnatisectum*	-/-/1B	Amador, Calaveras, Sacramento, Sonoma, and Tuolumne counties	Cismontane woodlands, lower montane coniferous forest, and vernal pools	May- August	None. There is a single occurrence of this species in Sacramento County. Not likely to occur in crop fields; no suitable habitat present (i.e. vernal pools).
Veiny monardella ***Monardella venosa***	-/-/1B	Butte, Sutter, Tuolumne, and Yuba counties	Clay soils of cismontane woodland and valley/foothill grasslands	May-July	None. There is a single occurrence of this species in Sutter County. Not likely to occur in crop fields; no suitable habitat present.
Vernal pool smallscale *Atriplex persistens*	-/-/1B	Colusa, Madera, Merced, Solano, Stanislaus, and Tulare counties	Vernal pools	June, August, September, October	None. There are CNDDB occurrences in the Seller Service Area. Not likely to occur in crop fields, no suitable habitat present (i.e. vernal pools).
Woolly rose-mallow *Hibiscus lasiocarpos var. occidentalis*	-/-/1B	Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties.	Marshes and swamps (freshwater). Moist, freshwater-soaked river banks and low peat islands in sloughs. Known from the Delta watershed 0 - 150m asl.	June - September	None. Previously observed in the Seller Service Area. Not likely to establish in rice fields given the lack of suitable habitat (marsh and swamp). This species is sensitive to habitat disturbance and agricultural amendments.

Common Name Scientific name	Special Status* (F/S/CNPS)	Distribution	Habitat Association	Blooming Period	Potential Impact

***Status explanations:**
x= critical habitat

F=Federal
E=Endangered
T=Threatened
SC= Special Concern

S=State
E=Endangered
T=Threatened
SSC=Species of Special Concern
R = Rare

CNPS=California Native Plant Society
1A= Presumed extirpated in California and either rare or extinct elsewhere
1B=Rare, threatened, or endangered in California and elsewhere
2=Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
3=Plants about which we need more information - A review list

Sources

California Department of Fish and Wildlife (CDFW) State and Federally Listed Endangered, Threatened, and Rare Plants Of California. October 2022.
CDFW California Natural Diversity Database (CNDDB). Rarefind 5. Accessed in December, 2022.
CNPS Rare Plant Inventory. Accessed in December, 2022.

Appendix D

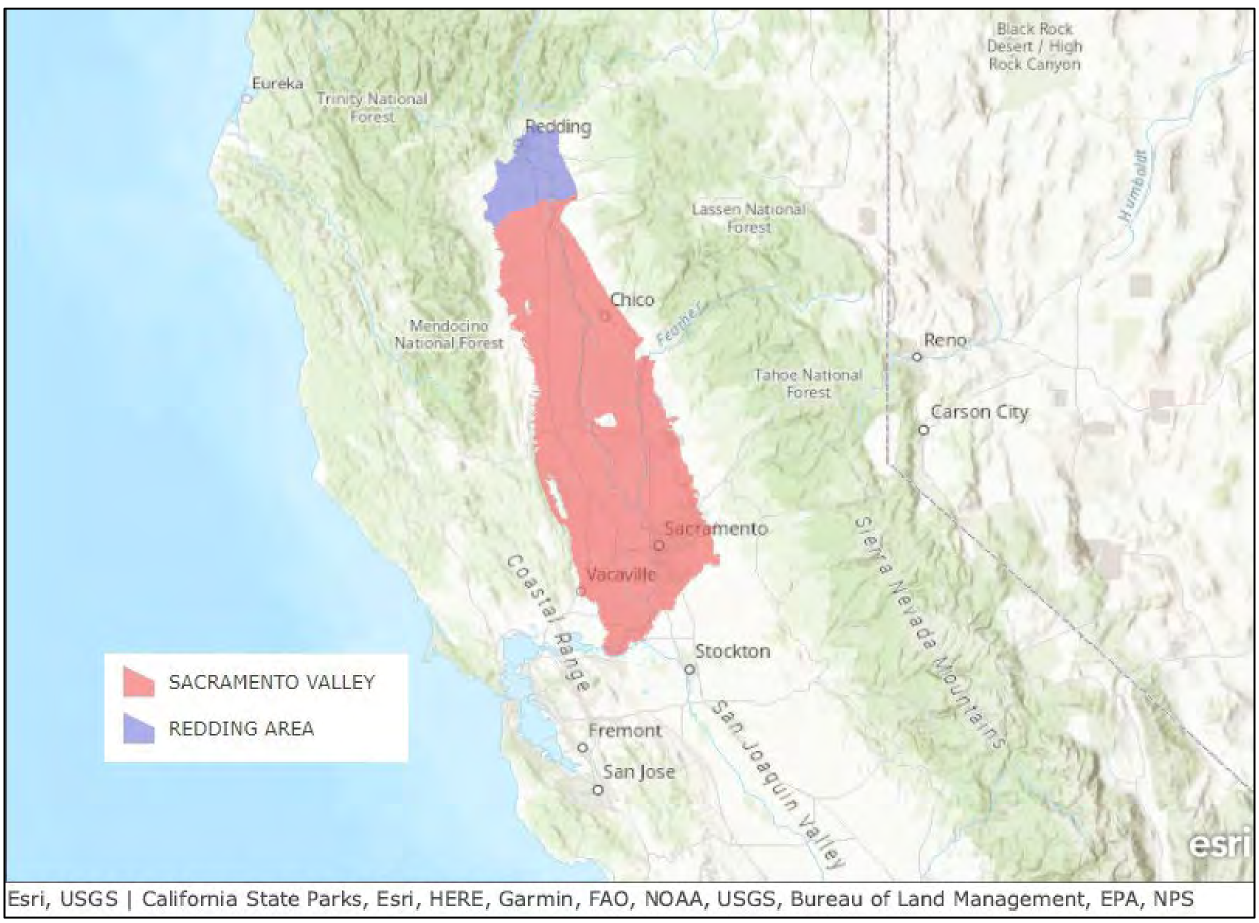
Groundwater Existing Conditions

Appendix D Groundwater Existing Conditions

This appendix provides an overview of groundwater existing conditions in the Seller Service Area, which includes the Redding Area and the Sacramento Valley groundwater basins.

D.1 Seller Service Area Groundwater Basins

As shown in Section 2.2.1 of the Initial Study/Environmental Assessment in Figure 2-1, Potential Selling Entities, the Seller Area is within the Sacramento Valley, which includes the Sacramento Valley Groundwater Basin and the Redding Area Groundwater Basin, as shown in Figure D-1. The Seller Service Area is located within two subbasins in the Redding Area Groundwater Basin: Anderson and Enterprise; and four subbasins in the Sacramento Valley Groundwater Basin: Colusa, North American, Sutter, and Yolo, as shown in Figure D-2.



Source: ArcGIS 2022

Figure D-1. Sacramento Valley and Redding Area Groundwater Basins

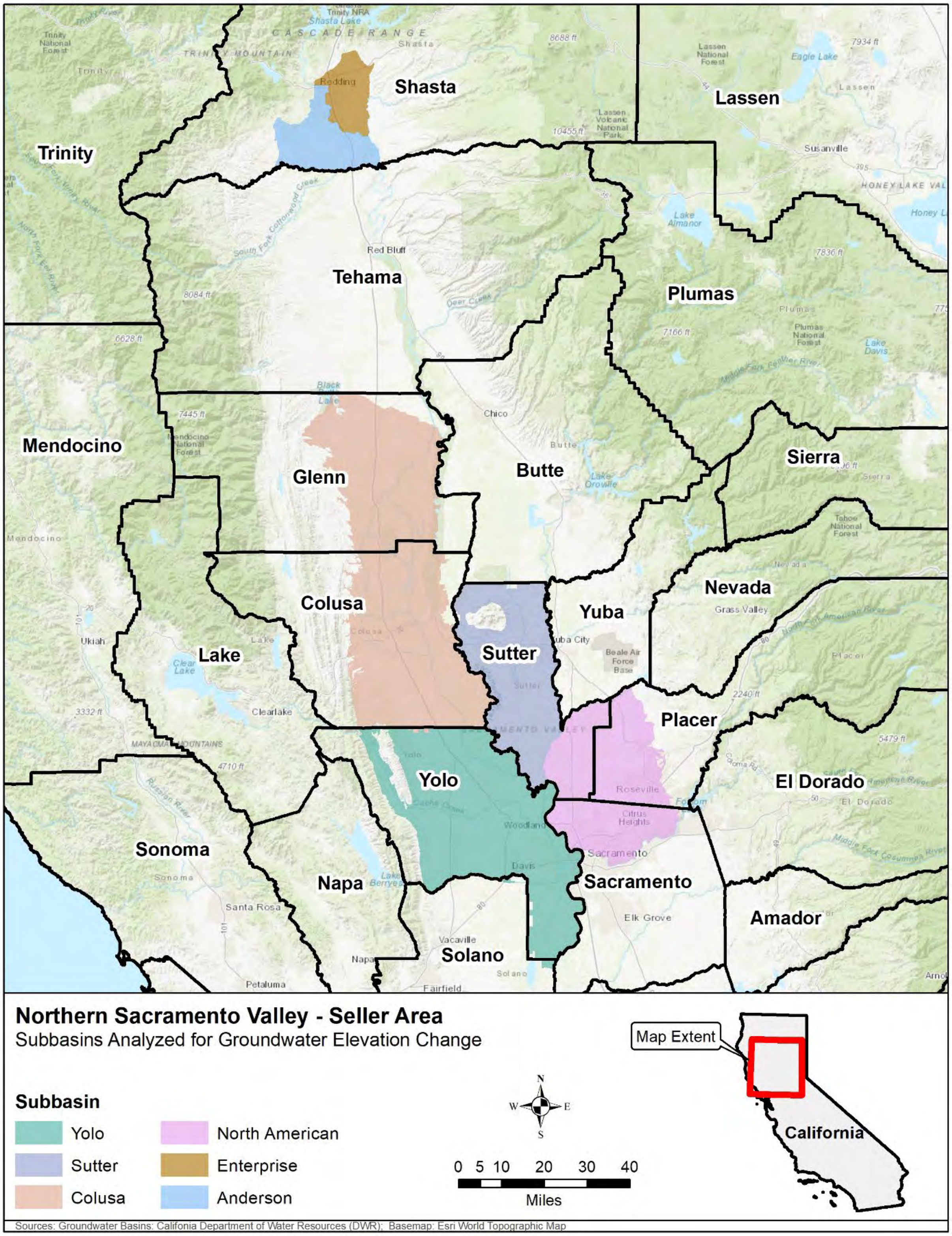


Figure D-2. Northern Sacramento Valley Seller Area

D.2 Sustainable Groundwater Management Act

According to the timeline set forth by California's Sustainable Groundwater Management Act (SGMA), high- and medium-priority groundwater subbasins were required to have Groundwater Sustainability Plans (GSP) developed and submitted to California Department of Water Resources (DWR) for review by January 31, 2022. Table D-1 provides the name of the Groundwater Sustainability Agency (GSA) and the SGMA basin prioritization for each subbasin within the Seller Service Area. GSPs for all the subbasins in the Seller Service Area were submitted and are currently under review by DWR. DWR evaluates GSPs within two years of submittal (DWR 2022a).

Table D-1. Sustainable Groundwater Management Act Basin Prioritization and Status in the Seller Area

Basin / Subbasin	Groundwater Sustainability Agency/Agencies (GSA)	Priority
Redding Area / Anderson	Enterprise-Anderson GSA	Medium
Redding Area / Enterprise	Enterprise-Anderson GSA	Medium
Sacramento Valley / Colusa	Colusa Groundwater Authority GSA - Colusa Glenn Groundwater Authority GSA	High
Sacramento Valley / Sutter	Sutter Community Service District GSA Butte Water District GSA - Sutter Sutter Extension Water District GSA City of Live Oak GSA County of Sutter GSA - Sutter Reclamation District No. 1500 GSA City of Yuba City GSA Reclamation District No. 70 GSA Reclamation District No. 1660 GSA	Medium
Sacramento Valley / Yolo	Yolo Subbasin GSA	High
Sacramento Valley / North American	Sacramento Groundwater Authority GSA West Placer GSA South Sutter Water District GSA Reclamation District No. 1001 GSA County of Sutter GSA - North American	High

Source: DWR 2022b, DWR 2022c

D.3 Change In Groundwater Elevation

Existing groundwater level measurements were reviewed to establish existing conditions in the project area and determine general groundwater elevation trends in the greater Sacramento Valley. The SGMA Data Viewer (DWR 2022d) was used to research water level data for four periods:

- Spring 2012 to Spring 2022,
- Spring 2017 to Spring 2022,

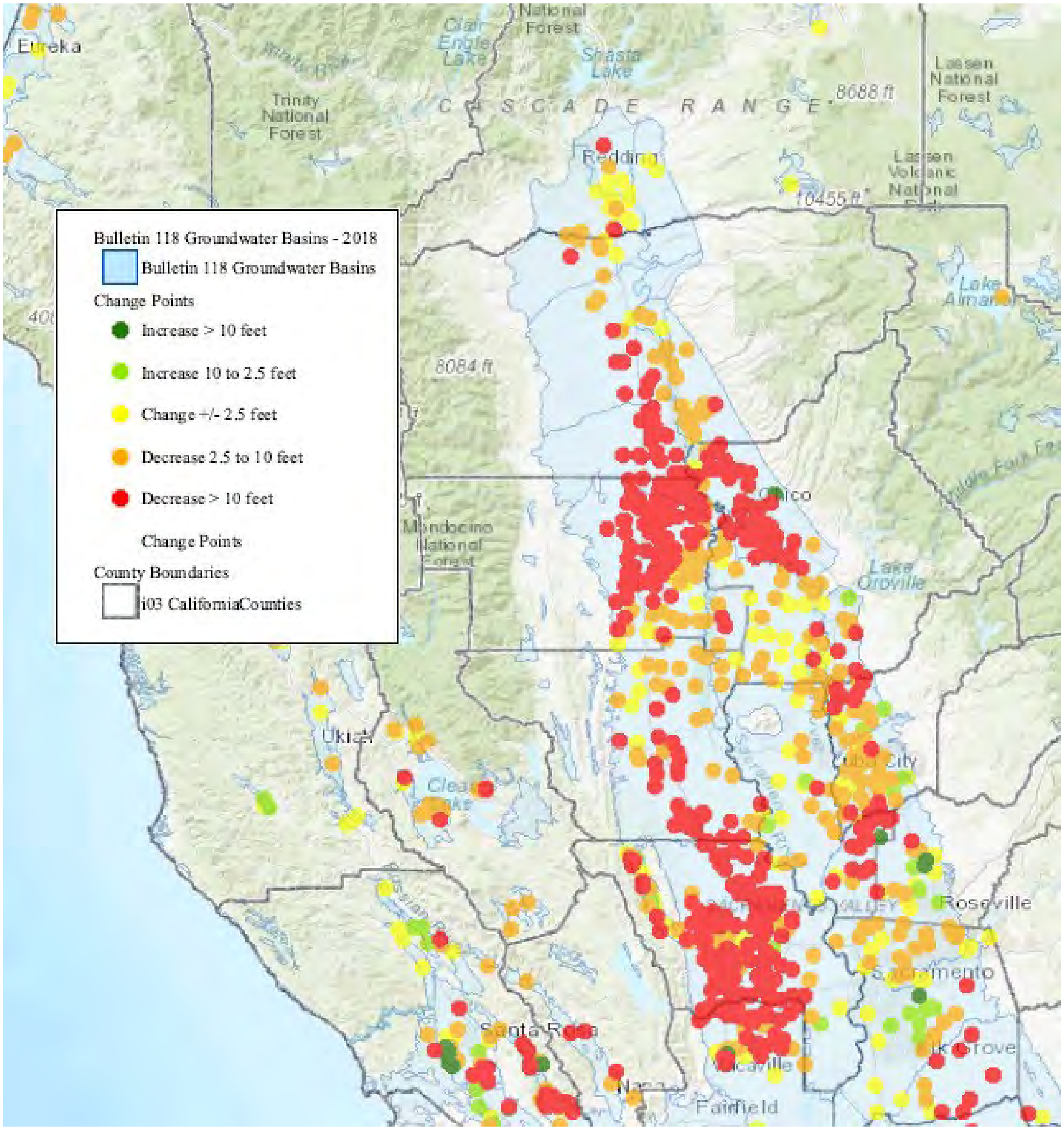
- Spring 2021 to Spring 2022, and
- Spring 2016 to Spring 2019.

The SGMA Data Viewer elevation change points show the difference between the measured groundwater levels from the selected time periods and are shown only if a measurement exists in both time periods (DWR 2022e). The spring measurements include dates that range from January to May.

To determine the general groundwater elevation trends in the Seller Service Area, groundwater level data was downloaded from the SGMA Data Viewer for the Seller Area subbasins: Anderson, Enterprise, Colusa, North American, Yolo and Sutter, as shown in Figure D-2 (DWR 2022d). The data was downloaded into Excel from the "Seasonal Reports" of the "Groundwater Levels" tab in the SGMA Data Viewer. The change in groundwater surface elevation data was then matched by well site code to well depth data from DWR's Groundwater Level Data library (DWR 2021). The combined data was then sorted by well depth: shallow (well depths less than 200 feet deep below ground surface [bgs]), intermediate (well depths greater than 200 feet and less than 600 feet deep bgs), and deep (well depths greater than 600 feet bgs). Wells without known depths were not included.

D.3.1 Spring 2012 to Spring 2022

Figure D-3 shows the SGMA Data Viewer change in groundwater elevation from Spring 2012 to Spring 2022 in the Northern Sacramento Valley. Table D-2 and Table D-3 provide a summary of the change in groundwater elevation from Spring 2012 to Spring 2022 in the Seller Area of the Redding Area Groundwater Basin and Sacramento Valley Groundwater Basin, respectively. Groundwater levels in the Sacramento Valley Groundwater Basin have declined over the last 10 years (Spring 2012 to Spring 2022) coinciding with the persistent dry weather conditions described in Section X, Environmental Setting.



Source: DWR 2022d

Figure D-3. Spring 2012 to Spring 2022 Change in Groundwater Elevation, Northern Sacramento Valley

Table D-2. Seller Area Change in Groundwater Elevation, Redding Area Groundwater Basin, Spring 2012 to Spring 2022

Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Shallow	6.2	-4.0	-0.6	11
Intermediate	2.6	-10.9	-2.3	13
Deep	-1.9	-9.3	-5.6	2
All	6.2	-10.9	-1.8	26

Source: DWR 2022d

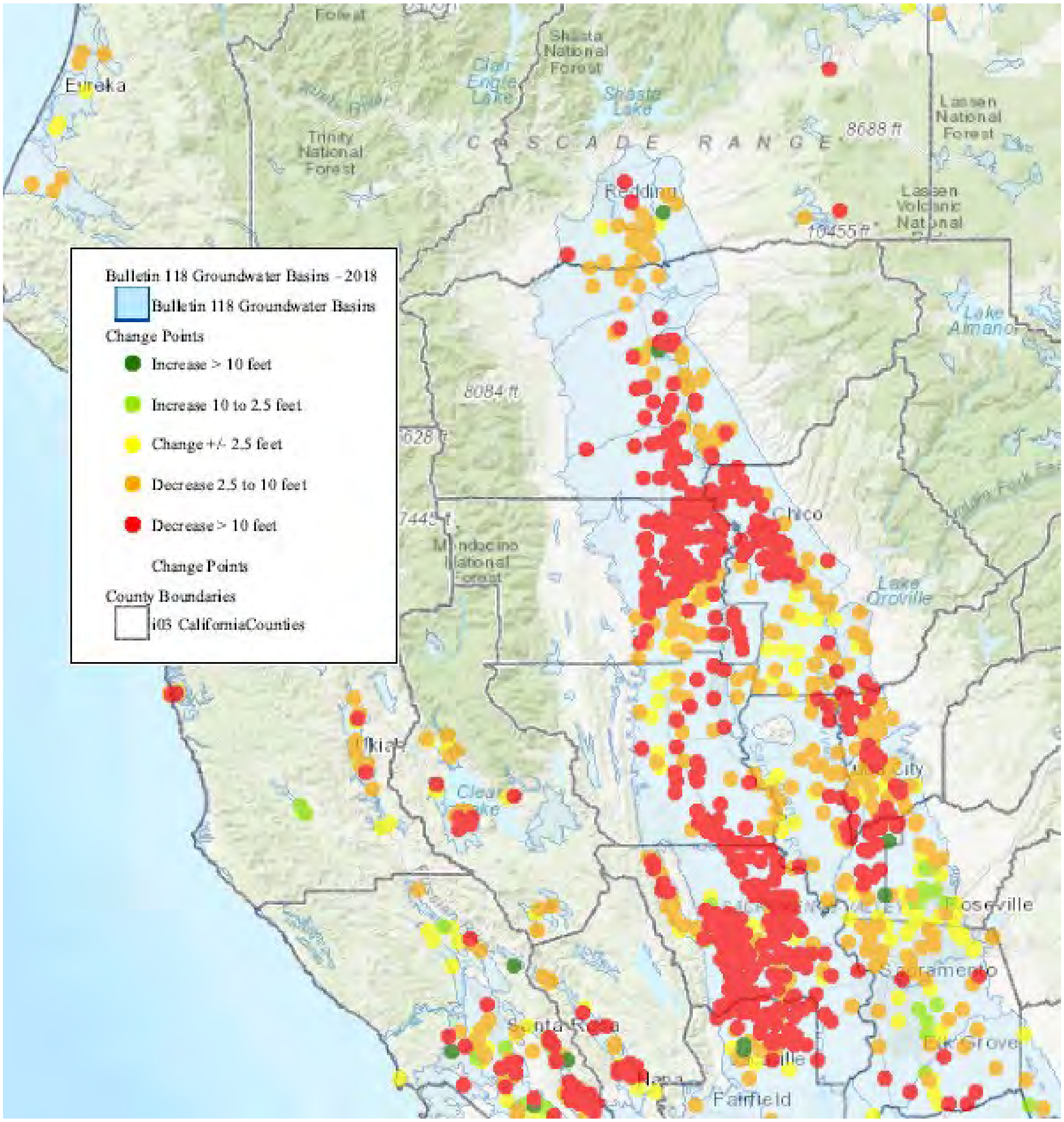
Table D-3. Seller Area Change in Groundwater Elevation, Sacramento Valley Groundwater Basin, Spring 2012 to Spring 2022

Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Shallow	6.9	-74.7	-11.0	177
Intermediate	14.8	-91.8	-18.8	275
Deep	0.5	-118.6	-22.7	95
All	14.8	-118.6	-17.0	547

Source: DWR 2022d

D.3.2 Spring 2017 to Spring 2022

Figure D-4 shows the SGMA Data Viewer change in groundwater elevation from Spring 2017 to Spring 2022 in the Northern Sacramento Valley. Table D-4 and Table D-5 provide a summary of the change in groundwater elevation from Spring 2017 to Spring 2022 in the Seller Area of the Redding Area Groundwater Basin and Sacramento Valley Groundwater Basin, respectively. In general, Spring 2022 groundwater levels in the Northern Sacramento Valley Groundwater Basin are lower in comparison to Spring 2017 levels.



Source: DWR 2022d

Figure D-4. Spring 2017 to Spring 2022 Change in Groundwater Elevation, Northern Sacramento Valley

Table D-4. Seller Area Change in Groundwater Elevation, Redding Area Groundwater Basin, Spring 2017 to Spring 2022

Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Shallow	-0.6	-40	-6.9	13

Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Intermediate	2.6	-6.1	-3.7	13
Deep	-4.3	-9.3	-6.9	2
All Wells	2.6	-40	-5.4	28

Source: DWR 2022d

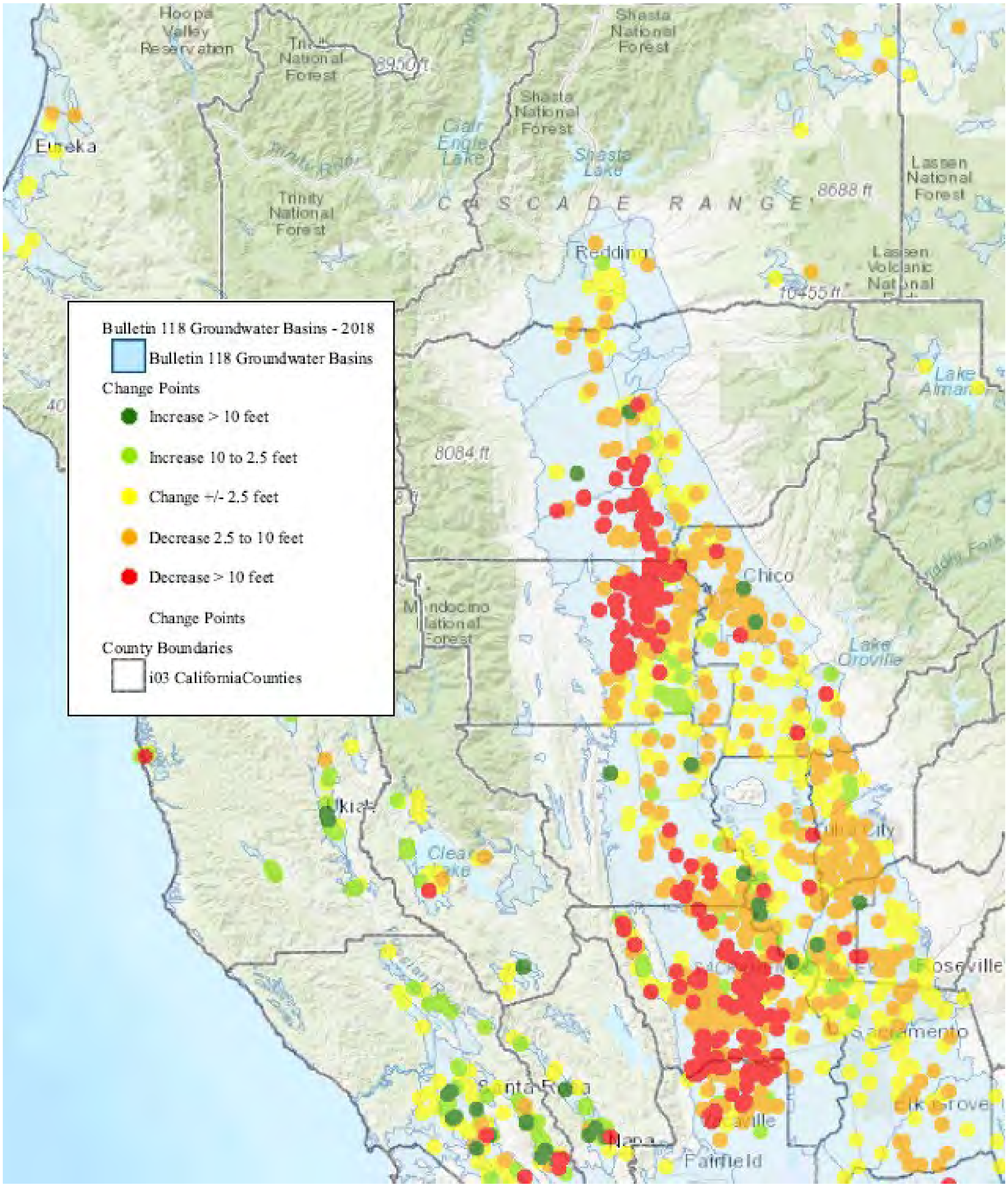
Table D-5. Seller Area Change in Groundwater Elevation, Sacramento Valley Groundwater Basin, Spring 2017 to Spring 2022

Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Shallow	4.2	-41.3	-10.2	186
Intermediate	17.5	-69.2	-15.1	273
Deep	1.5	-68.0	-15.3	88
All Wells	17.5	-69.2	-13.4	547

Source: DWR 2022d

D.3.3 Spring 2021 to Spring 2022

Figure D-5 shows the SGMA Data Viewer change in groundwater elevation for Spring 2021 to Spring 2022 in the Sacramento Valley. Table D-6 and Table D-7 provide a summary of the change in groundwater elevation from Spring 2021 to Spring 2022 in the Seller Area of the Redding Area Groundwater Basin and Sacramento Valley Groundwater Basin, respectively. Water Year 2021 was a dry year and, on average, Spring 2022 groundwater levels across the Northern Sacramento Valley showed slight decreases in comparison to Spring 2021 groundwater levels.



Source: DWR 2022d

Figure D-5. Spring 2021 to Spring 2022 Change in Groundwater Elevation, Northern Sacramento Valley

Table D-6. Seller Area Change in Groundwater Elevation, Redding Area Groundwater Basin, Spring 2021 to Spring 2022

Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Shallow	1.36	-1.72	-0.6	9
Intermediate	2.6	-8.7	-1.6	15
Deep	-1.2	-9.3	-5.3	2
All Wells	2.6	-9.3	-1.5	26

Source: DWR 2022d

Table D-7. Seller Area Change in Groundwater Elevation, Sacramento Valley Groundwater Basin, Spring 2021 to Spring 2022

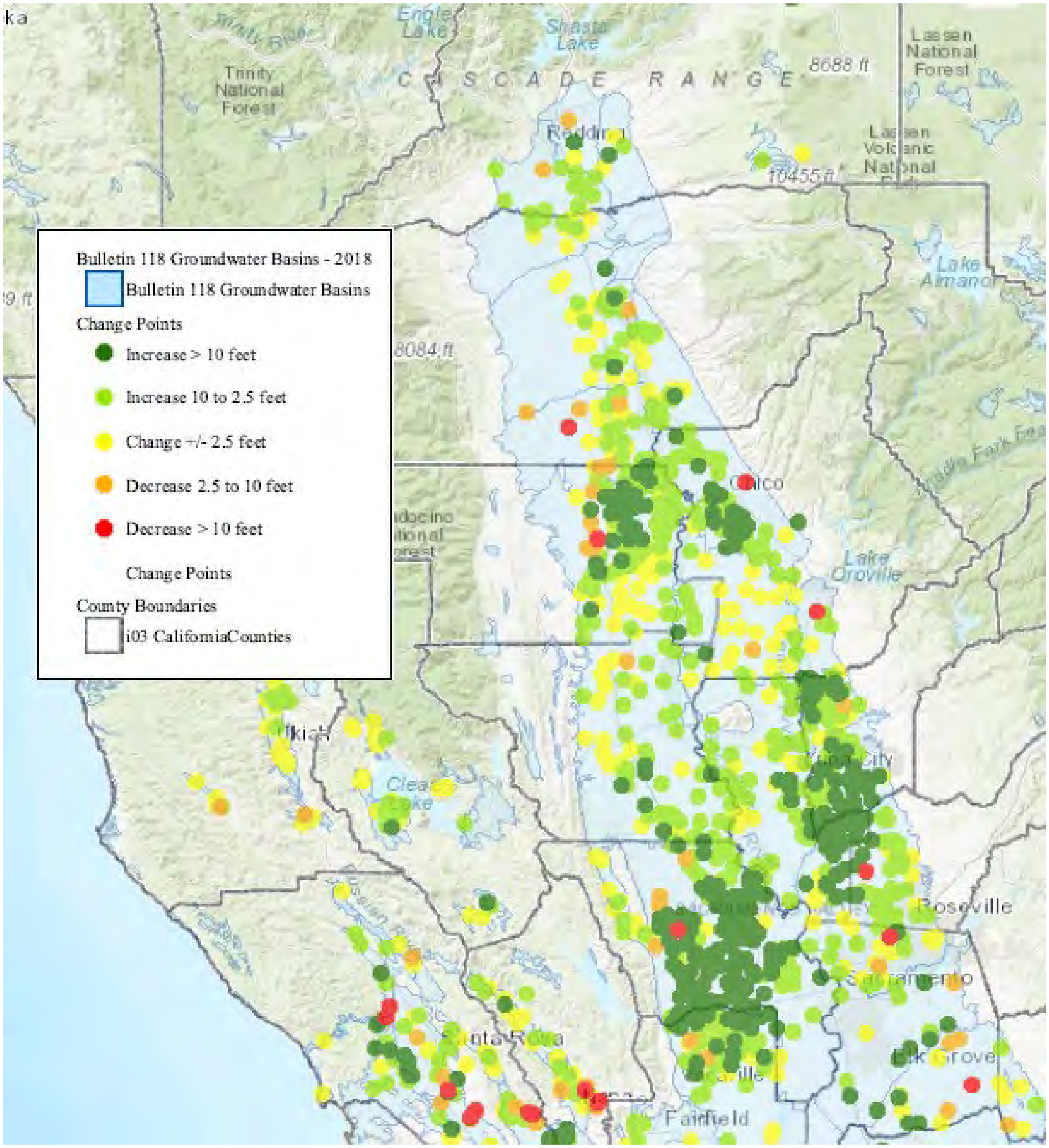
Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Shallow	12.4	-32.1	-2.8	230
Intermediate	26.7	-42.4	-3.7	427
Deep	12.5	-51.2	-6.1	118
All Wells	26.7	-51.2	-3.8	775

Source: DWR 2022d

D.3.4 Spring 2016 to Spring 2019

The groundwater level data for Spring 2016 to Spring 2019 was downloaded from the DWR Water Data Library (DWR 2021). Monitoring well data from both the Redding Area Groundwater Basin and the Sacramento Valley Groundwater Basin were exported into Excel. Data was then filtered by date to limit readings in the spring of the chosen year. For wells with multiple readings, those measurements were averaged to determine a singular measurement. The change in groundwater surface elevation was determined by subtracting the most recent measurement from the earlier measurement. Wells without measurements for one or both of the years were filtered out.

Figure D-6 shows the change in groundwater elevation from Spring 2016 to Spring 2019 in the Northern Sacramento Valley. Table D-8 and Table D-9 provide a summary of the change in groundwater elevation from Spring 2016 to Spring 2019 in the Redding Area Groundwater Basin and Sacramento Valley Groundwater Basin, respectively. In the subsequent wetter years of 2017 and 2019, groundwater levels recovered, with DWR noting an average increase in groundwater elevation of 1.6 feet in Spring 2019 (DWR 2021).



Source: DWR 2022d

Figure D-6. Spring 2016 to Spring 2019 Change in Groundwater Elevation, Northern Sacramento Valley

Table D-8. Change in Groundwater Elevation, Redding Area Groundwater Basin, Spring 2016 to Spring 2019

Well Depth	Maximum Increase (feet)	Maximum Decrease (feet)	Average Change (feet)	Number of Measurements
Shallow	6.0	-5.0	2.0	16
Intermediate	11.7	-12.8	1.8	19
Deep	2.6	--	2.0	7
All Wells	11.7	-12.8	1.9	42

Source: DWR 2021

Table D-9. Change in Groundwater Elevation, Sacramento Valley Groundwater Basin, Spring 2016 to Spring 2019

Well Depth	Maximum Increase (feet)	GWE Maximum Decrease (feet)	GWE Average Change (feet)	Number of Measurements
Shallow	20.8	-49.6	1.2	171
Intermediate	59.2	-52.0	2.4	258
Deep	90.8	-6.9	5.9	102
All Wells	90.8	-52.0	1.6	531

Key: GWE = groundwater elevation

D.4 Groundwater Monitoring Data

Figure D-7 through Figure D-30 show measured groundwater level data to further characterize groundwater conditions in the Sacramento Valley Groundwater Basin near the potential selling entities. These figures show the groundwater levels recorded over time (hydrograph) at a specific well for each of the potential groundwater substitution sellers. The hydrographs typically show a drop in water levels in the summer (irrigation) season and an increase in the winter (wet) season. The amount of water level decline and recovery typically depends on irrigation demands and hydrology. Seasonal groundwater level changes involve a wide variety of factors including rainfall, wetting of streams, and irrigation pumping.

Though the Sacramento Valley Groundwater Basin and other parts of California are currently experiencing declining groundwater level trends, past groundwater trends are indicative of groundwater levels declining moderately during extended droughts and recovering to pre-drought levels after subsequent wet periods.

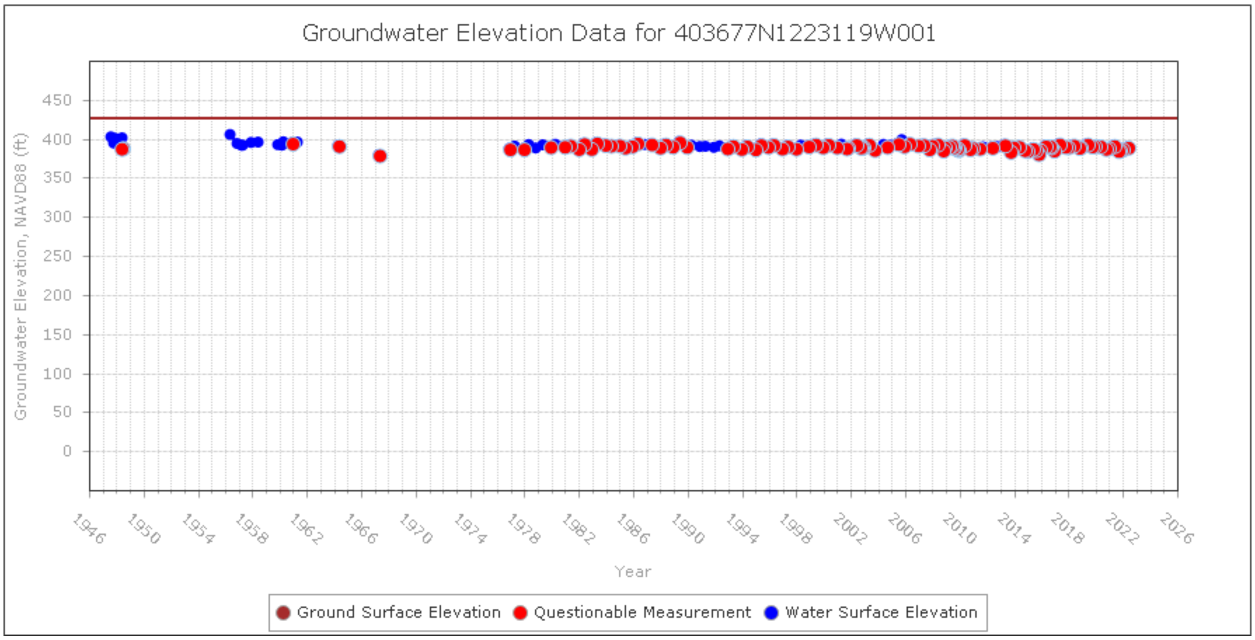
DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) website was used to obtain the monitoring data. The red symbols on the hydrographs are data noted "questionable" in CASGEM, identifying poor quality data. Directions to manually lookup groundwater level data from DWR's CASGEM website:

Example Well 29N04W15E002M

1. Go to CASGEM Public Login website: https://www.casgem.water.ca.gov/OSS/(S(dll4brrvxzfxr552mrmhepx4))/Default.aspx?ReturnUrl=/oss (setup login if not previously done)

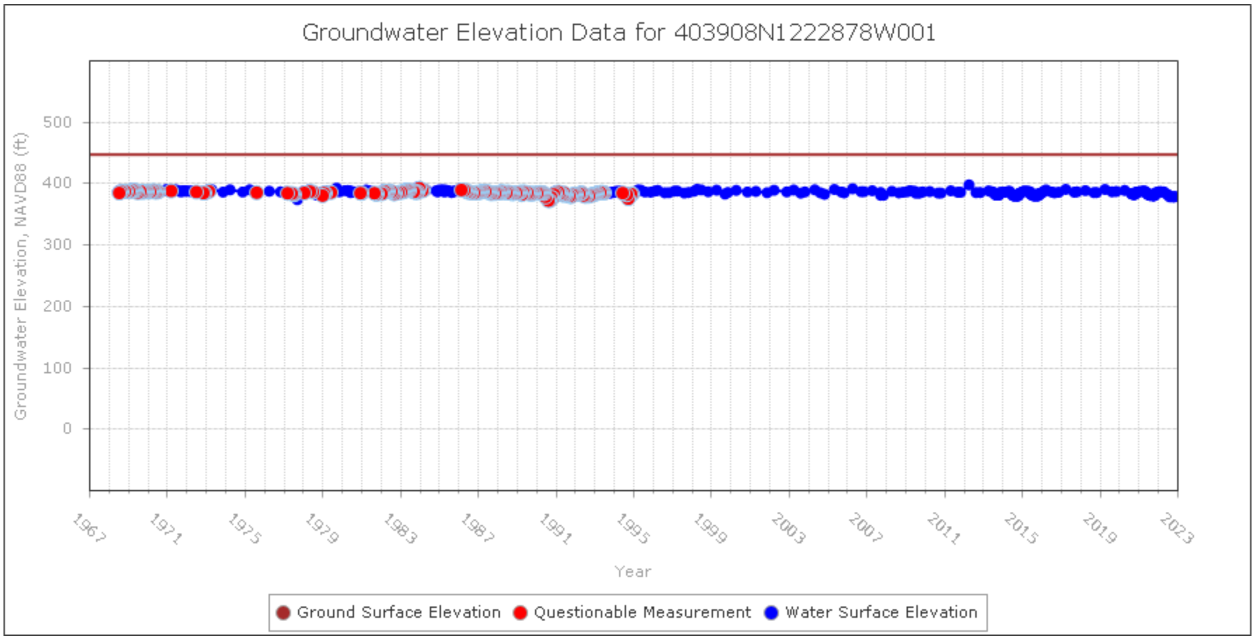
2. Select Well Information> State Well Number. Input well number (29N04W15E002M for this example)

3. Go to Well Details: View> View Hydrograph



Source: DWR 2022f
Note: Well number in the title of the figure is the CASGEM Well Number.

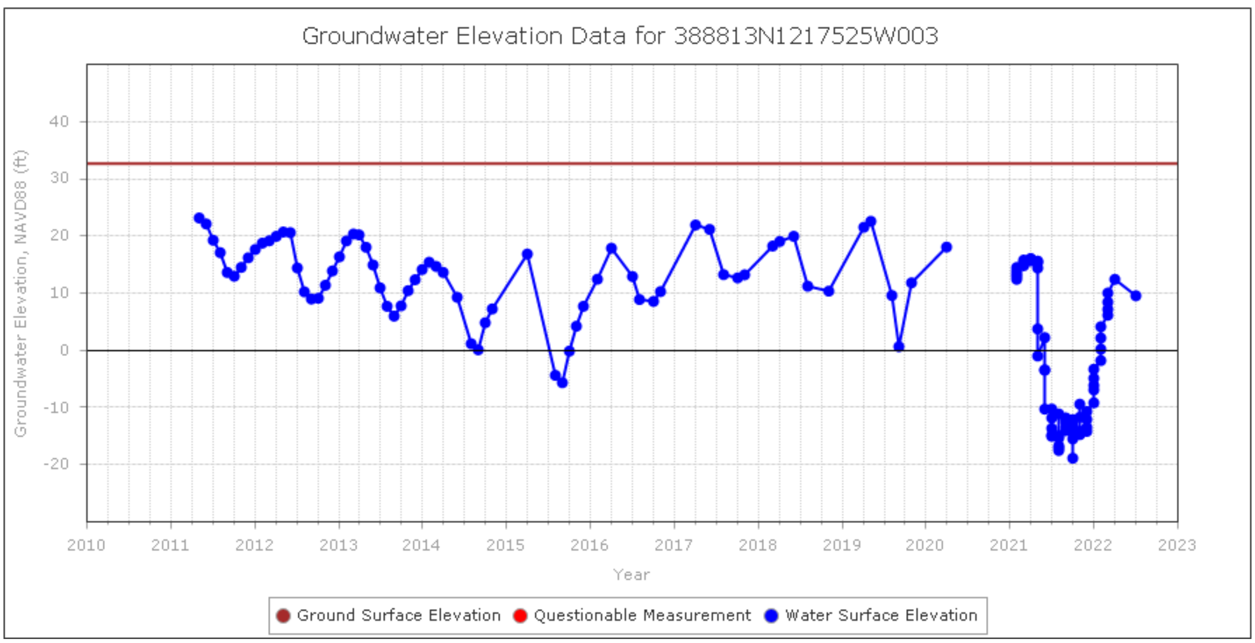
Figure D-7. Anderson-Cottonwood Irrigation District, State Well ID 29N04W15E002M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

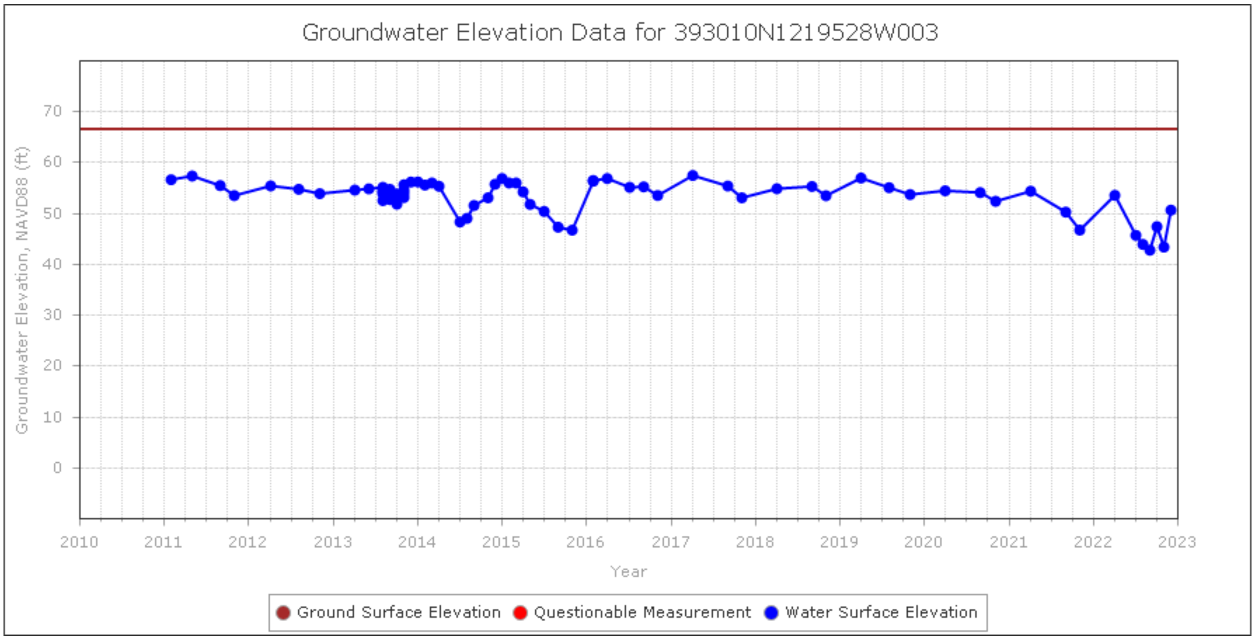
Figure D-8. Anderson-Cottonwood Irrigation District, State Well ID 29N04W02P001M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

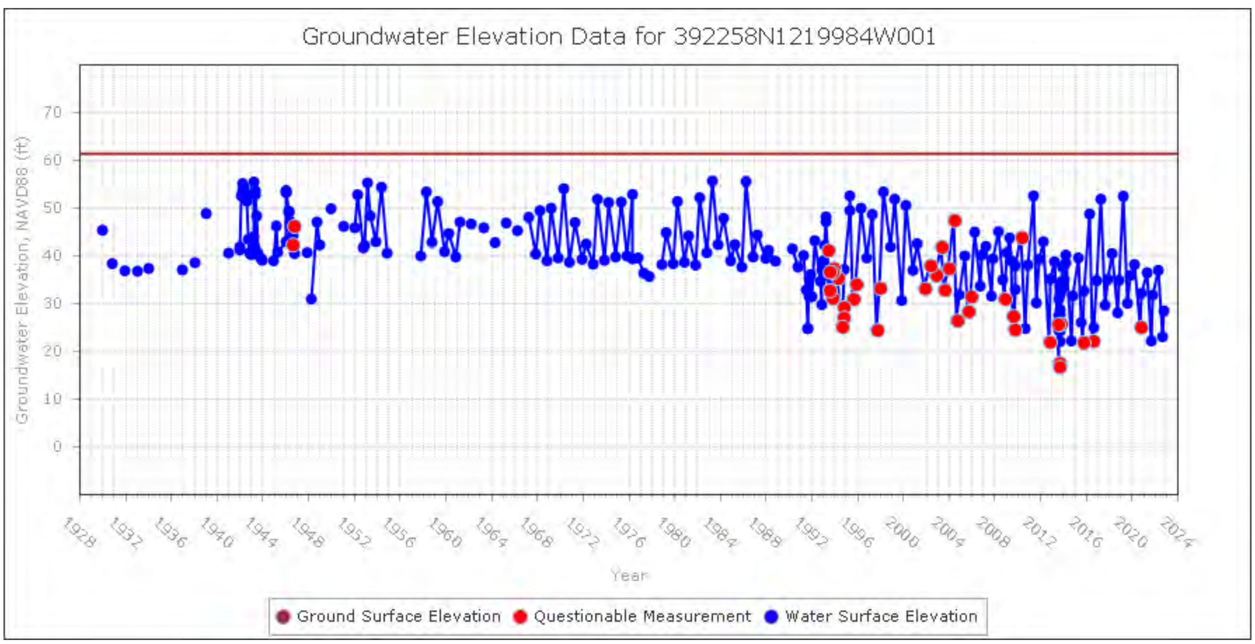
Figure D-9. Burroughs Farms, State Well ID 12N02E21Q003M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

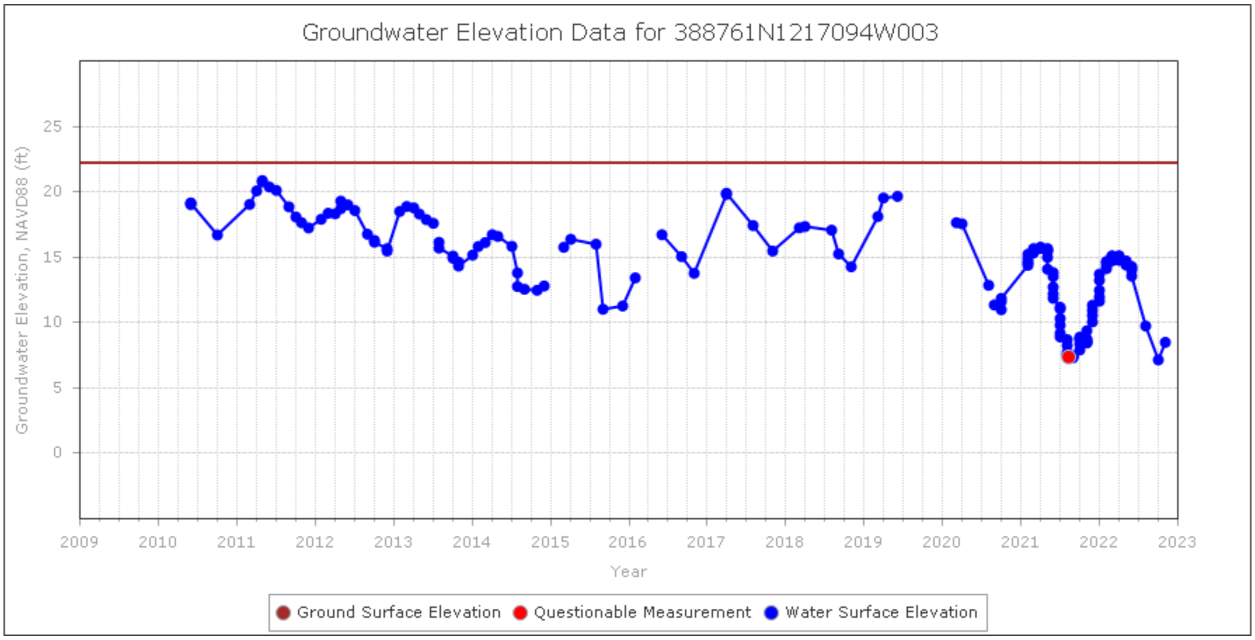
Figure D-10. Canal Farms, State Well ID 17N01W27A003M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

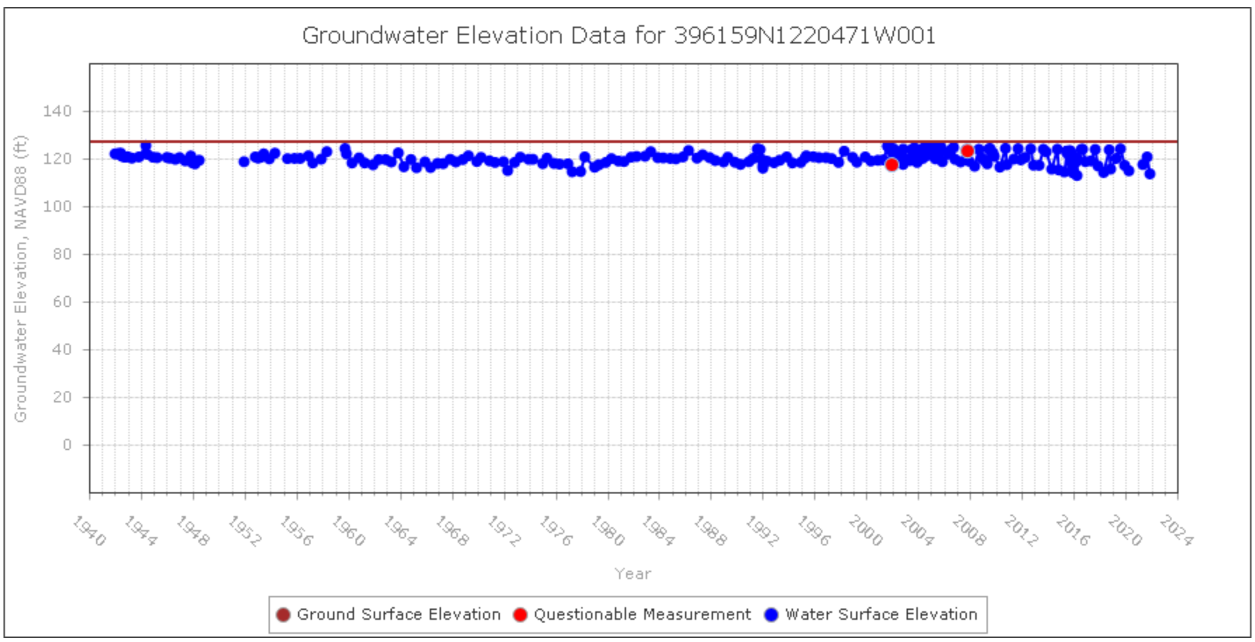
Figure D-11. Eastside Mutual Water Company, State Well ID 16N01W20F001M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

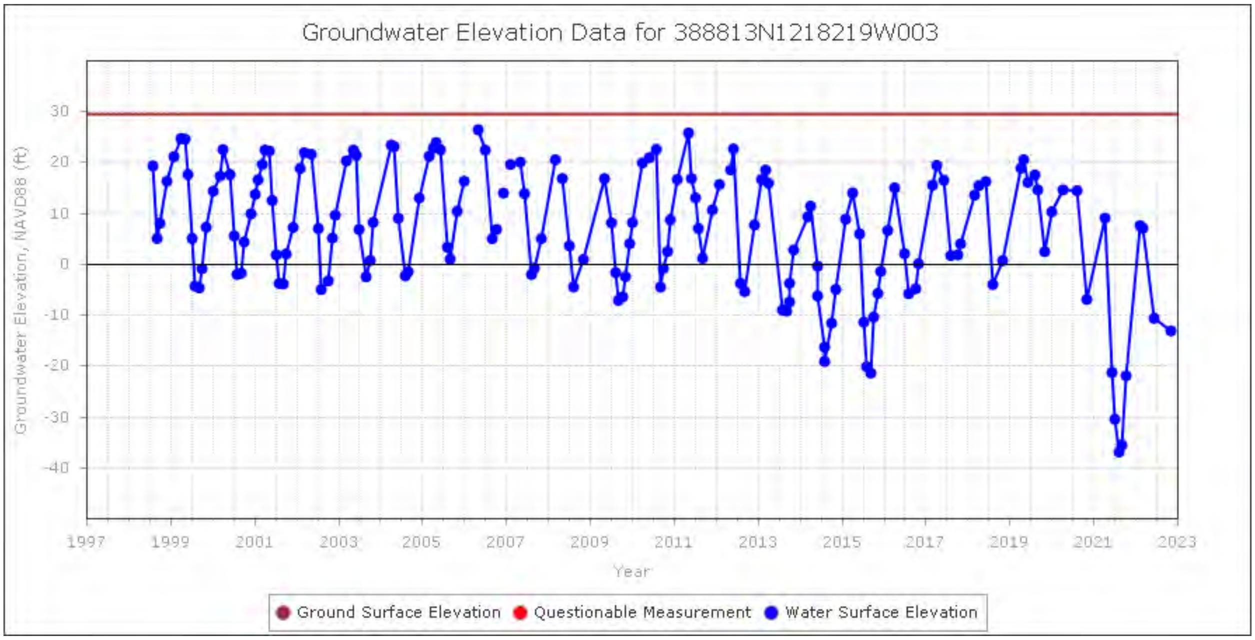
Figure D-12. Giusti Farms, State Well ID 12N02E23H003M



Source: DWR 2022f

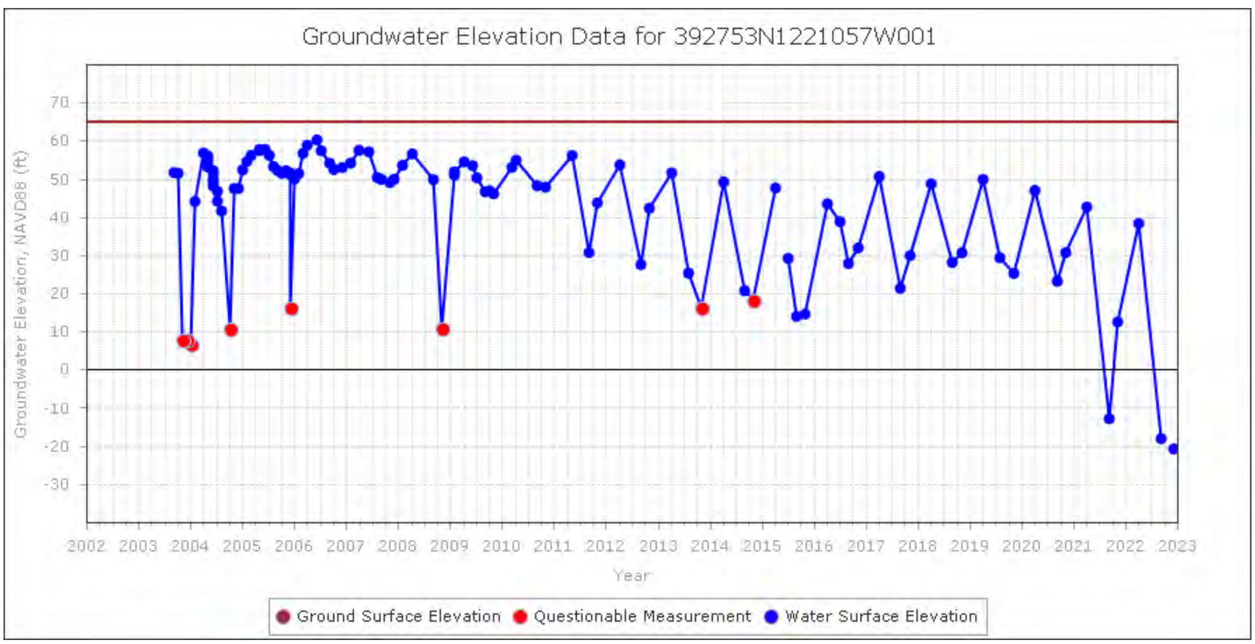
Note: Well number in the title of the figure is the CASGEM Well Number.

Figure D-13. Glenn-Colusa Irrigation District, State Well ID 20N02W02J001M



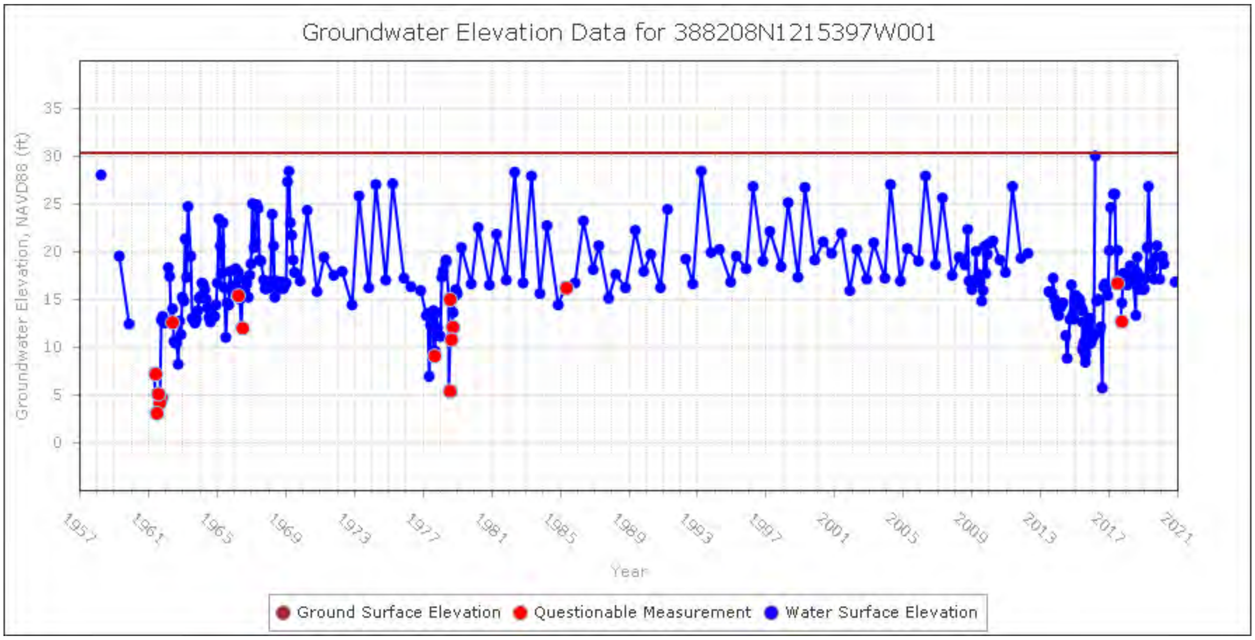
Source: DWR 2022f
Note: Well number in the title of the figure is the CASGEM Well Number.

Figure D-14. Henle Family Farms, State Well ID 12N01E14R003M



Source: DWR 2022f
Note: Well number in the title of the figure is the CASGEM Well Number.

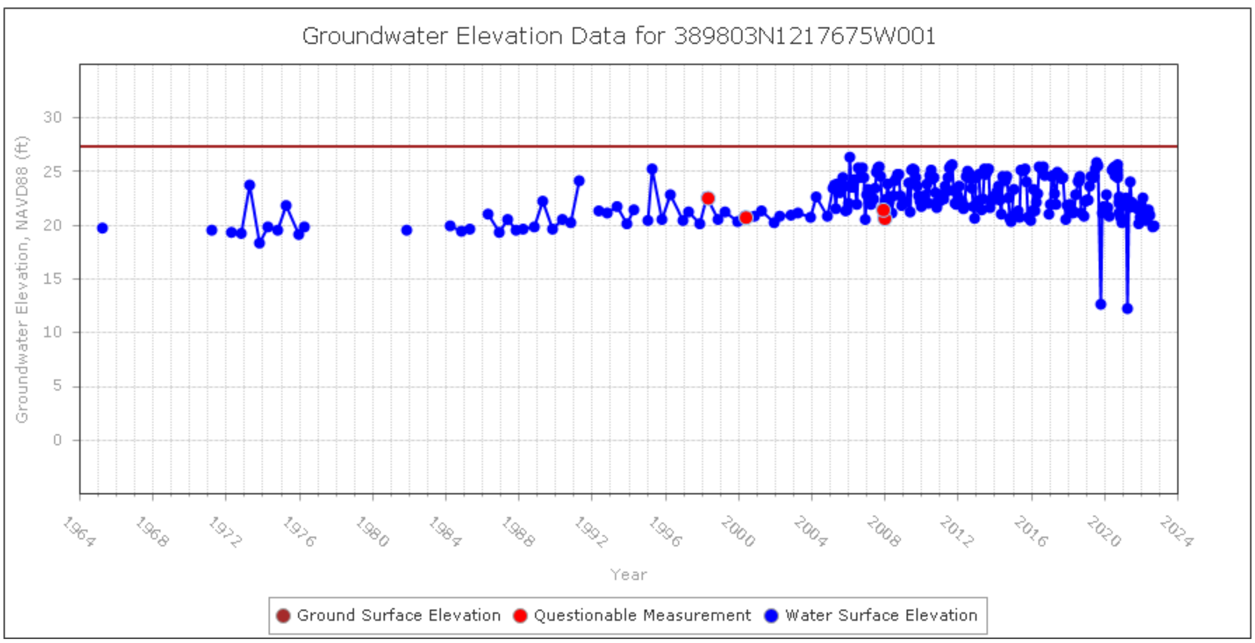
Figure D-15. Maxwell Irrigation District, State Well ID 16N02W05B001M (Deep well; Depth=797 feet)



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

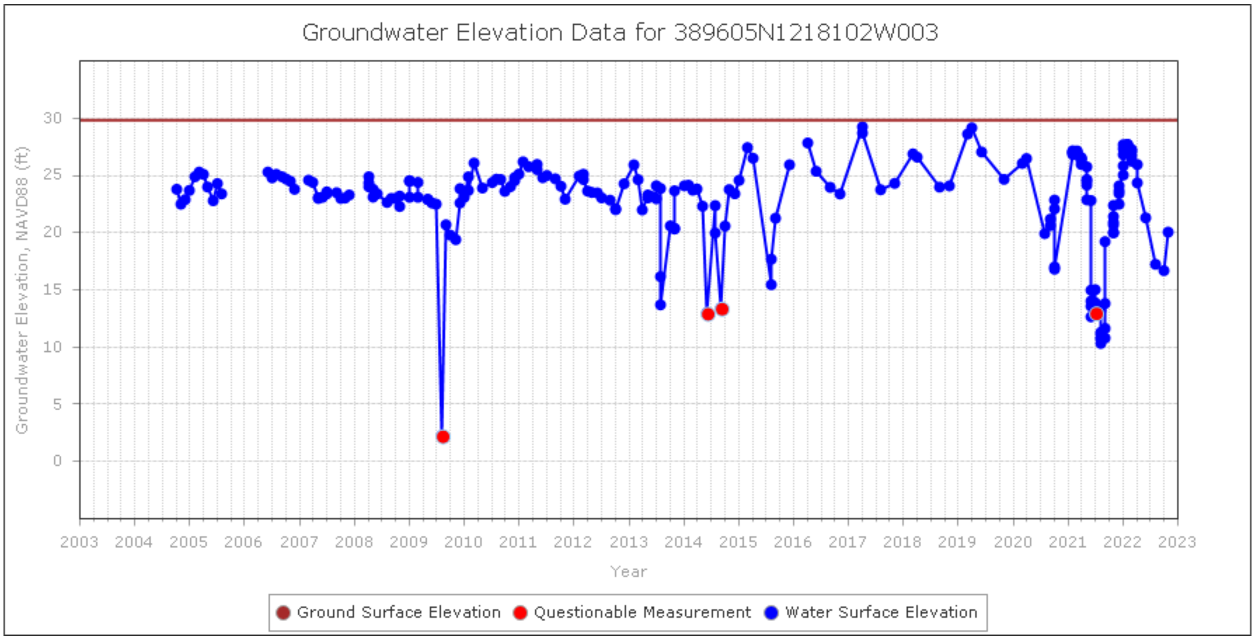
Figure D-16. Natomas Central Mutual Water Company, State Well ID 11N04E09D002M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

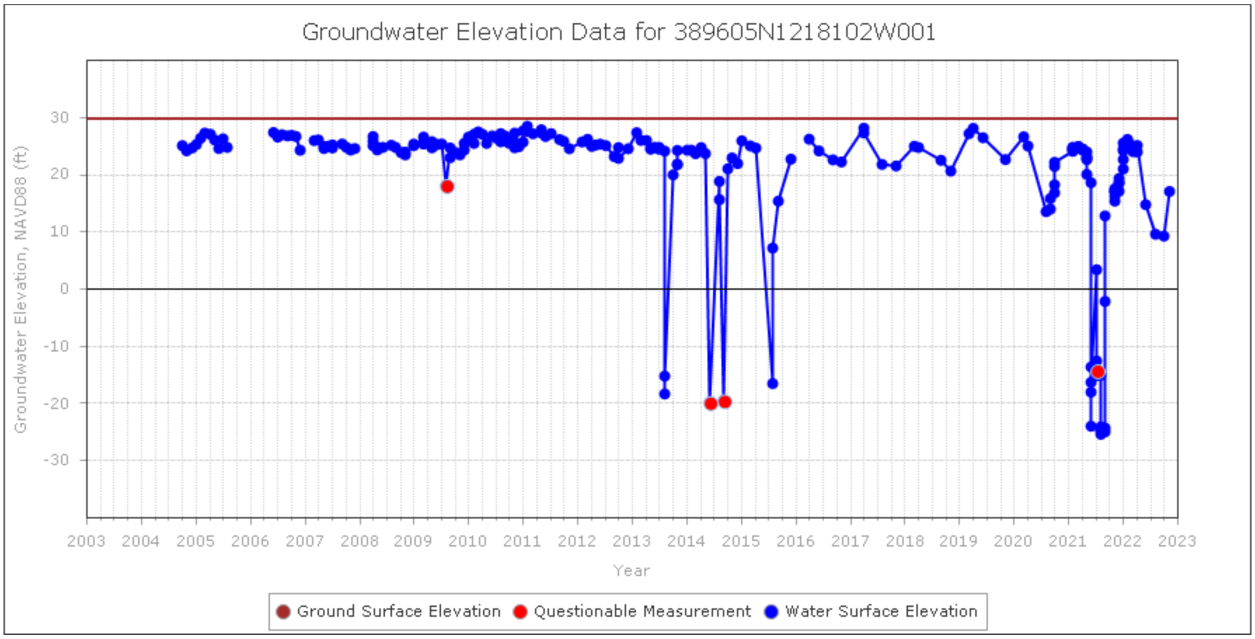
Figure D-17. Pelger Mutual Water Company, State Well ID 13N02E17A001M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

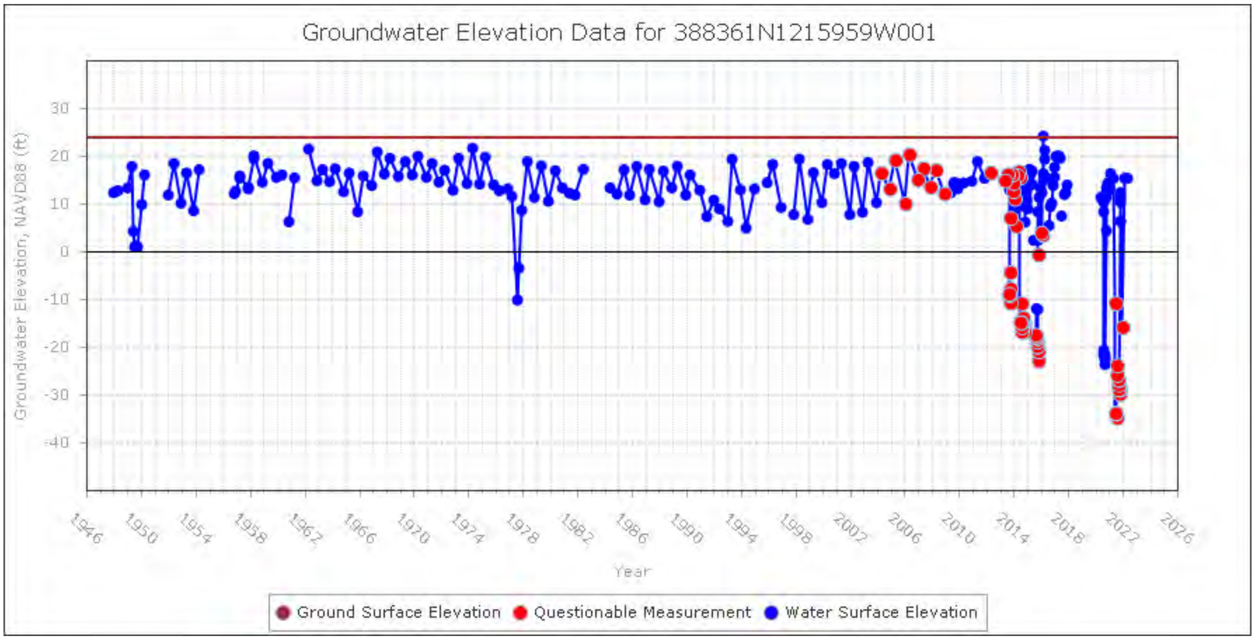
Figure D-18. Pelger Road 1700 LLC, State Well ID 13N01E24G004M (Shallow well; Depth=100 feet)



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

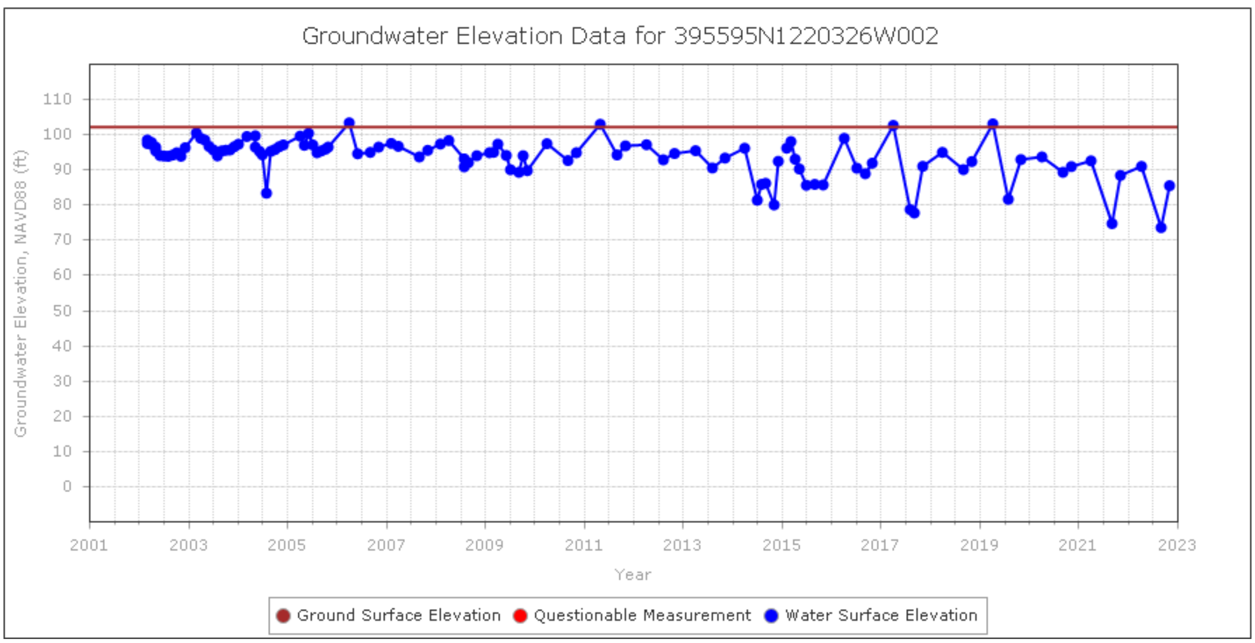
Figure D-19. Pelger Road 1700 LLC, State Well ID 13N01E24G002M (Deep well; Depth=310 feet)



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

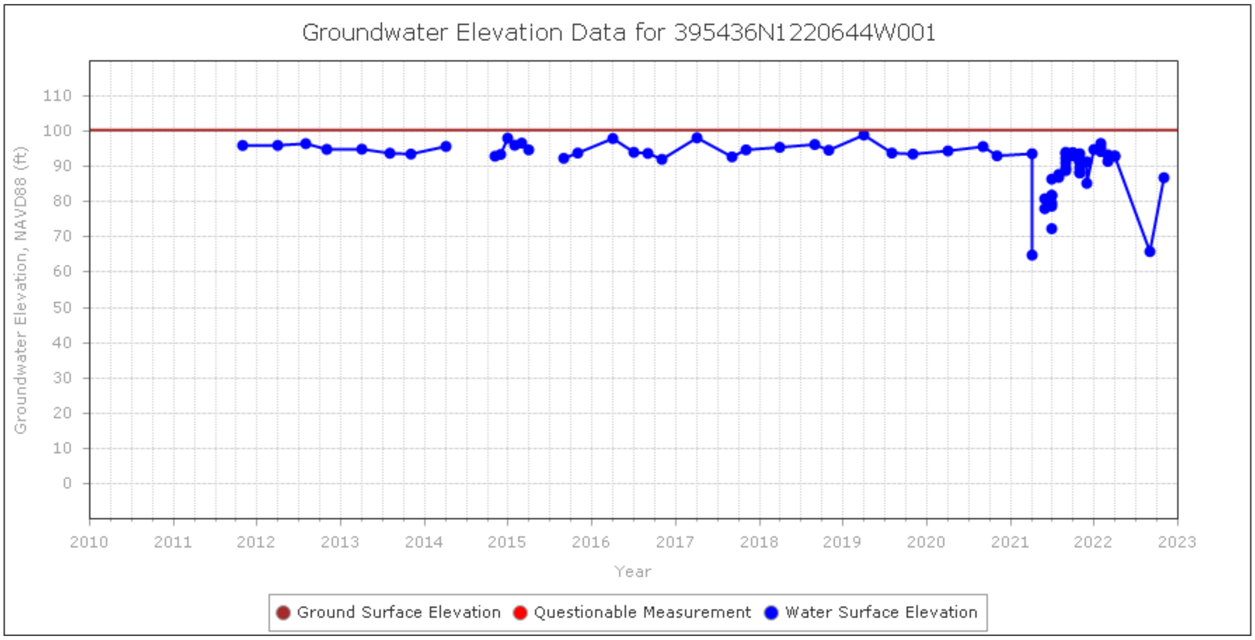
Figure D-20. Pleasant Grove-Verona Mutual Water Company, State Well ID 11N03E01D001M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

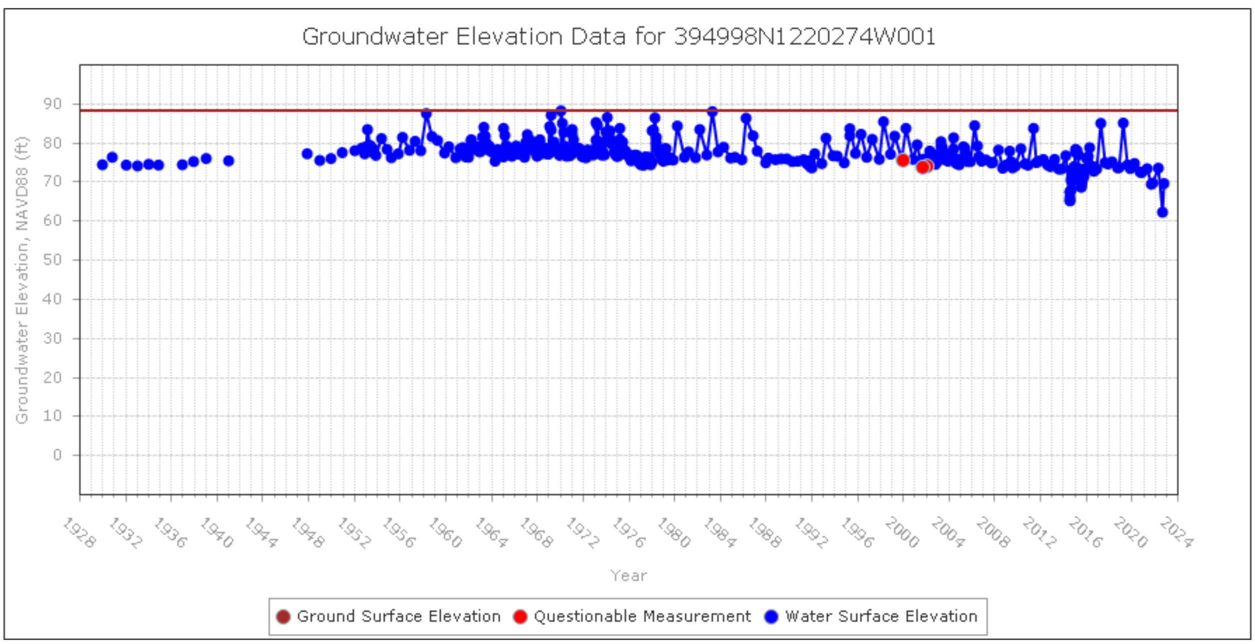
Figure D-21. Princeton-Codora-Glenn Irrigation District and Provident Irrigation District, State Well ID 20N02W25F002M (Depth= 513 feet)



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

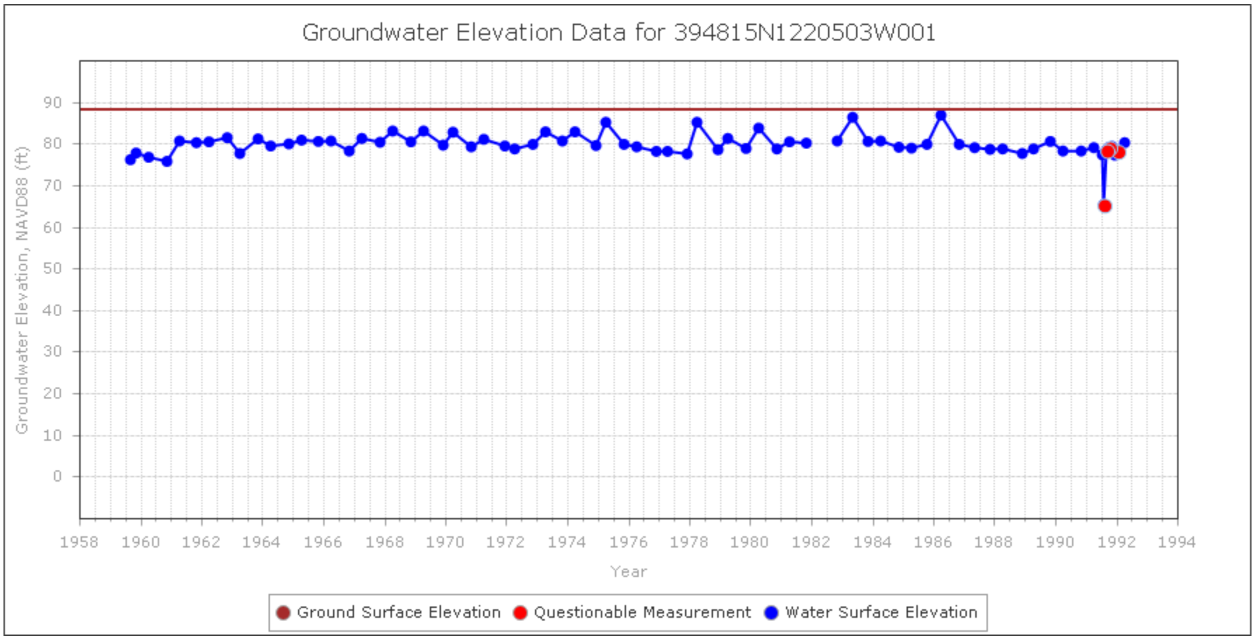
Figure D-22. Princeton-Codora-Glenn Irrigation District and Provident Irrigation District, State Well ID 20N02W34J001M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number

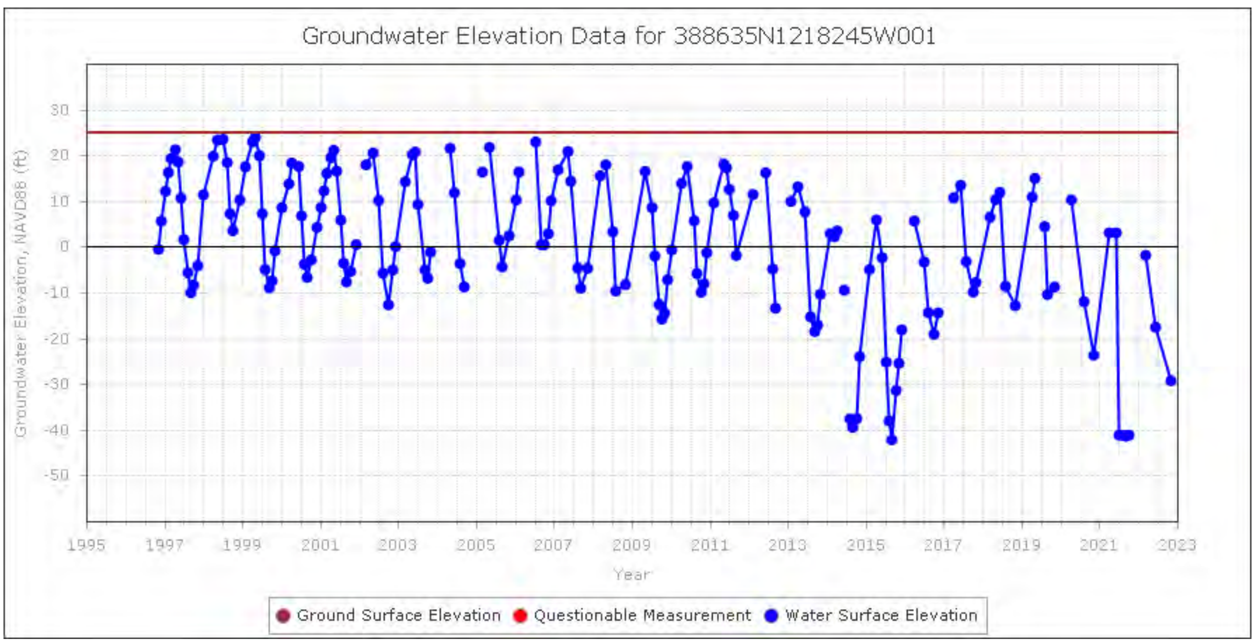
Figure D-23. Princeton-Codora-Glenn Irrigation District and Provident Irrigation District, State Well ID 19N02W13J001M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

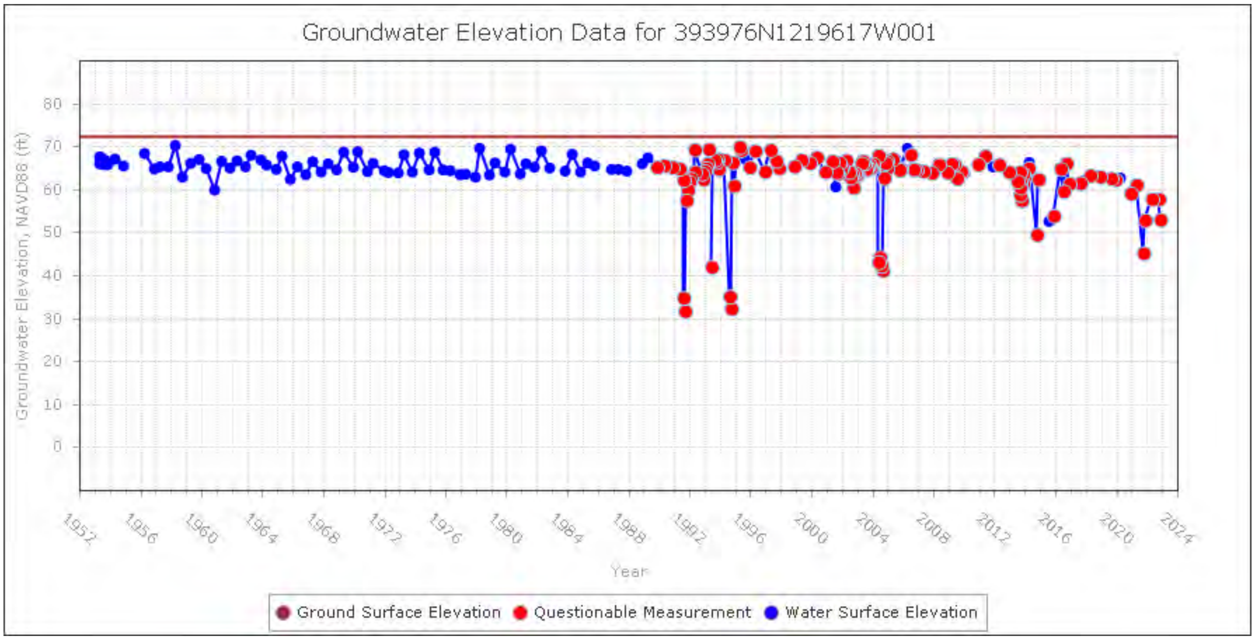
Figure D-24. Provident Irrigation District, State Well ID 19N02W23Q002M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

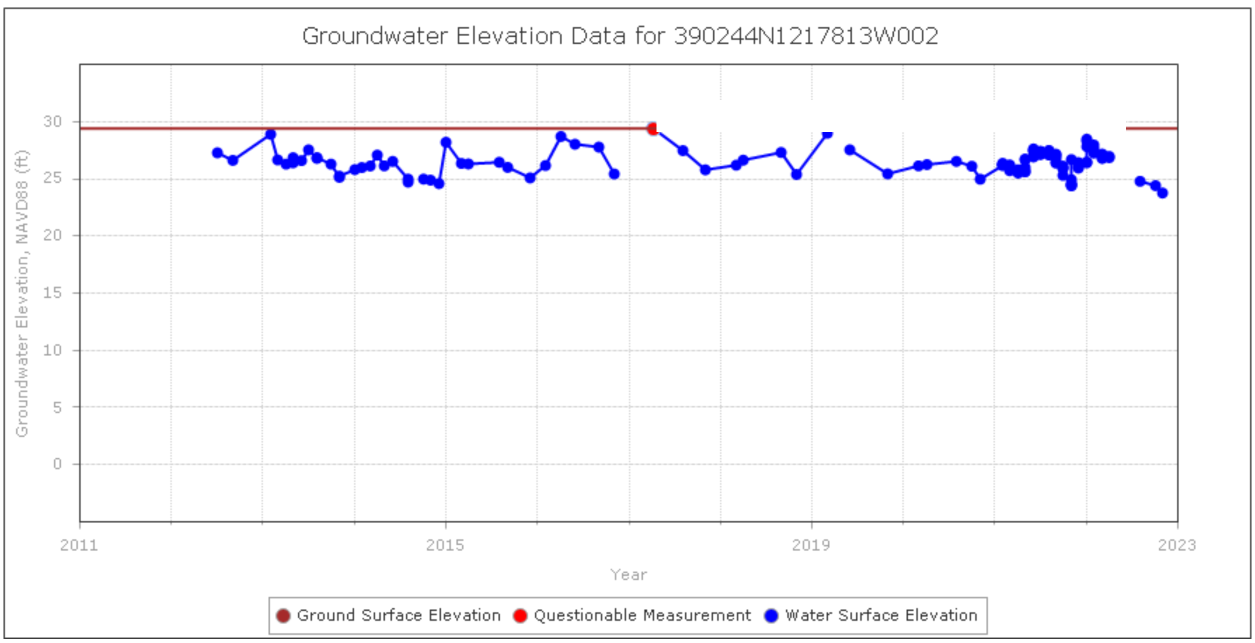
Figure D-25. River Garden Farms, Reclamation District 108, State Well ID 12N01E26A001M (Deep; Depth= 670 feet)



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

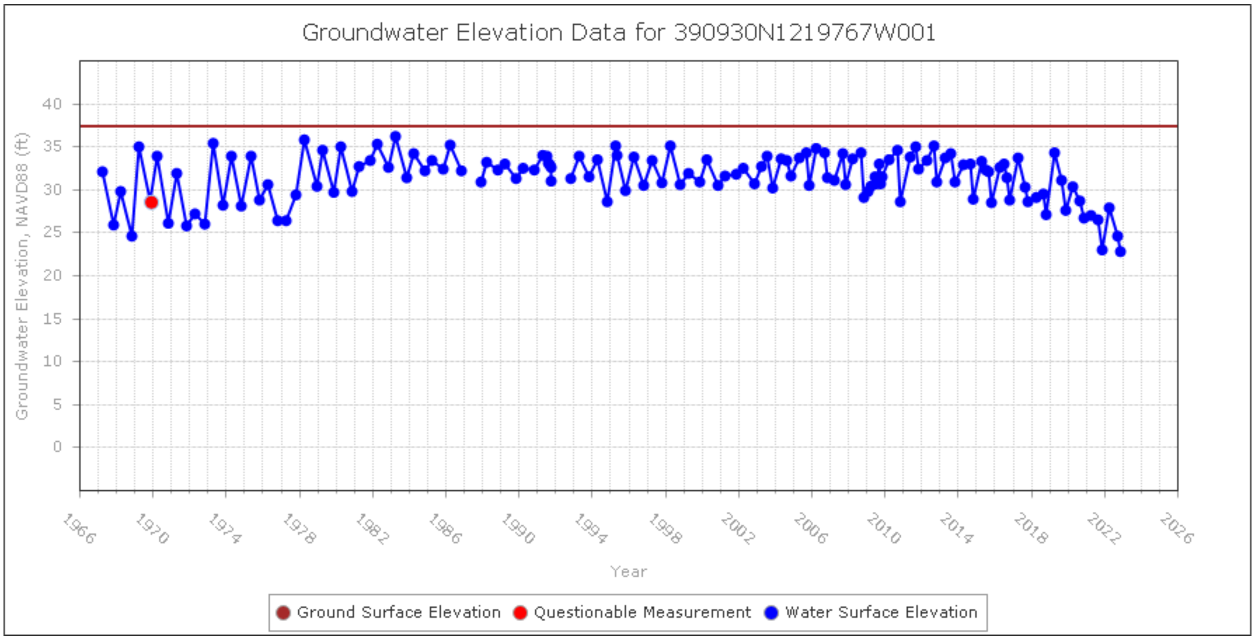
Figure D-26. Reclamation District 1004, State Well ID 18N01W22L001M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

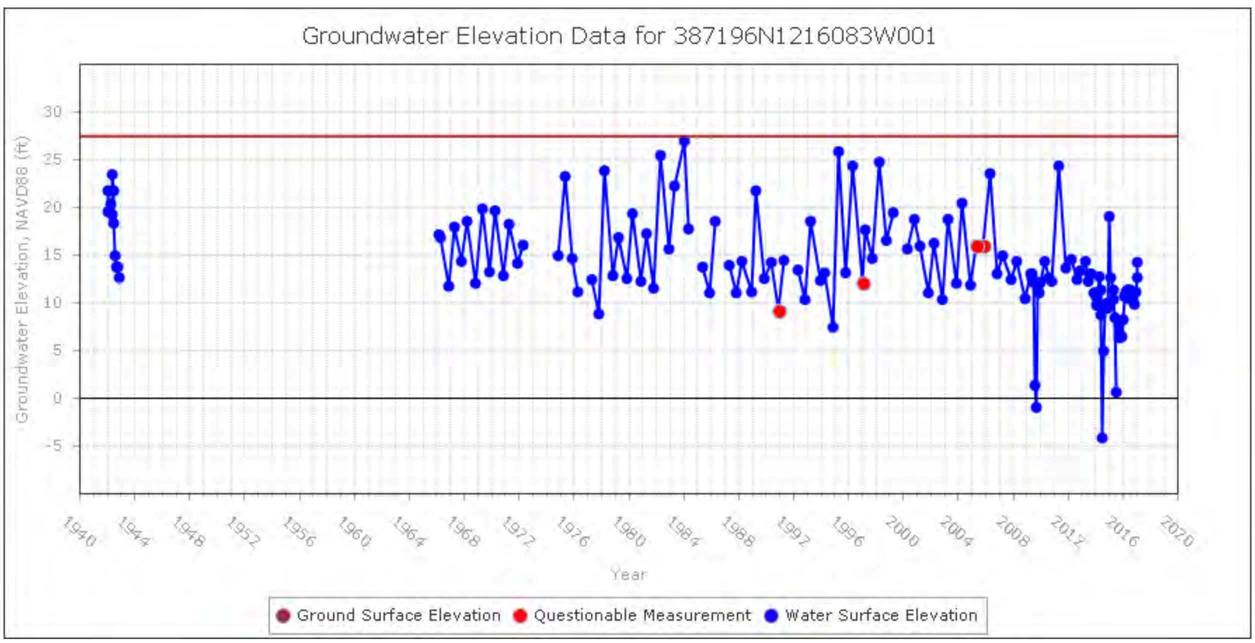
Figure D-27. Sutter Mutual Water Company, State Well ID 14N02E32D002M



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

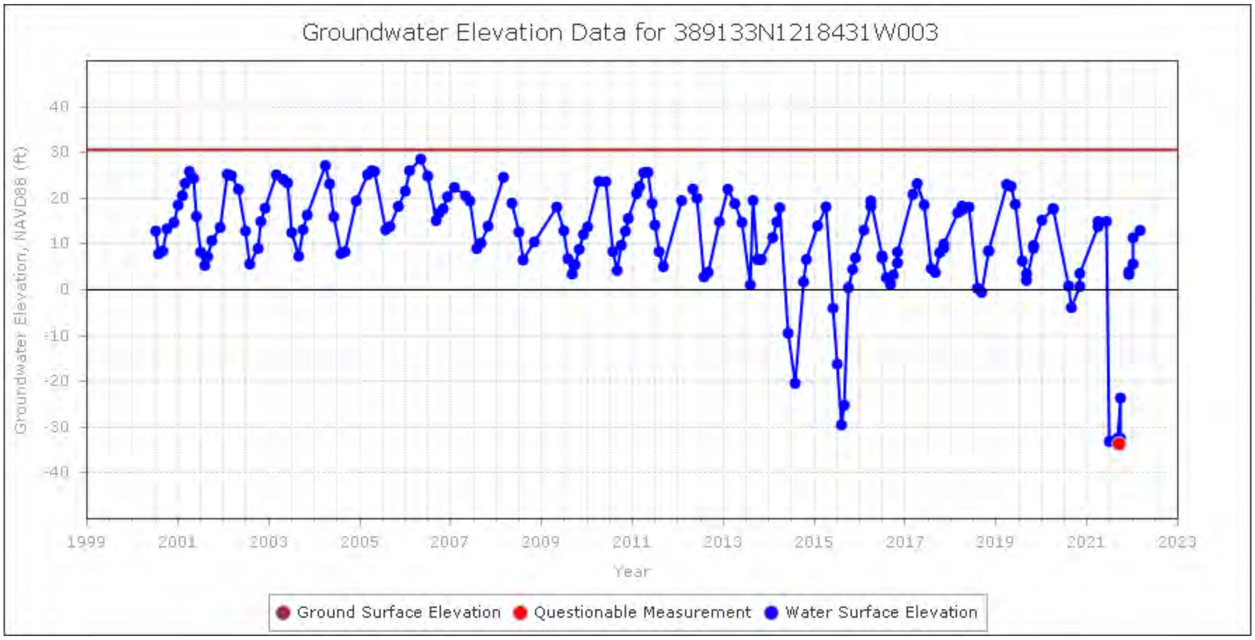
Figure D-28. Sycamore Mutual Water Company, State Well ID 14N01W04K003M (Shallow Well; Depth= 73 feet)



Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number.

Figure D-29. Te Velde Revocable Family Trust, State Well ID 10N03E14C001M



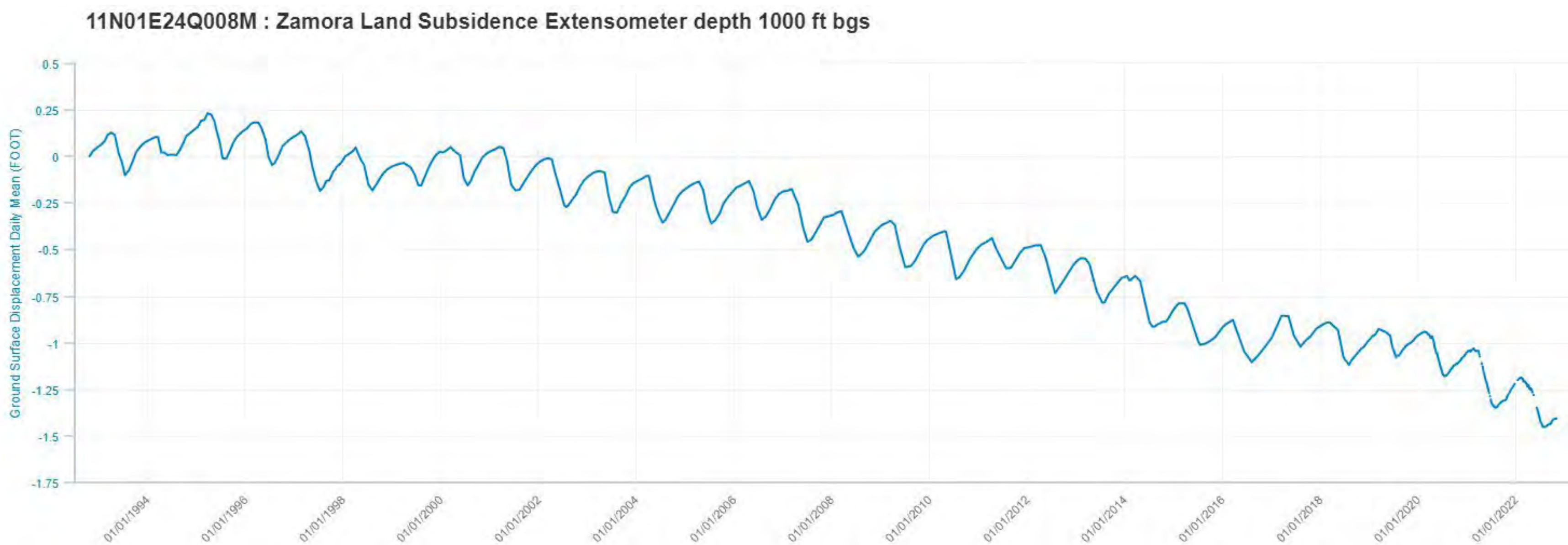
Source: DWR 2022f

Note: Well number in the title of the figure is the CASGEM Well Number

Figure D-30. Windswept Land & Livestock, State Well ID 12N01E03R003M

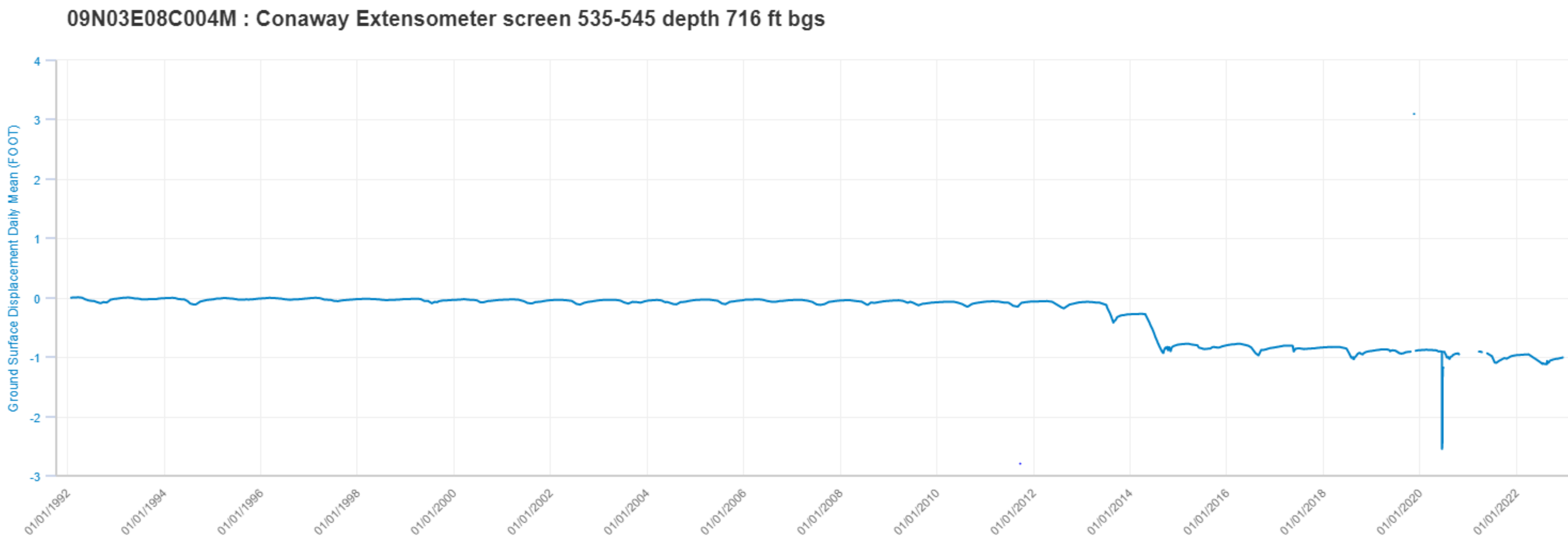
D.5 Land Subsidence

DWR maintains data at three extensometers in the northern Sacramento Valley to monitor potential subsidence (i.e., a lowering of the ground surface elevation). Figure D-31 shows the change in ground surface elevation at the Zamora extensometer in Yolo County, Figure D-32 shows the change in ground surface elevation at the Conaway Ranch extensometer in Yolo County, and Figure D-33 shows the change in ground surface elevation at the Sutter extensometer in Sutter County.



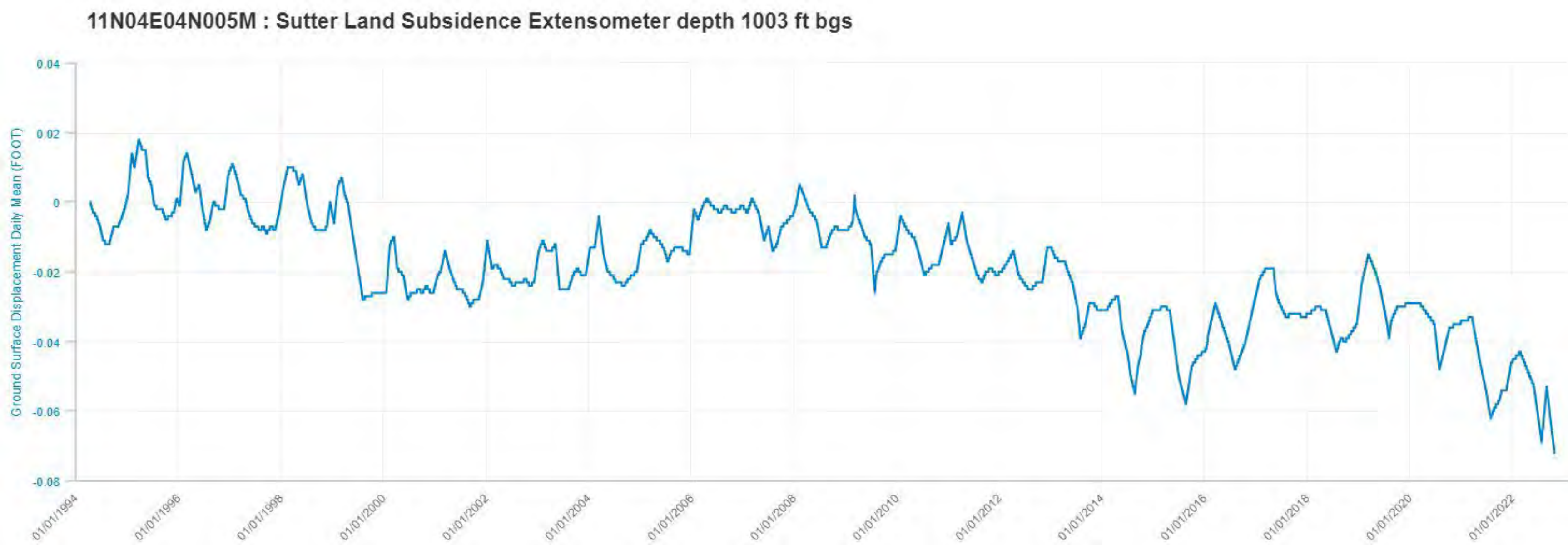
Source: DWR 2022g

Figure D-31. Zamora Extensometer (11N01E24Q008M) Ground Surface Displacement



Source: DWR 2022h

Figure D-32. Conaway Ranch Extensometer (09N03E08C004M) Ground Surface Displacement



Source: DWR 2022i

Figure D-33. Sutter Extensometer (11N04E04N005M) Ground Surface Displacement

D.6 References

ArcGIS. 2022. Bulletin 118 Basin Boundaries Data Viewer. Layer: i08_B118_CA_GroundwaterBasins. Available at: https://www.arcgis.com/home/webmap/viewer.html?url=https://gis.water.ca.gov/arcgis/rest/services/Geoscientific/i08_B118_CA_GroundwaterBasins/FeatureServer. [Accessed on December 27, 2022].

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Appendix E

Air Quality Emissions Calculations

Table E-1. General Conformity Applicability Evaluation (Unmitigated Emissions)

County/ Nonattainment Area	Emissions (tons per year)					
	VOC	NOx	CO	SOx	PM10	PM2.5
	Sacramento Metro[1]	Sacramento Metro[1]	Sacramento Area[2]	Sacramento[3,4]	Sacramento Co.	Sacramento[4]
Colusa	n/a	n/a	n/a	n/a	n/a	n/a
Glenn	n/a	n/a	n/a	n/a	n/a	n/a
Sacramento	0.3	1.6	1.4	0.6	0.0	0.0
Shasta	n/a	n/a	n/a	n/a	n/a	n/a
Sutter[5]	9.0	80.1	n/a	7.1	n/a	1.4
Tehama	n/a	n/a	n/a	n/a	n/a	n/a
Yolo	0.8	6.3	2.8	0.4	n/a	0.1
Total	10.2	88.0	4.1	8.0	0.0	1.5
Classification	Severe-15	Severe-15	Maintenance	PM2.5 Precursor	Maintenance	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100
Exceed?	No	Yes	No	No	No	No

Note:

[1]The Sacramento Metro 8-hour O3 nonattainment area consist of Sacramento and Yolo Counties and parts of El Dorado, Placer, Solano, and Sutter Counties. Emissions occurring within the attainment area of these counties are excluded from the total emissions.

[2]The Sacramento Area CO maintenance area is based on the Census Bureau Urbanized Area and consists of parts of Placer, Sacramento, and Yolo Counties. The general conformity applicability evaluation is based on emissions that would occur within the entire county to be conservative.

[3]All counties are designated as attainment areas for SO2; however, since SO2 is a precursor to PM2.5, its emissions must be evaluated under general conformity.

[4]The 24-hour PM2.5 nonattainment area for Sacramento includes Sacramento County and parts of El Dorado, Placer, Solano, and Yolo Counties. The general conformity applicability analysis assumes that all emissions that could occur within each county would occur within the Sacramento nonattainment area to be conservative.

[5]VOC and NOx emissions are excluded from Cranmore Farms, Pelger Mutual Water Company, and Reclamation District 1004 because they are located in areas designated as attainment for the federal 8-hour O3 NAAQS.

Table E-2. Emissions Outside of 8-Hour Ozone Nonattainment Area (tons per year)

Water Agency	County	VOC	NOx
Pelger Road 1700 LLC	Sutter	All Electric	All Electric
Pelger Mutual Water Company	Sutter	0.0	0.7
Reclamation District 1004	Sutter	No Engines	No Engines
Total		**0.0**	**0.7**

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table E-3. Daily VOC Emissions (Unmitigated)

Water Agency	Daily VOC Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	1.85							1.85
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	5.85							5.85
Giusti Farms								0.00
Glenn-Colusa Irrigation District	1.62	1.94						3.56
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			3.70		18.42			22.12
Pelger Mutual Water Company					0.99			0.99
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					37.65			37.65
Princeton-Codora-Glenn Irrigation District	7.65	15.30						22.94
Provident Irrigation District	No Engines	45.45						45.45
Reclamation District 1004	31.70	2.69			No Engines			34.39
Reclamation District 108	38.97						9.02	47.99
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	2.82							2.82
Sutter Mutual Water Company	4.33				78.67			83.00
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**97.27**	**65.37**	**3.70**	**0.00**	**135.73**	**0.00**	**9.02**	**311.11**

Key:
VOC = volatile organic compounds

Table E-4. Daily NOx Emissions (Unmitigated)

Water Agency	Daily NOx Emissions (pounds per day)							
	Colusa	**Glenn**	**Sacramento**	**Shasta**	**Sutter**	**Tehama**	**Yolo**	**Total**
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	3.70							3.70
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	49.89							49.89
Giusti Farms								0.00
Glenn-Colusa Irrigation District	20.00	23.89						43.90
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	47.10							47.10
Natomas Central Mutual Water Company			17.28		78.82			96.10
Pelger Mutual Water Company					18.76			18.76
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					284.48			284.48
Princeton-Codora-Glenn Irrigation District	94.31	188.61						282.92
Provident Irrigation District	No Engines	560.46						560.46
Reclamation District 1004	405.20	33.13			No Engines			438.33
Reclamation District 108	383.84						67.70	451.54
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	5.64							5.64
Sutter Mutual Water Company	53.39				844.36			897.75
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**1,063.07**	**806.10**	**17.28**	**0.00**	**1,226.42**	**0.00**	**67.70**	**3,180.58**

Key:
NOx = nitrogen oxides

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table E-5. Daily CO Emissions (Unmitigated)

Water Agency	Daily CO Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	7.40							7.40
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	55.85							55.85
Giusti Farms								0.00
Glenn-Colusa Irrigation District	4.31	5.15						9.46
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	43.38							43.38
Natomas Central Mutual Water Company			14.99		69.48			84.46
Pelger Mutual Water Company					24.68			24.68
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					152.36			152.36
Princeton-Codora-Glenn Irrigation District	20.32	40.64						60.96
Provident Irrigation District	No Engines	120.77						120.77
Reclamation District 1004	115.72	7.14			No Engines			122.86
Reclamation District 108	116.11						29.63	145.74
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	11.29							11.29
Sutter Mutual Water Company	11.51				304.27			315.77
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**385.89**	**173.70**	**14.99**	**0.00**	**550.78**	**0.00**	**29.63**	**1,154.99**

Key:
CO = carbon monoxide

Table E-6. Daily SOx Emissions (Unmitigated)

Water Agency	Daily SOx Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	24.41							24.41
Giusti Farms								0.00
Glenn-Colusa Irrigation District	1.32	1.58						2.90
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	15.44							15.44
Natomas Central Mutual Water Company			5.95		5.05			11.00
Pelger Mutual Water Company					6.15			6.15
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					33.12			33.12
Princeton-Codora-Glenn Irrigation District	6.24	12.47						18.71
Provident Irrigation District	No Engines	37.06						37.06
Reclamation District 1004	35.28	2.19			No Engines			37.47
Reclamation District 108	24.15						3.92	28.07
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	3.53				68.61			72.14
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**110.38**	**53.31**	**5.95**	**0.00**	**112.93**	**0.00**	**3.92**	**286.48**

Key:
SOx = sulfur oxides

Table E-7. Daily PM10 Emissions (Unmitigated)

Water Agency	Daily PM10 Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.78							2.78
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.21	0.25						0.47
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			0.08		0.89			0.97
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					7.72			7.72
Princeton-Codora-Glenn Irrigation District	1.01	2.01						3.02
Provident Irrigation District	No Engines	6.69						6.69
Reclamation District 1004	6.07	0.35			No Engines			6.42
Reclamation District 108	4.00						0.68	4.68
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.03							0.03
Sutter Mutual Water Company	0.57				13.14			13.70
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**17.17**	**9.31**	**0.08**	**0.00**	**23.22**	**0.00**	**0.68**	**50.45**

Key:
PM10 = inhalable particulate matter

Table E-8. Daily PM2.5 Emissions (Unmitigated)

Water Agency	Daily PM2.5 Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.78							2.78
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.21	0.25						0.46
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			0.08		0.87			0.95
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					7.58			7.58
Princeton-Codora-Glenn Irrigation District	0.98	1.96						2.95
Provident Irrigation District	No Engines	6.53						6.53
Reclamation District 1004	5.97	0.34			No Engines			6.32
Reclamation District 108	3.90						0.67	4.57
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.03							0.03
Sutter Mutual Water Company	0.56				12.95			13.51
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**16.94**	**9.08**	**0.08**	**0.00**	**22.88**	**0.00**	**0.67**	**49.65**

Key:
PM2.5 = fine particulate matter

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table E-9. Annual VOC Emissions (Unmitigated)

Water Agency	Annual VOC Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.15							0.15
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.32							0.32
Glenn-Colusa Irrigation District	0.15	0.18						0.33
Giusti Farms								0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.34		1.71			2.06
Pelger Mutual Water Company					0.04			0.04
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.84			1.84
Princeton-Codora-Glenn Irrigation District	0.48	0.95						1.43
Provident Irrigation District	No Engines	3.52						3.52
Reclamation District 1004	1.29	0.11			No Engines			1.40
Reclamation District 108	3.62						0.84	4.46
Roberts Ditch Irrigation Company	0.24							0.24
River Garden Farms							All Electric	0.00
Sutter Mutual Water Company	0.30				5.49			5.79
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**6.71**	**4.77**	**0.34**	**0.00**	**9.08**	**0.00**	**0.84**	**21.74**

Key:
VOC = volatile organic compounds

Table E-10. Annual NOx Emissions (Unmitigated)

Water Agency	Annual NOx Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.30							0.30
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.72							2.72
Glenn-Colusa Irrigation District	1.86	2.22						4.08
Giusti Farms								0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.88							2.88
Natomas Central Mutual Water Company			1.61		7.33			8.94
Pelger Mutual Water Company					0.72			0.72
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					13.90			13.90
Princeton-Codora-Glenn Irrigation District	5.88	11.77						17.65
Provident Irrigation District	No Engines	43.44						43.44
Reclamation District 1004	16.49	1.35			No Engines			17.83
Reclamation District 108	35.70						6.30	41.99
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.49							0.49
Sutter Mutual Water Company	3.72				58.89			62.62
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**70.04**	**58.77**	**1.61**	**0.00**	**80.85**	**0.00**	**6.30**	**217.56**

Key:
NOx = nitrogen oxides

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table E-11. Annual CO Emissions (Unmitigated)

Water Agency	Annual CO Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.60							0.60
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	3.04							3.04
Glenn-Colusa Irrigation District	0.40	0.48						0.88
Giusti Farms								0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.65							2.65
Natomas Central Mutual Water Company			1.39		6.46			7.86
Pelger Mutual Water Company					0.94			0.94
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					7.45			7.45
Princeton-Codora-Glenn Irrigation District	1.27	2.54						3.80
Provident Irrigation District	No Engines	9.36						9.36
Reclamation District 1004	4.71	0.29			No Engines			5.00
Reclamation District 108	10.80						2.76	13.55
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.97							0.97
Sutter Mutual Water Company	0.80				21.22			22.03
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**25.25**	**12.66**	**1.39**	**0.00**	**36.08**	**0.00**	**2.76**	**78.13**

Key:
CO = carbon monoxide

Table E-12. Annual SOx Emissions (Unmitigated)

Water Agency	Annual SOx Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	1.33							1.33
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.12	0.15						0.27
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.94							0.94
Natomas Central Mutual Water Company			0.55		0.47			1.02
Pelger Mutual Water Company					0.24			0.24
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.62			1.62
Princeton-Codora-Glenn Irrigation District	0.39	0.78						1.17
Provident Irrigation District	No Engines	2.87						2.87
Reclamation District 1004	1.44	0.09			No Engines			1.52
Reclamation District 108	2.25						0.36	2.61
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	0.25				4.79			5.03
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**6.71**	**3.89**	**0.55**	**0.00**	**7.11**	**0.00**	**0.36**	**18.63**

Key:
SOx = sulfur oxides

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table E-13. Annual PM10 Emissions (Unmitigated)

Water Agency	Annual PM10 Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.15							0.15
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.02	0.02						0.04
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.01		0.08			0.09
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.38			0.38
Princeton-Codora-Glenn Irrigation District	0.06	0.13						0.19
Provident Irrigation District	No Engines	0.52						0.52
Reclamation District 1004	0.25	0.01			No Engines			0.26
Reclamation District 108	0.37						0.06	0.43
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	0.04				0.92			0.96
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**1.05**	**0.68**	**0.01**	**0.00**	**1.43**	**0.00**	**0.06**	**3.23**

Key:
PM10 = inhalable particulate matter

Table E-14. Annual PM2.5 Emissions (Unmitigated)

Water Agency	Annual PM2.5 Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.15							0.15
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.02	0.02						0.04
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.01		0.08			0.09
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.37			0.37
Princeton-Codora-Glenn Irrigation District	0.06	0.12						0.18
Provident Irrigation District	No Engines	0.51						0.51
Reclamation District 1004	0.24	0.01			No Engines			0.26
Reclamation District 108	0.36						0.06	0.42
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	0.04				0.90			0.94
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**1.03**	**0.67**	**0.01**	**0.00**	**1.41**	**0.00**	**0.06**	**3.18**

Key:
PM2.5 = fine particulate matter

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Anderson-Cottonwood Irrigation District			Peak Pumping by Transfer Period	
Transfer Volume	2,400	acre-feet	(Apr-Jun)	800	AF/month
	2,400	acre-feet	(Jul-Sep)	800	AF/month
	4,800	acre-feet/year			

Table E-15. Anderson-Cottonwood Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Shasta	0	2	0	0	2
Tehama	0	0	0	0	0
	0	0	0	0	0
Total	0	2	0	0	2

Table E-16. Anderson-Cottonwood Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Barney Street	Shasta	Electric	2012	200	n/a	5,500	85%	677	4,062	22	4,010
Crowley Gulch	Shasta	Electric	2012	50	n/a	1,000	15%	123	738	22	4,010
					Total	**6,500**	**100%**	**800**	**4,800**	**43**	**8,021**
					Total (Shasta County)	**6,500**	**100%**	**800**	**4,800**	**43**	**8,021**
					Total (Tehama County)	**0**	**0%**	**0**	**0**	**0**	**0**
					Total (0 County)	**0**	**0%**	**0**	**0**	**0**	**0**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Shasta	Tehama
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Peak Month
800 AF/month
5,840 gallons/minute
90% peak pump rate

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Canal Farms			Peak Pumping by Transfer Period
Transfer Volume	575 acre-feet	(Apr-Jun)		192 AF/month
	425 acre-feet	(Jul-Sep)		142 AF/month
	1,000 acre-feet/year			

Table E-17. Canal Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	1	3
Total	0	2	0	1	3

Table E-18. Canal Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane
Dennis Well North	Colusa	Electric	unknown	125	n/a	2,500	25%	48	250	3	543	n/a
Dennis Well South	Colusa	Electric	unknown	125	n/a	2,500	25%	48	250	3	543	n/a
East Well	Colusa	Propane	unknown	250	n/a	5,000	50%	96	500	3	543	345
Total						**10,000**	**100%**	**192**	**1,000**	**10**	**1,629**	**345**
Total (Colusa County)						**10,000**	**100%**	**192**	**1,000**	**10**	**1,629**	**345**

Well	Emission Factors (g/hp-hr) VOC	NOx	CO	Emission Factors (lb/MMBtu) SOx	PM10	PM2.5
Dennis Well North						
Dennis Well South						
East Well	1.0	2.0	4.0	0.000588	0.00999	0.00999
Total						
Total (Colusa County)						

Well	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Dennis Well North												
Dennis Well South												
East Well	1.85	3.70	7.40	0.00	0.02	0.02	0.15	0.30	0.60	0.000101	0.0017	0.0017
Total	**1.85**	**3.70**	**7.40**	**0.00**	**0.02**	**0.02**	**0.15**	**0.30**	**0.60**	**0.000101**	**0.0017**	**0.0017**
Total (Colusa County)	**1.85**	**3.70**	**7.40**	**0.00**	**0.02**	**0.02**	**0.15**	**0.30**	**0.60**	**0.000101**	**0.0017**	**0.0017**

Note: Natural gas emission factors used for propane.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
192 AF/month
1,399 gallons/minute
14% peak pump rate

Legend
(blue) Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
(green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Propane Emission Factor Sources
http://www.valleyair.org/notices/Docs/2013/08-19-13%20(C-1132198)/Prelim%20C-1132198.pdf
https://www.valleyair.org/busind/pto/gears/GEAR11_Emergcy_Engns.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Eastside Mutual Water Company			Peak Pumping by Transfer Period	
Transfer Volume	1,067	acre-feet	(Apr-Jun)	634	AF/month
	1,163	acre-feet	(Jul-Sep)	443	AF/month
	2,230	acre-feet/year			

Table E-19. Eastside Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	3	0	0	0	3
Total	3	0	0	0	3

Table E-20. Eastside Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
ATW-1	Colusa	Diesel	2006	150	T2	4,720	37%	235	827	9	952	8,012	0.2	4.7	3.7	0.93	0.22	0.22	0.71	13.52	10.78	2.69	0.65	0.65	0.04	0.74	0.59	0.15	0.04	0.04
ATW-2	Colusa	Diesel	2002	275	T1	4,000	31%	200	701	9	952	14,689	1.0	6.9	8.5	4.10	0.40	0.40	5.14	36.37	45.07	21.72	2.13	2.13	0.28	1.98	2.46	1.18	0.12	0.12
ATW-3	Colusa	Diesel	2010	200	T3	4,000	31%	200	701	9	952	10,683	0.1	2.8	2.6	4.10	0.15	0.15	0.58	10.93	10.06	15.80	0.58	0.58	0.03	0.60	0.55	0.86	0.03	0.03
					Total	**12,720**	**100%**	**634**	**2,230**	**26**	**2,856**	**33,384**							**5.85**	**49.89**	**55.85**	**24.41**	**2.78**	**2.78**	**0.32**	**2.72**	**3.04**	**1.33**	**0.15**	**0.15**
					Total (Colusa County)	**12,720**	**100%**	**634**	**2,230**	**26**	**2,856**	**33,384**							**5.85**	**49.89**	**55.85**	**24.41**	**2.78**	**2.78**	**0.32**	**2.72**	**3.04**	**1.33**	**0.15**	**0.15**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
634 AF/month
4,631 gallons/minute
36% peak pump rate

Legend
Emission factors based on NMHC+NOx standard
Estimated model year

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Giusti Farms		Peak Pumping by Transfer Period	
Transfer Volume	500 acre-feet	(Apr-Jun)	167	AF/month
	500 acre-feet	(Jul-Sep)	167	AF/month
	1,000 acre-feet/year			

Table E-21. Giusti Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	0	0	2	2
Total	0	0	0	2	2

Table E-22. Giusti Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	Emission Factors (g/hp-hr) VOC	Emission Factors (g/hp-hr) NOx	Emission Factors (g/hp-hr) CO	Emission Factors (lb/MMBtu) SOx	Emission Factors (lb/MMBtu) PM10	Emission Factors (lb/MMBtu) PM2.5	Daily Emissions (pounds per day) VOC	Daily Emissions (pounds per day) NOx	Daily Emissions (pounds per day) CO	Daily Emissions (pounds per day) SOx	Daily Emissions (pounds per day) PM10	Daily Emissions (pounds per day) PM2.5	Annual Emissions (tons per year) VOC	Annual Emissions (tons per year) NOx	Annual Emissions (tons per year) CO	Annual Emissions (tons per year) SOx	Annual Emissions (tons per year) PM10	Annual Emissions (tons per year) PM2.5
Giusti Well 1	Sutter	Propane	2015	150	n/a	3,200	50%	83	500	5	849	324	1.0	2.0	4.0	0.000588	0.00999	0.00999	1.51	3.02	6.03	0.00	0.02	0.02	0.14	0.28	0.56	0.000095	0.0016	0.0016
Giusti Well 2	Sutter	Propane	2015	150	n/a	3,200	50%	83	500	5	849	324	1.0	2.0	4.0	0.000588	0.00999	0.00999	1.51	3.02	6.03	0.00	0.02	0.02	0.14	0.28	0.56	0.000095	0.0016	0.0016
					Total	**6,400**	**100%**	**167**	**1,000**	**9**	**1,697**	**647**							**3.02**	**6.03**	**12.07**	**0.00**	**0.03**	**0.03**	**0.28**	**0.56**	**1.12**	**0.00019**	**0.0032**	**0.0032**
					Total (Sutter County)	**6,400**	**100%**	**167**	**1,000**	**9**	**1,697**	**647**							**3.02**	**6.03**	**12.07**	**0.00**	**0.03**	**0.03**	**0.28**	**0.56**	**1.12**	**0.00019**	**0.0032**	**0.0032**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
167 AF/month
10 gallons/minute
0% peak pump rate

Legend
Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Glenn-Colusa Irrigation District		Peak Pumping by Transfer Period
Transfer Volume	5,748 acre-feet	(Apr-Jun)	1,916 AF/month
	5,748 acre-feet	(Jul-Sep)	1,916 AF/month
	11,495 acre-feet/year		

Table E-23. Glenn-Colusa Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	20	7	0	0	27
Colusa	8	6	0	0	14
Total	28	13	0	0	41

Table E-24. Glenn-Colusa Irrigation District Criteria Pollutant Emissions

	Well Location			Power Rating	Emission	Pump Rate		Transfer Volume		Operations		Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (pounds per day)						Annual Emissions (tons per year)					
Well	(County)	Fuel Type	Model Year	(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
33	Glenn	Diesel	unknown	185	T0	3,000	3%	61	368	4	667	6,921	1.1	14.1	3.0	0.93	0.15	0.15	1.67	20.56	4.43	1.36	0.22	0.21	0.16	1.91	0.41	0.13	0.02	0.02
34	Glenn	Diesel	unknown	140	T0	4,000	4%	82	491	4	667	5,237	1.1	14.1	3.0	0.93	0.22	0.21	1.26	15.56	3.35	1.03	0.24	0.24	0.12	1.45	0.31	0.10	0.02	0.02
62	Glenn	Diesel	unknown	145	T0	3,000	3%	61	368	4	667	5,424	1.1	14.1	3.0	0.93	0.22	0.21	1.31	16.11	3.47	1.07	0.25	0.25	0.12	1.50	0.32	0.10	0.02	0.02
80	Glenn	Diesel	unknown	200	T0	2,000	2%	41	246	4	667	7,482	1.1	14.1	3.0	0.93	0.15	0.15	1.80	22.23	4.79	1.47	0.24	0.23	0.17	2.07	0.45	0.14	0.02	0.02
81	Glenn	Diesel	unknown	200	T0	2,000	2%	41	246	4	667	7,482	1.1	14.1	3.0	0.93	0.15	0.15	1.80	22.23	4.79	1.47	0.24	0.23	0.17	2.07	0.45	0.14	0.02	0.02
83	Glenn	Diesel	unknown	75	T0	1,500	2%	31	184	4	667	2,806	1.1	14.1	3.0	0.93	0.3	0.29	0.68	8.34	1.80	0.55	0.18	0.17	0.06	0.78	0.17	0.05	0.02	0.02
165	Glenn	Diesel	unknown	160	T0	3,000	3%	61	368	4	667	5,985	1.1	14.1	3.0	0.93	0.22	0.21	1.44	17.78	3.83	1.18	0.28	0.27	0.13	1.65	0.36	0.11	0.03	0.03
185	Glenn	Diesel	unknown	150	T0	3,000	3%	61	368	4	667	5,611	1.1	14.1	3.0	0.93	0.22	0.21	1.35	16.67	3.59	1.10	0.26	0.25	0.13	1.55	0.33	0.10	0.02	0.02
187	Glenn	Diesel	unknown	200	T0	3,500	4%	72	430	4	667	7,482	1.1	14.1	3.0	0.93	0.15	0.15	1.80	22.23	4.79	1.47	0.24	0.23	0.17	2.07	0.45	0.14	0.02	0.02
15-3-22H-3	Colusa	Diesel	unknown	121	T0	630	1%	13	77	4	667	4,527	1.1	14.1	3.0	0.93	0.22	0.21	1.09	13.45	2.90	0.89	0.21	0.21	0.10	1.25	0.27	0.08	0.02	0.02
17-2-6B-1	Colusa	Electric	unknown	121	n/a	2,050	2%	42	252	4	667	n/a																		
322N	Colusa	Diesel	unknown	250	T0	2,000	2%	41	246	4	667	9,352	1.1	14.1	3.0	0.93	0.15	0.15	2.25	27.78	5.99	1.84	0.30	0.29	0.21	2.58	0.56	0.17	0.03	0.03
GRS-22H-1	Glenn	Electric	unknown	121	n/a	2,300	2%	47	282	4	667	n/a																		
GRS-34N-1	Glenn	Diesel	unknown	121	T0	1,500	2%	31	184	4	667	4,527	1.1	14.1	3.0	0.93	0.22	0.21	1.09	13.45	2.90	0.89	0.21	0.21	0.10	1.25	0.27	0.08	0.02	0.02
GRS-35A-2	Glenn	Electric	unknown	121	n/a	3,600	4%	74	442	4	667	n/a																		
GRS-84A-1	Glenn	Electric	unknown	121	n/a	3,000	3%	61	368	4	667	n/a																		
Haymen	Colusa	Diesel	unknown	121	T0	2,000	2%	41	246	4	667	4,527	1.1	14.1	3.0	0.93	0.22	0.21	1.09	13.45	2.90	0.89	0.21	0.21	0.10	1.25	0.27	0.08	0.02	0.02
LaCroix 1	Glenn	Electric	unknown	121	n/a	600	1%	12	74	4	667	n/a																		
LaCroix 2	Glenn	Electric	unknown	121	n/a	600	1%	12	74	4	667	n/a																		
LaCroix 3	Glenn	Electric	unknown	121	n/a	600	1%	12	74	4	667	n/a																		
Lagrande	Colusa	Diesel	unknown	121	T0	2,900	3%	59	356	4	667	4,527	1.1	14.1	3.0	0.93	0.22	0.21	1.09	13.45	2.90	0.89	0.21	0.21	0.10	1.25	0.27	0.08	0.02	0.02
Reister 1	Colusa	Electric	unknown	121	n/a	850	1%	17	104	4	667	n/a																		
Reister 2	Colusa	Electric	unknown	121	n/a	850	1%	17	104	4	667	n/a																		
Reister 3	Colusa	Electric	unknown	121	n/a	850	1%	17	104	4	667	n/a																		
Reister 4	Colusa	Electric	unknown	121	n/a	890	1%	18	109	4	667	n/a																		
S2-36T	Glenn	Electric	unknown	121	n/a	2,800	3%	57	344	4	667	n/a																		
Vann 1	Colusa	Diesel	unknown	121	T0	1,500	2%	31	184	4	667	4,527	1.1	14.1	3.0	0.93	0.22	0.21	1.09	13.45	2.90	0.89	0.21	0.21	0.10	1.25	0.27	0.08	0.02	0.02
Vann 2	Colusa	Electric	unknown	121	n/a	3,500	4%	72	430	4	667	n/a																		
8	Glenn	Diesel	unknown	100	T0	1,100	1%	23	135	4	667	3,741	1.1	14.1	3.0	0.93	0.22	0.21	0.90	11.11	2.39	0.73	0.17	0.17	0.08	1.03	0.22	0.07	0.02	0.02
2	Colusa	Diesel	unknown	215	T0	3,500	4%	72	430	4	667	8,043	1.1	14.1	3.0	0.93	0.15	0.15	1.94	23.89	5.15	1.58	0.25	0.25	0.18	2.22	0.48	0.15	0.02	0.02
19	Colusa	Diesel	unknown	180	T0	2,500	3%	51	307	4	667	6,734	1.1	14.1	3.0	0.93	0.15	0.15	1.62	20.00	4.31	1.32	0.21	0.21	0.15	1.86	0.40	0.12	0.02	0.02
38	Glenn	Diesel	unknown	100	T0	2,500	3%	51	307	4	667	3,741	1.1	14.1	3.0	0.93	0.22	0.21	0.90	11.11	2.39	0.73	0.17	0.17	0.08	1.03	0.22	0.07	0.02	0.02
42	Glenn	Diesel	unknown	162	T0	3,500	4%	72	430	4	667	6,060	1.1	14.1	3.0	0.93	0.22	0.21	1.46	18.00	3.88	1.19	0.28	0.27	0.14	1.67	0.36	0.11	0.03	0.03
43	Glenn	Diesel	unknown	200	T0	3,500	4%	72	430	4	667	7,482	1.1	14.1	3.0	0.93	0.15	0.15	1.80	22.23	4.79	1.47	0.24	0.23	0.17	2.07	0.45	0.14	0.02	0.02
45	Glenn	Diesel	unknown	160	T0	4,000	4%	82	491	4	667	5,985	1.1	14.1	3.0	0.93	0.22	0.21	1.44	17.78	3.83	1.18	0.28	0.27	0.13	1.65	0.36	0.11	0.03	0.03
46	Glenn	Diesel	unknown	155	T0	3,000	3%	61	368	4	667	5,798	1.1	14.1	3.0	0.93	0.22	0.21	1.40	17.23	3.71	1.14	0.27	0.26	0.13	1.60	0.35	0.11	0.03	0.02
47	Glenn	Diesel	unknown	125	T0	3,000	3%	61	368	4	667	4,676	1.1	14.1	3.0	0.93	0.22	0.21	1.13	13.89	2.99	0.92	0.22	0.21	0.10	1.29	0.28	0.09	0.02	0.02
51	Glenn	Diesel	unknown	125	T0	1,500	2%	31	184	4	667	4,676	1.1	14.1	3.0	0.93	0.22	0.21	1.13	13.89	2.99	0.92	0.22	0.21	0.10	1.29	0.28	0.09	0.02	0.02
190	Glenn	Diesel	unknown	160	T0	3,000	3%	61	368	4	667	5,985	1.1	14.1	3.0	0.93	0.22	0.21	1.44	17.78	3.83	1.18	0.28	0.27	0.13	1.65	0.36	0.11	0.03	0.03
191	Glenn	Diesel	unknown	200	T0	2,500	3%	51	307	4	667	7,482	1.1	14.1	3.0	0.93	0.15	0.15	1.80	22.23	4.79	1.47	0.24	0.23	0.17	2.07	0.45	0.14	0.02	0.02
196	Colusa	Diesel	unknown	250	T0	2,000	2%	41	246	4	667	9,352	1.1	14.1	3.0	0.93	0.15	0.15	2.25	27.78	5.99	1.84	0.30	0.29	0.21	2.58	0.56	0.17	0.03	0.03
					Total	**93,620**	**100%**	**1,916**	**11,495**	**147**	**27,340**	**166,172**							**40.04**	**493.67**	**106.38**	**32.65**	**6.62**	**6.46**	**3.72**	**45.91**	**9.89**	**3.04**	**0.62**	**0.60**
					Total (Glenn County)	**67,600**	**72%**	**1,383**	**8,300**	**97**	**18,004**	**114,584**							**15.11**	**186.26**	**40.14**	**12.32**	**2.53**	**2.47**	**1.40**	**17.32**	**3.73**	**1.15**	**0.24**	**0.23**
					Total (Colusa County)	**26,020**	**28%**	**532**	**3,195**	**50**	**9,335**	**51,587**							**6.62**	**81.57**	**17.58**	**5.39**	**1.14**	**1.11**	**0.62**	**7.59**	**1.63**	**0.50**	**0.11**	**0.10**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Glenn	Colusa
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Peak Month
1,916 AF/month
13,985 gallons/minute
15% peak pump rate

Legend
Engine power rating equal to average horsepower of all wells in GCID's well database

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Henle Family LP		
Transfer Volume	350 acre-feet	(Apr-Jun)	
	350 acre-feet	(Jul-Sep)	
	700 acre-feet/year		

Peak Pumping by Transfer Period
117 AF/month
117 AF/month

Table E-25. Henle Family LP Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	1	0	0	1
Total	0	1	0	0	1

Table E-26. Henle Family LP Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Well #2	Sutter	Electric	unknown	200	n/a	3,600	100%	117	700	6	1,056
					Total	**3,600**	**100%**	**117**	**700**	**6**	**1,056**
					Total (Sutter County)	**3,600**	**100%**	**117**	**700**	**6**	**1,056**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
117 AF/month
7 gallons/minute
0% peak pump rate

Legend
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Maxwell Irrigation District			Peak Pumping by Transfer Period
Transfer Volume	1,000 acre-feet	(Apr-Jun)		600 AF/month
	2,000 acre-feet	(Jul-Sep)		760 AF/month
	3,000 acre-feet/year			

Table E-27. Maxwell Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	2	0	0	0	2
Total	2	0	0	0	2

Table E-28. Maxwell Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate		Transfer Volume		Operations		Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (pounds per day)						Annual Emissions (tons per year)					
						(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
MainWell	Colusa	Diesel	2006	215	T3	3,800	50%	380	1,500	18	2,144	25,857	0.1	2.8	2.6	0.93	0.14925	0.15	1.24	23.55	21.69	7.72	1.24	1.24	0.08	1.44	1.33	0.47	0.08	0.08
TuttleWell	Colusa	Diesel	2006	215	T3	3,800	50%	380	1,500	18	2,144	25,857	0.1	2.8	2.6	0.93	0.14925	0.15	1.24	23.55	21.69	7.72	1.24	1.24	0.08	1.44	1.33	0.47	0.08	0.08
					Total	**7,600**	**100%**	**760**	**3,000**	**35**	**4,288**	**51,715**							**2.48**	**47.10**	**43.38**	**15.44**	**2.48**	**2.48**	**0.15**	**2.88**	**2.65**	**0.94**	**0.15**	**0.15**
					Total (Colusa County)	**7,600**	**100%**	**760**	**3,000**	**35**	**4,288**	**51,715**							**2.48**	**47.10**	**43.38**	**15.44**	**2.48**	**2.48**	**0.15**	**2.88**	**2.65**	**0.94**	**0.15**	**0.15**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
760 AF/month
5,548 gallons/minute
73% peak pump rate

Legend
Engine information assumed to be equivalent to Eastside MWC because it is the adjacent water district.
Emission factors based on NMHC+NOx standard

Conversion Factors
1 lb = 453.6 g
1 ton = 2,000 lbs
1 kW = 1.34 hp
1 day = 24 hours
1 month = 31 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Natomas Central Mutual Water Company			Peak Pumping by Transfer Period	
Transfer Volume	10,000	acre-feet	(Apr-Jun)	3,333	AF/month
	10,000	acre-feet	(Jul-Sep)	3,333	AF/month
	20,000	acre-feet/year			

Table E-29. Natomas Central Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sacramento	2	13	0	1	16
Sutter	2	15	0	4	21
Total	4	28	0	5	37

Table E-30. Natomas Central Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane: VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day): VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year): VOC	NOx	CO	SOx	PM10	PM2.5
Ameral	Sacramento	Propane	unknown	200	n/a	1,500	2%	71	428	8	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	3.68	7.35	14.70	0.00	0.04	0.04	0.34	0.68	1.37	0.00	0.00	0.00
TNBC Atkinson	Sutter	Electric	unknown	125	n/a	1,800	3%	86	514	8	1,551	n/a																		
TNBC Bennett North	Sutter	Electric	unknown	125	n/a	2,200	3%	105	628	8	1,551	n/a																		
TNBC Betts	Sacramento	Electric	unknown	125	n/a	1,500	2%	71	428	8	1,551	n/a																		
Bianchi	Sutter	Propane	unknown	200	n/a	1,500	2%	71	428	8	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	3.68	7.35	14.70	0.00	0.04	0.04	0.34	0.68	1.37	0.00	0.00	0.00
Dhaliwal	Sacramento	Electric	unknown	125	n/a	3,000	4%	143	857	8	1,551	n/a																		
Elkhorn	Sacramento	Electric	unknown	125	n/a	2,700	4%	128	771	8	1,551	n/a																		
TNBC Frazer	Sutter	Electric	unknown	125	n/a	2,000	3%	95	571	8	1,551	n/a																		
Greenbriar	Sacramento	Electric	unknown	150	n/a	3,200	5%	152	914	8	1,551	n/a																		
Kubo	Sacramento	Electric	unknown	25	n/a	1,300	2%	62	371	8	1,551	n/a																		
L-1	Sutter	Diesel	unknown	125	T0	1,600	2%	76	457	8	1,551	10,874	0.1	2.4	0.5	0.93	0.014914	0.01	0.15	5.48	1.20	2.14	0.03	0.03	0.01	0.51	0.11	0.20	0.00	0.00
L-10	Sutter	Electric	unknown	30	n/a	1,000	1%	48	286	8	1,551	n/a																		
L-11	Sutter	Electric	unknown	50	n/a	1,500	2%	71	428	8	1,551	n/a																		
L-12	Sutter	Electric	unknown	50	n/a	1,500	2%	71	428	8	1,551	n/a																		
L-13 Bolen Pasture	Sutter	Propane	unknown	200	n/a	2,800	4%	133	799	8	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	3.68	7.35	14.70	0.00	0.04	0.04	0.34	0.68	1.37	0.00	0.00	0.00
L-14 Chappell	Sutter	Electric	unknown	75	n/a	1,800	3%	86	514	8	1,551	n/a																		
L-2	Sutter	Electric	unknown	30	n/a	1,900	3%	90	542	8	1,551	n/a																		
L-3	Sutter	Electric	unknown	50	n/a	1,300	2%	62	371	8	1,551	n/a																		
L-4	Sutter	Electric	unknown	75	n/a	1,300	2%	62	371	8	1,551	n/a																		
L-6	Sutter	Electric	unknown	50	n/a	2,000	3%	95	571	8	1,551	n/a																		
L-7	Sutter	Electric	unknown	30	n/a	1,200	2%	57	343	8	1,551	n/a																		
L-8	Sutter	Electric	unknown	200	n/a	2,800	4%	133	799	8	1,551	n/a																		
L-9	Sutter	Electric	unknown	50	n/a	1,500	2%	71	428	8	1,551	n/a																		
Lauppe	Sutter	Propane	unknown	200	n/a	1,050	1%	50	300	8	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	3.68	7.35	14.70	0.00	0.04	0.04	0.34	0.68	1.37	0.00	0.00	0.00
L-MW	Sutter	Propane	unknown	200	n/a	1,800	3%	86	514	8	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	3.68	7.35	14.70	0.00	0.04	0.04	0.34	0.68	1.37	0.00	0.00	0.00
TNBC Lucich North	Sutter	Diesel	unknown	170	T0	2,500	4%	119	714	8	1,551	14,788	1.1	14.1	3.0	0.93	0.22	0.21	3.56	43.93	9.47	2.91	0.69	0.67	0.33	4.09	0.88	0.27	0.06	0.06
MAP	Sacramento	Electric	unknown	125	n/a	2,000	3%	95	571	8	1,551	n/a																		
TNBC Fisherman's Lake	Sacramento	Electric	unknown	125	n/a	1,500	2%	71	428	8	1,551	n/a																		
Ose-1	Sacramento	Diesel	2013	200	T4I	1,800	3%	86	514	8	1,551	17,398	0.002	1.3	0.02	0.93	0.007457	0.01	0.01	4.66	0.08	3.42	0.03	0.03	0.00	0.43	0.01	0.32	0.00	0.00
Ose-2	Sacramento	Electric	unknown	150	n/a	2,400	3%	114	685	8	1,551	n/a																		
Perry	Sacramento	Electric	unknown	125	n/a	2,600	4%	124	742	8	1,551	n/a																		
Plant 3	Sacramento	Electric	unknown	150	n/a	2,500	4%	119	714	8	1,551	n/a																		
Pond R	Sacramento	Electric	unknown	50	n/a	2,300	3%	109	657	8	1,551	n/a																		
TNBC Silva Dairy	Sacramento	Electric	unknown	125	n/a	1,000	1%	48	286	8	1,551	n/a																		
Souza	Sacramento	Electric	unknown	40	n/a	1,200	2%	57	343	8	1,551	n/a																		
Spangler	Sutter	Electric	unknown	80	n/a	2,500	4%	119	714	8	1,551	n/a																		
Willey	Sacramento	Diesel	2012	148	T4I	2,000	3%	95	571	8	1,551	12,874	0.01	1.9	0.07	0.93	0.002237	0.002	0.02	5.27	0.20	2.53	0.01	0.01	0.00	0.49	0.02	0.24	0.00	0.00
					Total	**70,050**	**100%**	**3,333**	**20,000**	**308**	**57,371**	**59,876**							**22.12**	**96.10**	**84.46**	**11.00**	**0.97**	**0.95**	**2.06**	**8.94**	**7.86**	**1.02**	**0.09**	**0.09**
					Total (Sacramento County)	**32,500**	**46%**	**1,547**	**9,279**	**133**	**24,809**	**31,060**							**3.70**	**17.28**	**14.99**	**5.95**	**0.08**	**0.08**	**0.34**	**1.61**	**1.39**	**0.55**	**0.01**	**0.01**
					Total (Sutter County)	**37,550**	**54%**	**1,787**	**10,721**	**175**	**32,562**	**28,815**							**18.42**	**78.82**	**69.48**	**5.05**	**0.89**	**0.87**	**1.71**	**7.33**	**6.46**	**0.47**	**0.08**	**0.08**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sacramento	Sutter
PM10	M	A
PM2.5	N	M
O3	N	N

Engines subject to ATCM.

Peak Month
3,333 AF/month
24,332 gallons/minute
35% peak pump rate

Legend
(green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
(red) Engine-specific emission factors
(blue) Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pelger Mutual Water Company			Peak Pumping by Transfer Period	
Transfer Volume	2,000	acre-feet	(Apr-Jun)	1,189	AF/month
	2,670	acre-feet	(Jul-Sep)	1,017	AF/month
	4,670	acre-feet/year			

Table E-31. Pelger Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	1	3	0	0	4
Total	1	3	0	0	4

Table E-32. Pelger Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
PMWC#1	Sutter	Electric	unknown	150	n/a	4,800	25%	293	1,149	24	1,300	n/a																		
Well 1 Tucker	Sutter	Electric	unknown	75	n/a	3,100	25%	293	1,149	24	2,013	n/a																		
Well 2 Flopet	Sutter	Diesel	2,008	125	T3	2,300	17%	198	778	24	1,837	12,882	0.1	2.8	3.7	0.93	0.22	0.22	0.99	18.76	24.68	6.15	1.48	1.48	0.04	0.72	0.94	0.24	0.06	0.06
Well 3 Klein	Sutter	Electric	unknown	150	n/a	4,300	34%	406	1,594	24	2,013	n/a																		
					Total	**14,500**	**100%**	**1,190**	**4,670**	**96**	**7,163**	**12,882**							**0.99**	**18.76**	**24.68**	**6.15**	**1.48**	**1.48**	**0.04**	**0.72**	**0.94**	**0.24**	**0.06**	**0.06**
					Total (Sutter County)	**14,500**	**100%**	**1,190**	**4,670**	**96**	**7,163**	**12,882**							**0.99**	**18.76**	**24.68**	**6.15**	**1.48**	**1.48**	**0.04**	**0.72**	**0.94**	**0.24**	**0.06**	**0.06**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
1,189 AF/month
8,681 gallons/minute
60% peak pump rate

Legend
Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pelger Road 1700 LLC			Peak Pumping by Transfer Period
Transfer Volume	2,600 acre-feet	(Apr-Jun)		867 AF/month
	2,600 acre-feet	(Jul-Sep)		867 AF/month
	5,200 acre-feet/year			

Table E-33. Pelger Road 1700 LLC Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	6	0	0	6
Total	0	6	0	0	6

Table E-34. Pelger Road 1700 LLC Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)
North Well	Sutter	Electric	unknown	200	n/a	3,500	19%	162	973	8	1,510	n/a
North Well B	Sutter	Electric	unknown	200	n/a	3,000	16%	139	834	8	1,510	n/a
South Well	Sutter	Electric	unknown	200	n/a	3,000	16%	139	834	8	1,510	n/a
South Well B	Sutter	Electric	unknown	200	n/a	3,000	16%	139	834	8	1,510	n/a
Well #3	Sutter	Electric	unknown	200	n/a	3,100	17%	144	862	8	1,510	n/a
Well #4	Sutter	Electric	unknown	200	n/a	3,100	17%	144	862	8	1,510	n/a
					Total	**18,700**	**100%**	**867**	**5,200**	**49**	**9,061**	**0**
					Total (Sutter County)	**18,700**	**100%**	**867**	**5,200**	**49**	**9,061**	**0**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
867 AF/month
6,326 gallons/minute
34% peak pump rate

Legend
[shaded cell] Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pleasant Grove-Verona Mutual Water Company		Peak Pumping by Transfer Period
Transfer Volume	8,000 acre-feet	(Apr-Jun)	4,757 AF/month
	7,000 acre-feet	(Jul-Sep)	2,667 AF/month
	15,000 acre-feet/year		

Table E-35. Pleasant Grove-Verona Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	11	20	0	3	34
Total	11	20	0	3	34

Table E-36. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

	Well											Fuel	Emission Factors						Daily Emissions						Annual Emissions					
	Location			Power Rating	Emission	Pump Rate		Transfer Volume		Operations		Consumption	(g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane						(pounds per day)						(tons per year)					
Well	(County)	Fuel Type	Model Year	(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr) - diesel (MMBtu/yr) - propane	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Kelly 190 Field Well #2	Sutter	Electric	unknown	30	n/a	2,100	3%	135	427	11	1,104	n/a																		
Kelly Windmill Field Well #2	Sutter	Electric	2002	62.1	n/a	2,000	3%	129	407	11	1,104	n/a																		
Kelly Windmill North Field Well	Sutter	Propane	2014	133	T2	1,800	2%	116	366	11	1,104	373	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	3.31	6.62	13.24	0.00	0.04	0.04	0.16	0.32	0.65	0.00	0.00	0.00
Kelly306	Sutter	Electric	unknown	60	n/a	3,500	5%	226	711	11	1,104	n/a																		
MLF Clubhouse B Well	Sutter	Electric	unknown	300	n/a	3,600	5%	232	732	11	1,104	n/a																		
MLF Marsh Well	Sutter	Electric	unknown	300	n/a	3,200	4%	206	650	11	1,104	n/a																		
MLF Monster Well	Sutter	Electric	unknown	60	n/a	3,100	4%	200	630	11	1,104	n/a																		
MLF Well #1	Sutter	Electric	unknown	30	n/a	2,000	3%	129	407	11	1,104	n/a																		
MLF Well #16	Sutter	Electric	unknown	50	n/a	1,700	2%	110	346	11	1,104	n/a																		
MLF Well#11	Sutter	Diesel	2004	250	T2	1,400	2%	90	285	11	1,104	15,482	0.2	4.7	2.6	0.93	0.15	0.15	1.53	29.12	16.26	5.79	0.93	0.93	0.07	1.42	0.79	0.28	0.05	0.05
MLF Well#12/17	Sutter	Electric	unknown	50	n/a	2,200	3%	142	447	11	1,104	n/a																		
MLF Well#13&#15	Sutter	Electric	2000	215	n/a	1,900	3%	122	386	11	1,104	n/a																		
MLF Well#2B	Sutter	Electric	2000	300	n/a	2,800	4%	180	569	11	1,104	n/a																		
Nicholas 72-Acre Field North	Sutter	Electric	unknown	40	n/a	1,700	2%	110	346	11	1,104	n/a																		
Nicholas 72-Acre Field South	Sutter	Diesel	2002	62.1	T1	2,000	3%	129	407	11	1,104	3,846	1.1	6.9	3.0	0.93	0.30	0.29	1.76	10.61	4.68	1.44	0.46	0.45	0.09	0.52	0.23	0.07	0.02	0.02
Nicholas BBC Well	Sutter	Electric	unknown	30	n/a	2,000	3%	129	407	11	1,104	n/a																		
Nicholas Filipino Camp South	Sutter	Diesel	2002	62.1	T1	800	1%	52	163	11	1,104	3,846	1.1	6.9	3.0	0.93	0.30	0.29	1.76	10.61	4.68	1.44	0.46	0.45	0.09	0.52	0.23	0.07	0.02	0.02
Nicholas Filipino Camp#2	Sutter	Electric	unknown	40	n/a	2,300	3%	148	467	11	1,104	n/a																		
Nicholas Johnston Field Well #2	Sutter	Electric	unknown	40	n/a	2,000	3%	129	407	11	1,104	n/a																		
Nicholas Sand Field Well	Sutter	Diesel	2002	62.1	T2	2,000	3%	129	407	11	1,104	3,846	0.3	5.3	3.7	0.93	0.30	0.29	0.43	8.22	5.77	1.44	0.46	0.45	0.02	0.40	0.28	0.07	0.02	0.02
RiverRanch#19	Sutter	Diesel	2008	99	T3	2,500	3%	161	508	11	1,104	6,131	0.2	3.3	3.7	0.93	0.30	0.29	0.43	8.21	9.20	2.29	0.74	0.72	0.02	0.40	0.45	0.11	0.04	0.04
S&O#16	Sutter	Electric	2014	159	n/a	2,000	3%	129	407	11	1,104	n/a																		
S&O#17	Sutter	Diesel	1999	101	T0	3,000	4%	193	610	11	1,104	6,255	1.1	14.1	3.0	0.93	0.22	0.21	2.87	35.35	7.62	2.34	0.55	0.54	0.14	1.73	0.37	0.11	0.03	0.03
S&O#18A	Sutter	Diesel	1999	101	T0	1,800	2%	116	366	11	1,104	6,255	1.1	14.1	3.0	0.93	0.22	0.21	2.87	35.35	7.62	2.34	0.55	0.54	0.14	1.73	0.37	0.11	0.03	0.03
S&O#19	Sutter	Diesel	2007	215	T3	1,800	2%	116	366	11	1,104	13,314	0.1	2.8	2.6	0.93	0.15	0.15	0.80	15.18	13.98	4.98	0.80	0.80	0.04	0.74	0.68	0.24	0.04	0.04
S&O#20	Sutter	Propane	2014	154	n/a	1,800	2%	116	366	11	1,104	432	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	3.83	7.67	15.33	0.00	0.04	0.04	0.19	0.37	0.75	0.00	0.00	0.00
Willey#1	Sutter	Diesel	2000	168	T1	3,000	4%	193	610	11	1,104	10,404	1.1	6.9	3.0	0.93	0.22	0.21	4.77	28.71	12.67	3.89	0.92	0.90	0.23	1.40	0.62	0.19	0.04	0.04
Willey#3	Sutter	Electric	unknown	75	n/a	1,800	2%	116	366	11	1,104	n/a																		
Willey#4	Sutter	Diesel	1974	150	T0	2,000	3%	129	407	11	1,104	9,289	1.1	14.1	3.0	0.93	0.22	0.21	4.26	52.51	11.31	3.47	0.82	0.80	0.21	2.57	0.55	0.17	0.04	0.04
Willey#5	Sutter	Propane	unknown	180	n/a	2,000	3%	129	407	11	1,104	505	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	4.48	8.96	17.92	0.00	0.05	0.05	0.22	0.44	0.88	0.00	0.00	0.00
Will-Lee Well#31	Sutter	Electric	unknown	50	n/a	1,500	2%	97	305	11	1,104	n/a																		
Will-Lee Well#32	Sutter	Electric	unknown	300	n/a	2,500	3%	161	508	11	1,104	n/a																		
Will-Lee Well#33	Sutter	Electric	unknown	75	n/a	2,500	3%	161	508	11	1,104	n/a																		
Will-Lee Well#4A	Sutter	Diesel	2000	160	T1	1,500	2%	97	305	11	1,104	9,908	1.1	6.9	3.0	0.93	0.22	0.21	4.54	27.35	12.07	3.70	0.88	0.86	0.22	1.34	0.59	0.18	0.04	0.04
					Total	**73,800**	**100%**	**4,757**	**15,000**	**384**	**37,530**	**89,883**							**37.65**	**284.48**	**152.36**	**33.12**	**7.72**	**7.58**	**1.84**	**13.90**	**7.45**	**1.62**	**0.38**	**0.37**
				Total (Sutter County)		**73,800**	**100%**	**4,757**	**15,000**	**384**	**37,530**	**89,883**							**37.65**	**284.48**	**152.36**	**33.12**	**7.72**	**7.58**	**1.84**	**13.90**	**7.45**	**1.62**	**0.38**	**0.37**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
4,757 AF/month
34,722 gallons/minute
47% peak pump rate

Legend
(blue) Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
(orange) Emission factors based on NMHC+NOx standard
(purple) Emission factor from AP-42 because emission standards for pollutant not available for emissions tier
(green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Princeton-Codora-Glenn Irrigation District			Peak Pumping by Transfer Period	
Transfer Volume	2,500	acre-feet	(Apr-Jun)	1,000	AF/month
	4,100	acre-feet	(Jul-Sep)	1,640	AF/month
	6,600	acre-feet/year			

Table E-37. Princeton-Codora-Glenn Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	2	1	0	0	3
Colusa	1	1	0	0	2
Total	3	2	0	0	5

Table E-38. Princeton-Codora-Glenn Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
J. Southam	Colusa	Electric	unknown	200	n/a	4,000	24%	386	1,553	17	2,108	n/a																		
Joel Mann	Glenn	Diesel	unknown	180	T0	3,500	21%	338	1,359	17	2,108	21,291	1.1	14.1	3.0	0.93	0.15	0.15	7.65	94.31	20.32	6.24	1.01	0.98	0.48	5.88	1.27	0.39	0.06	0.06
Jones Well	Glenn	Electric	2012	200	n/a	3,500	21%	338	1,359	17	2,108	n/a																		
M. Cota	Colusa	Diesel	unknown	180	T0	3,000	18%	289	1,165	17	2,108	21,291	1.1	14.1	3.0	0.93	0.15	0.15	7.65	94.31	20.32	6.24	1.01	0.98	0.48	5.88	1.27	0.39	0.06	0.06
Zoller A	Glenn	Diesel	unknown	180	T0	3,000	18%	289	1,165	17	2,108	21,291	1.1	14.1	3.0	0.93	0.15	0.15	7.65	94.31	20.32	6.24	1.01	0.98	0.48	5.88	1.27	0.39	0.06	0.06
Total						**17,000**	**100%**	**1,640**	**6,600**	**85**	**10,542**	**63,874**							**22.94**	**282.92**	**60.96**	**18.71**	**3.02**	**2.95**	**1.43**	**17.65**	**3.80**	**1.17**	**0.19**	**0.18**
Total (Glenn County)						**10,000**	**59%**	**965**	**3,882**	**51**	**6,325**	**42,583**							**15.30**	**188.61**	**40.64**	**12.47**	**2.01**	**1.96**	**0.95**	**11.77**	**2.54**	**0.78**	**0.13**	**0.12**
Total (Colusa County)						**7,000**	**41%**	**675**	**2,718**	**34**	**4,217**	**21,291**							**7.65**	**94.31**	**20.32**	**6.24**	**1.01**	**0.98**	**0.48**	**5.88**	**1.27**	**0.39**	**0.06**	**0.06**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Glenn	Colusa
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Peak Month
1,640 AF/month
11,971 gallons/minute
70% peak pump rate

Legend
- Emission factors based on NMHC+NOx standard
- Information on engine not available; therefore, engine assumed to be diesel as worst-case.
- Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
- Tier 4 Exhaust Emission Standards, Phase-In (100<=hp<=175, 2012-2014 model year)

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Provident Irrigation District		
Transfer Volume	4,000 acre-feet	(Apr-Jun)	
	6,000 acre-feet	(Jul-Sep)	
	10,000 acre-feet/year		

Peak Pumping by Transfer Period
1,333 AF/month
2,000 AF/month

Table E-39. Provident Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	13	3	0	0	16
Colusa	0	0	0	0	0
Total	13	3	0	0	16

Table E-40. Provident Irrigation District Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Calvert	Glenn	Diesel	unknown	150	T0	3,000	6%	120	600	7	1,086	9,140	1.1	14.1	3.0	0.93	0.22	0.21	2.64	32.59	7.02	2.15	0.51	0.50	0.20	2.53	0.54	0.17	0.04	0.04
D. Alves	Glenn	Diesel	unknown	165	T0	3,000	6%	120	600	7	1,086	10,054	1.1	14.1	3.0	0.93	0.22	0.21	2.91	35.84	7.72	2.37	0.56	0.55	0.23	2.78	0.60	0.18	0.04	0.04
D. Kennedy	Glenn	Electric	unknown	120	n/a	3,000	6%	120	600	7	1,086	n/a																		
E Weller	Glenn	Diesel	unknown	200	T0	2,500	5%	100	500	7	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	3.52	43.45	9.36	2.87	0.46	0.45	0.27	3.37	0.73	0.22	0.04	0.04
G. Clark #1	Glenn	Diesel	unknown	200	T0	3,000	6%	120	600	7	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	3.52	43.45	9.36	2.87	0.46	0.45	0.27	3.37	0.73	0.22	0.04	0.04
K Hansen#1	Glenn	Diesel	unknown	200	T0	2,600	5%	104	520	7	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	3.52	43.45	9.36	2.87	0.46	0.45	0.27	3.37	0.73	0.22	0.04	0.04
K Hansen#2	Glenn	Electric	unknown	120	n/a	3,500	7%	140	700	7	1,086	n/a																		
L Hansen#1	Glenn	Diesel	unknown	200	T0	3,800	8%	152	760	7	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	3.52	43.45	9.36	2.87	0.46	0.45	0.27	3.37	0.73	0.22	0.04	0.04
L Hansen#2	Glenn	Diesel	unknown	200	T0	4,500	9%	180	900	7	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	3.52	43.45	9.36	2.87	0.46	0.45	0.27	3.37	0.73	0.22	0.04	0.04
M. Jones #1	Glenn	Diesel	unknown	275	T0	3,000	6%	120	600	7	1,086	16,757	1.1	14.1	3.0	0.93	0.15	0.15	4.84	59.74	12.87	3.95	0.64	0.62	0.38	4.63	1.00	0.31	0.05	0.05
M. Jones #2	Glenn	Diesel	unknown	250	T0	3,000	6%	120	600	7	1,086	15,234	1.1	14.1	3.0	0.93	0.15	0.15	4.40	54.31	11.70	3.59	0.58	0.57	0.34	4.21	0.91	0.28	0.04	0.04
Perez and Perez	Glenn	Diesel	unknown	200	T0	3,200	6%	128	640	7	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	3.52	43.45	9.36	2.87	0.46	0.45	0.27	3.37	0.73	0.22	0.04	0.04
S. Jones #1	Glenn	Diesel	unknown	170	T0	3,200	6%	128	640	7	1,086	10,359	1.1	14.1	3.0	0.93	0.22	0.21	3.00	36.93	7.96	2.44	0.58	0.56	0.23	2.86	0.62	0.19	0.04	0.04
S. Jones #2	Glenn	Diesel	unknown	170	T0	3,200	6%	128	640	7	1,086	10,359	1.1	14.1	3.0	0.93	0.22	0.21	3.00	36.93	7.96	2.44	0.58	0.56	0.23	2.86	0.62	0.19	0.04	0.04
Weller#4	Glenn	Electric	unknown	120	n/a	3,500	7%	140	700	7	1,086	n/a																		
Weller62V	Glenn	Diesel	unknown	200	T0	2,000	4%	80	400	7	1,086	12,187	1.1	14.1	3.0	0.93	0.15	0.15	3.52	43.45	9.36	2.87	0.46	0.45	0.27	3.37	0.73	0.22	0.04	0.04
					Total	**50,000**	**100%**	**2,000**	**10,000**	**112**	**17,379**	**157,213**							**45.45**	**560.46**	**120.77**	**37.06**	**6.69**	**6.53**	**3.52**	**43.44**	**9.36**	**2.87**	**0.52**	**0.51**
					Total (Glenn County)	**50,000**	**100%**	**2,000**	**10,000**	**112**	**17,379**	**157,213**							**45.45**	**560.46**	**120.77**	**37.06**	**6.69**	**6.53**	**3.52**	**43.44**	**9.36**	**2.87**	**0.52**	**0.51**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Glenn	Colusa
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Peak Month
2,000 AF/month
14,599 gallons/minute
29% peak pump rate

Legend
(blue) Information on engine not available; therefore, engine assumed to be diesel as worst-case.
(green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors
1 lb = 453.6 g
1 ton = 2,000 lbs
1 kW = 1.34 hp
1 day = 24 hours
1 month = 31 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 108		Peak Pumping by Transfer Period
Transfer Volume	7,500 acre-feet	(Apr-Jun)	2,500 AF/month
	7,500 acre-feet	(Jul-Sep)	2,500 AF/month
	15,000 acre-feet/year		

Table E-41. Reclamation District 108 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	5	7	0	3	15
Yolo	1	3	0	1	5
Yuba	0	0	0	0	0
Total	6	10	0	4	20

Table E-42. Reclamation District 108 Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane
Field 1	Colusa	Propane	unknown	105	n/a	3,420	6%	149	896	8	1,423	380
Field 100H	Colusa	Diesel	unknown	250	T0	2,385	4%	104	625	8	1,423	19,952
Field 100L1 East	Colusa	Electric	unknown	125	n/a	1,950	3%	85	511	8	1,423	n/a
Field 93A	Colusa	Propane	unknown	250	n/a	3,500	6%	153	917	8	1,423	904
Field 100M	Colusa	Diesel	unknown	240	T0	2,200	4%	96	576	8	1,423	19,154
Field 107F	Colusa	Electric	unknown	200	n/a	3,195	6%	139	837	8	1,423	n/a
Field 125A	Colusa	Propane	unknown	200	n/a	2,800	5%	122	733	8	1,423	723
Field 4	Colusa	Electric	unknown	200	n/a	3,150	6%	138	825	8	1,423	n/a
Field 53E	Yolo	Propane	unknown	250	n/a	2,295	4%	100	601	8	1,423	904
Field 65E	Yolo	Diesel	unknown	250	T0	3,195	6%	139	837	8	1,423	19,952
Field 66C	Yolo	Electric	unknown	150	n/a	1,620	3%	71	424	8	1,423	n/a
Field 81D	Colusa	Diesel	unknown	400	T0	4,250	7%	186	1,113	8	1,423	31,923
Field 81E	Colusa	Diesel	unknown	400	T0	4,250	7%	186	1,113	8	1,423	31,923
Field 90B	Colusa	Electric	unknown	125	n/a	2,295	4%	100	601	8	1,423	n/a
Field 92C	Colusa	Diesel	unknown	250	T0	1,440	3%	63	377	8	1,423	19,952
Well#1	Colusa	Electric	unknown	100	n/a	2,550	4%	111	668	8	1,423	n/a
Well #4	Colusa	Electric	unknown	150	n/a	1,250	2%	55	327	8	1,423	n/a
Well #5	Colusa	Electric	unknown	250	n/a	4,950	9%	216	1,297	8	1,423	n/a
Well #6	Yolo	Electric	unknown	250	n/a	3,375	6%	147	884	8	1,423	n/a
Well#7	Yolo	Electric	unknown	250	n/a	3,195	6%	139	837	8	1,423	n/a
Total						**57,265**	**100%**	**2,500**	**15,000**	**153**	**28,451**	**145,766**
Total (Colusa County)						**43,585**	**76%**	**1,903**	**11,417**	**115**	**21,338**	**124,910**
Total (Yolo County)						**13,680**	**24%**	**597**	**3,583**	**38**	**7,113**	**20,856**

Well	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane: VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day): VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year): VOC	NOx	CO	SOx	PM10	PM2.5
Field 1	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	1.77	3.54	7.08	0.00	0.02	0.02	0.16	0.33	0.66	0.00	0.00	0.00
Field 100H	1.1	14.1	3.0	0.93	0.15	0.15	4.81	59.27	12.77	3.92	0.63	0.62	0.45	5.51	1.19	0.36	0.06	0.06
Field 100L1 East																		
Field 93A	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	4.22	8.43	16.86	0.00	0.04	0.04	0.39	0.78	1.57	0.00	0.00	0.00
Field 100M	1.1	14.1	3.0	0.93	0.15	0.15	4.61	56.90	12.26	3.76	0.61	0.59	0.43	5.29	1.14	0.35	0.06	0.06
Field 107F																		
Field 125A	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	3.37	6.74	13.49	0.00	0.04	0.04	0.31	0.63	1.25	0.00	0.00	0.00
Field 4																		
Field 53E	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	4.22	8.43	16.86	0.00	0.05	0.05	0.39	0.78	1.57	0.00	0.00	0.00
Field 65E	1.1	14.1	3.0	0.93	0.15	0.15	4.81	59.27	12.77	3.92	0.63	0.62	0.45	5.51	1.19	0.36	0.06	0.06
Field 66C																		
Field 81D	1.1	14.1	3.0	0.93	0.15	0.15	7.69	94.84	20.44	6.27	1.01	0.99	0.72	8.82	1.90	0.58	0.09	0.09
Field 81E	1.1	14.1	3.0	0.93	0.15	0.15	7.69	94.84	20.44	6.27	1.01	0.99	0.72	8.82	1.90	0.58	0.09	0.09
Field 90B																		
Field 92C	1.1	14.1	3.0	0.93	0.15	0.15	4.81	59.27	12.77	3.92	0.63	0.62	0.45	5.51	1.19	0.36	0.06	0.06
Well#1																		
Well #4																		
Well #5																		
Well #6																		
Well#7																		
Total							**47.99**	**451.54**	**145.74**	**28.07**	**4.68**	**4.57**	**4.46**	**41.99**	**13.55**	**2.61**	**0.43**	**0.42**
Total (Colusa County)							**38.97**	**383.84**	**116.11**	**24.15**	**4.00**	**3.90**	**3.62**	**35.70**	**10.80**	**2.25**	**0.37**	**0.36**
Total (Yolo County)							**9.02**	**67.70**	**29.63**	**3.92**	**0.68**	**0.67**	**0.84**	**6.30**	**2.76**	**0.36**	**0.06**	**0.06**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa	Yolo	Yuba
PM10	A	A	
PM2.5	A	N	
O3	A	N	

Engines subject to ATCM.

Peak Month
2,500 AF/month
18,249 gallons/minute
32% peak pump rate

Legend
Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 1004		Peak Pumping by Transfer Period	
Transfer Volume	0 acre-feet	(Apr-Jun)	0	AF/month
	7,175 acre-feet	(Jul-Sep)	2,733	AF/month
	7,175 acre-feet/year			

Table E-43. Reclamation District 1004 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	1	7	0	0	8
Colusa	17	5	0	0	22
Sutter	0	0	0	0	0
Total	18	12	0	0	30

Table E-44. Reclamation District 1004 Criteria Pollutant Emissions

	Well Location			Power Rating	Emission	Pump Rate		Transfer Volume		Operations		Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (pounds per day)						Annual Emissions (tons per year)					
Well	(County)	Fuel Type	Model Year	(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Barale Well	Colusa	Diesel	TBD	225	T0	4,000	4%	108	285	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Behring Ranch 10 Field Well No. 496441	Colusa	Diesel	2,008	225	T3	5,800	6%	157	413	5	387	4,880	0.1	2.8	2.6	0.93	0.15	0.15	0.35	6.68	6.15	2.19	0.35	0.35	0.01	0.27	0.25	0.09	0.01	0.01
Behring Ranch Club House Well No.496461	Colusa	Electric	unknown	125	n/a	3,400	3%	92	242	5	387	n/a																		
Behring Ranch Nursery Well No. 17N1W10H1	Colusa	Diesel	TBD	225	T0	1,000	1%	27	71	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Behring Ranch Pearl Well No. 20094	Colusa	Diesel	TBD	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Behring Ranch Well	Colusa	Electric	unknown	125	n/a	4,000	4%	108	285	5	387	n/a																		
Behring Ranch West Well No.97863	Colusa	Electric	unknown	125	n/a	2,300	2%	62	164	5	387	n/a																		
Claudia Charter	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Dan Charter Well#1	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Dan Charter Well#2	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Drumheller Well No.7	Colusa	Diesel	TBD	225	T0	4,000	4%	108	285	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
East Morgan Well #1 No. 374667 17N01W14N001M	Colusa	Diesel	TBD	225	T0	2,600	3%	71	185	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
East Morgan Well#2 No. 498195 17N01W15Q001M	Colusa	Diesel	TBD	225	T0	1,300	1%	35	93	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Gardener No. 374672	Colusa	Diesel	2,008	215	T3	3,500	3%	95	249	5	387	4,663	0.1	2.8	2.6	0.93	0.15	0.15	0.34	6.39	5.88	2.09	0.34	0.34	0.01	0.26	0.24	0.09	0.01	0.01
Gardener No. 498178	Colusa	Diesel	2,009	215	T3	3,500	3%	95	249	5	387	4,663	0.1	2.8	2.6	0.93	0.15	0.15	0.34	6.39	5.88	2.09	0.34	0.34	0.01	0.26	0.24	0.09	0.01	0.01
Glenn East	Glenn	Electric	unknown	300	n/a	4,500	4%	122	320	5	387	n/a																		
Glenn West	Glenn	Electric	unknown	300	n/a	4,500	4%	122	320	5	387	n/a																		
GVL Well#1	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
GVL Well#2	Colusa	Diesel	unknown	225	T0	2,500	2%	68	178	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Hall Well No. X	Glenn	Electric	TBD	125	n/a	4,500	4%	122	320	5	387	n/a																		
Hall Well No.369428	Glenn	Electric	2,011	125	n/a	4,500	4%	122	320	5	387	n/a																		
Mohammad No.e0084085 17N01W02D001M	Colusa	Electric	TBD	125	n/a	4,500	4%	122	320	5	387	n/a																		
Myers Well #1 No.3457	Glenn	Electric	2,006	40	n/a	2,200	2%	60	157	5	387	n/a																		
Myers Well #2 No. 340884	Glenn	Electric	1,982	100	n/a	4,100	4%	111	292	5	387	n/a																		
Rancho Caleta No. 726883	Colusa	Diesel	2,004	170	T2	4,500	4%	122	320	5	387	3,687	0.2	4.7	3.7	0.93	0.22	0.22	0.44	8.33	6.64	1.66	0.40	0.40	0.02	0.34	0.27	0.07	0.02	0.02
Sikes & Parachini Well #1 WS No.93124	Colusa	Diesel	2,006	173	T2	4,000	4%	108	285	5	387	3,752	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.48	6.76	1.68	0.41	0.41	0.02	0.34	0.28	0.07	0.02	0.02
Sikes & Parachini Well #2 WS No. 374682	Colusa	Diesel	2,008	150	T3	4,000	4%	108	285	5	387	3,253	0.1	2.8	3.7	0.93	0.22	0.22	0.23	4.45	5.86	1.46	0.35	0.35	0.01	0.18	0.24	0.06	0.01	0.01
Southam Sartain Well 18N01W26D001M	Glenn	Diesel	TBD	225	T0	4,800	5%	130	342	5	387	4,880	1.1	14.1	3.0	0.93	0.15	0.15	2.69	33.13	7.14	2.19	0.35	0.34	0.11	1.35	0.29	0.09	0.01	0.01
Stone Well #6 No.11334	Colusa	Electric	2,006	40	n/a	1,800	2%	49	128	5	387	n/a																		
Wilder Farms Well	Glenn	Electric	unknown	125	n/a	2,500	2%	68	178	5	387	n/a																		
					Total	**100,800**	**100%**	**2,733**	**7,175**	**143**	**11,597**	**83,452**							**34**	**438**	**123**	**37**	**6**	**6**	**1**	**18**	**5**	**2**	**0**	**0**
					Total (Glenn County)	**31,600**	**31%**	**857**	**2,249**	**38**	**3,093**	**4,880**							**2.69**	**33.13**	**7.14**	**2.19**	**0.35**	**0.34**	**0.11**	**1.35**	**0.29**	**0.09**	**0.01**	**0.01**
					Total (Colusa County)	**69,200**	**69%**	**1,876**	**4,926**	**105**	**8,505**	**78,572**							**31.70**	**405.20**	**115.72**	**35.28**	**6.07**	**5.97**	**1.29**	**16.49**	**4.71**	**1.44**	**0.25**	**0.24**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Glenn	Colusa	Sutter
PM10	A	A	A
PM2.5	A	A	M
O3	A	A	N

Engines subject to ATCM.

Peak Month
2,733 AF/month
19,952 gallons/minute
20% peak pump rate

Legend

(green shading)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
(orange shading)	Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	River Garden Farms			Peak Pumping by Transfer Period
Transfer Volume	5,000 acre-feet	(Apr-Jun)		3,000 AF/month
	5,000 acre-feet	(Jul-Sep)		1,905 AF/month
	10,000 acre-feet/year			

Table E-45. River Garden Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	10	0	0	10
Total	0	10	0	0	10

Table E-46. River Garden Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
F-1	Yolo	Electric	unknown	150	n/a	3,400	11%	344	1,147	18	1,832
Field 104 PW	Yolo	Electric	2008	200	n/a	2,800	9%	283	945	18	1,832
Field 104-09 PW	Yolo	Electric	2009	200	n/a	3,276	11%	332	1,105	18	1,832
Field 117 PW	Yolo	Electric	2009	200	n/a	2,800	9%	283	945	18	1,832
Field 65 PW	Yolo	Electric	2008	200	n/a	3,200	11%	324	1,080	18	1,832
Field 71 PW	Yolo	Electric	2001	200	n/a	2,200	7%	223	742	18	1,832
Field 91-09 PW	Yolo	Electric	2009	200	n/a	3,300	11%	334	1,113	18	1,832
Field 93 PW	Yolo	Electric	unknown	200	n/a	2,200	7%	223	742	18	1,832
Field 98 PW	Yolo	Electric	1963	200	n/a	3,177	11%	322	1,072	18	1,832
Shop PW	Yolo	Electric	2009	200	n/a	3,287	11%	333	1,109	18	1,832
					Total	**29,640**	**100%**	**3,000**	**10,000**	**177**	**18,323**
					Total (Yolo County)	**29,640**	**100%**	**3,000**	**10,000**	**177**	**18,323**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Yolo
PM10	A
PM2.5	N
O3	N

Engines subject to ATCM.

Peak Month
3,000 AF/month
21,899 gallons/minute
74% peak pump rate

Legend
(shaded cell) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Roberts Ditch Irrigation Company		Peak Pumping by Transfer Period	
Transfer Volume	2,214 acre-feet	(Apr-Jun)	738	AF/month
	1,886 acre-feet	(Jul-Sep)	629	AF/month
	4,100 acre-feet/year			

Table E-47. Roberts Ditch Irrigation Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	7	0	1	8
Total	0	7	0	1	8

Table E-48. Roberts Ditch Irrigation Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane
Andreotti	Colusa	Propane	unknown	200	n/a	2,200	11%	80	447	6	1,102	561
Ash	Colusa	Electric	unknown	250	n/a	1,500	7%	55	304	6	1,102	n/a
Hickel	Colusa	Electric	unknown	250	n/a	1,300	6%	47	264	6	1,102	n/a
Stegals	Colusa	Electric	unknown	250	n/a	1,800	9%	66	365	6	1,102	n/a
Well #1	Colusa	Electric	unknown	350	n/a	4,500	22%	164	913	6	1,102	n/a
Well #2	Colusa	Electric	unknown	350	n/a	4,500	22%	164	913	6	1,102	n/a
Yearxa North	Colusa	Electric	unknown	250	n/a	2,200	11%	80	447	6	1,102	n/a
Yearxa South	Colusa	Electric	unknown	250	n/a	2,200	11%	80	447	6	1,102	n/a
Total						**20,200**	**100%**	**738**	**4,100**	**51**	**8,818**	**561**
Total (Colusa County)						**20,200**	**100%**	**738**	**4,100**	**51**	**8,818**	**561**

Well	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane						Daily Emissions (pounds per day)						Annual Emissions (tons per year)					
	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Andreotti	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	2.82	5.64	11.29	0.00	0.03	0.03	0.24	0.49	0.97	0.00	0.00	0.00
Ash																		
Hickel																		
Stegals																		
Well #1																		
Well #2																		
Yearxa North																		
Yearxa South																		
Total							**2.82**	**5.64**	**11.29**	**0.00**	**0.03**	**0.03**	**0.24**	**0.49**	**0.97**	**0.00**	**0.00**	**0.00**
Total (Colusa County)							**2.82**	**5.64**	**11.29**	**0.00**	**0.03**	**0.03**	**0.24**	**0.49**	**0.97**	**0.00**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa		
PM10	A	A	A
PM2.5	A	A	M
O3	A	A	N

Engines subject to ATCM.

Peak Month
738 AF/month
5,387 gallons/minute
27% peak pump rate

Legend
Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
Emission factors based on NMHC+NOx standard

Conversion Factors
1 bhp-hr = 2,542.5 Btu
1 lb = 453.6 g
1 ton = 2,000 lbs
1 kW = 1.34 hp
1 day = 24 hours
1 month = 31 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sutter Mutual Water Company			Peak Pumping by Transfer Period	
Transfer Volume	8,000 acre-feet	(Apr-Jun)		3,200	AF/month
	10,000 acre-feet	(Jul-Sep)		4,000	AF/month
	18,000 acre-feet/year				

Table E-47. Sutter Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	27	10	0	7	44
Colusa	1	0	0	0	1
Total	28	10	0	7	45

Table E-48. Sutter Mutual Water Company Criteria Pollutant Emissions

Well	Well Location	Fuel Type	Model Year	Power Rating	Emission	Pump Rate		Transfer Volume		Operations		Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (pounds per day)						Annual Emissions (tons per year)					
	(County)			(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr) - diesel (MMBtu/yr) - propane	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Ag Industries - Sioux Creek	Sutter	Diesel	unknown	350	T0	2,800	2%	79	354	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
Ag Industries - Sutter Basin	Sutter	Diesel	unknown	350	T0	3,000	2%	84	379	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
BD-1	Sutter	Diesel	unknown	225	T0	2,500	2%	70	316	5	686	8,665	1.1	14.1	3.0	0.93	0.15	0.15	2.78	34.32	7.40	2.27	0.37	0.36	0.19	2.39	0.52	0.16	0.03	0.02
BD-2	Sutter	Diesel	unknown	225	T0	4,000	3%	112	506	5	686	8,665	1.1	14.1	3.0	0.93	0.15	0.15	2.78	34.32	7.40	2.27	0.37	0.36	0.19	2.39	0.52	0.16	0.03	0.02
BD-3	Sutter	Propane	unknown	250	n/a	3,000	2%	84	379	5	686	436	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	2.71	5.42	10.85	0.00	0.03	0.03	0.19	0.38	0.76	0.00	0.00	0.00
DB-1	Sutter	Diesel	unknown	350	T0	4,500	3%	126	569	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
Driver	Colusa	Diesel	unknown	350	T0	2,500	2%	70	316	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
F4N	Sutter	Diesel	unknown	290	T0	3,500	2%	98	442	5	686	11,169	1.1	14.1	3.0	0.93	0.15	0.15	3.59	44.24	9.53	2.93	0.47	0.46	0.25	3.09	0.66	0.20	0.03	0.03
FG	Sutter	Propane	unknown	250	n/a	1,500	1%	42	190	5	686	436	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	2.71	5.42	10.85	0.00	0.03	0.03	0.19	0.38	0.76	0.00	0.00	0.00
FT5	Sutter	Diesel	unknown	450	T0	5,200	4%	146	657	5	686	17,331	1.1	14.1	3.0	0.93	0.15	0.15	5.57	68.65	14.79	4.54	0.73	0.71	0.39	4.79	1.03	0.32	0.05	0.05
G-16	Sutter	Electric	unknown	250	n/a	4,200	3%	118	531	5	686	n/a																		
G-2	Sutter	Propane	unknown	125	n/a	3,500	2%	98	442	5	686	218	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	1.36	2.71	5.42	0.00	0.02	0.02	0.09	0.19	0.38	0.00	0.00	0.00
H-1	Sutter	Electric	unknown	150	n/a	2,600	2%	73	329	5	686	n/a																		
Hoppin	Sutter	Electric	unknown	250	n/a	2,500	2%	70	316	5	686	n/a																		
L&N Farms	Sutter	Diesel	unknown	170	T2	5,000	4%	140	632	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
L1-1	Sutter	Diesel	unknown	350	T0	4,000	3%	112	506	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
L1-2	Sutter	Diesel	unknown	350	T0	5,000	4%	140	632	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
L2-1	Sutter	Diesel	unknown	350	T0	5,500	4%	154	695	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
LM-11	Sutter	Electric	unknown	150	n/a	3,100	2%	87	392	5	686	n/a																		
LM-53	Sutter	Electric	unknown	150	n/a	4,000	3%	112	506	5	686	n/a																		
Matteoli	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
MB-1	Sutter	Propane	unknown	268	n/a	5,300	4%	149	670	5	686	468	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	2.91	5.81	11.63	0.00	0.03	0.03	0.20	0.41	0.81	0.00	0.00	0.00
ME-1	Sutter	Diesel	unknown	350	T0	1,300	1%	37	164	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
QHR	Sutter	Propane	unknown	250	n/a	5,200	4%	146	657	5	686	436	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	2.71	5.42	10.85	0.00	0.03	0.03	0.19	0.38	0.76	0.00	0.00	0.00
R-24	Sutter	Diesel	unknown	350	T0	2,500	2%	70	316	5	686	13,479	1.1	14.1	3.0	0.93	0.15	0.15	4.33	53.39	11.51	3.53	0.57	0.56	0.30	3.72	0.80	0.25	0.04	0.04
R-29	Sutter	Diesel	unknown	150	T0	2,500	2%	70	316	5	686	5,777	1.1	14.1	3.0	0.93	0.22	0.21	1.86	22.88	4.93	1.51	0.36	0.35	0.13	1.60	0.34	0.11	0.02	0.02
S-18	Sutter	Electric	unknown	100	n/a	2,700	2%	76	341	5	686	n/a																		
TVN	Sutter	Electric	unknown	75	n/a	3,000	2%	84	379	5	686	n/a																		
VR-57	Sutter	Diesel	unknown	450	T0	5,500	4%	154	695	5	686	17,331	1.1	14.1	3.0	0.93	0.15	0.15	5.57	68.65	14.79	4.54	0.73	0.71	0.39	4.79	1.03	0.32	0.05	0.05
Well #1	Sutter	Electric	unknown	250	n/a	2,500	2%	70	316	5	686	n/a																		
Well #10	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #11	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #12	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #13	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #14	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #15	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #16	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #2	Sutter	Electric	unknown	150	n/a	2,500	2%	70	316	5	686	n/a																		
Well #3	Sutter	Electric	unknown	150	n/a	2,500	2%	70	316	5	686	n/a																		
Well #4	Sutter	Propane	unknown	150	n/a	2,500	2%	70	316	5	686	262	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	1.63	3.25	6.51	0.00	0.02	0.02	0.11	0.23	0.45	0.00	0.00	0.00
Well #5	Sutter	Propane	unknown	180	n/a	2,500	2%	70	316	5	686	314	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	1.95	3.91	7.81	0.00	0.02	0.02	0.14	0.27	0.54	0.00	0.00	0.00
Well #6	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #7	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #8	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
Well #9	Sutter	Diesel	unknown	170	T2	2,500	2%	70	316	5	686	6,547	0.2	4.7	3.7	0.93	0.22	0.22	0.45	8.63	6.88	1.71	0.41	0.41	0.03	0.60	0.48	0.12	0.03	0.03
					Total	**142,400**	**100%**	**4,000**	**18,000**	**221**	**30,892**	**277,935**							**83.00**	**897.75**	**315.77**	**72.14**	**13.70**	**13.51**	**5.79**	**62.62**	**22.03**	**5.03**	**0.96**	**0.94**
					Total (Sutter County)	**139,900**	**98%**	**3,930**	**17,684**	**217**	**30,205**	**264,455**							**78.67**	**844.36**	**304.27**	**68.61**	**13.14**	**12.95**	**5.49**	**58.89**	**21.22**	**4.79**	**0.92**	**0.90**
					Total (Colusa County)	**2,500**	**2%**	**70**	**316**	**5**	**686**	**13,479**							**4.33**	**53.39**	**11.51**	**3.53**	**0.57**	**0.56**	**0.30**	**3.72**	**0.80**	**0.25**	**0.04**	**0.04**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter	Colusa
PM10	A	
PM2.5	M	
O3	N	

Engines subject to ATCM.

Peak Month
4,000 AF/month
29,198 gallons/minute
21% peak pump rate

Legend
- (green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
- (red) Tier 4 Exhaust Emission Standards, Phase-In (100<=hp<=175, 2012-2014 model year)
- (blue) Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
- (lavender) Engine tier adjusted to be consistent with minimum emission standard required to meet requirements of 17 CCR 93115.
- (orange) Emission factors based on NMHC+NOx standard
- (grey-blue) Engine information not provided and assumed to be diesel as worst-case scenario

Conversion Factors
1 bhp-hr = 2,542.5 Btu
1 lb = 453.6 g
1 ton = 2,000 lbs
1 kW = 1.34 hp
1 day = 24 hours
1 month = 31 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Swenson Farms			Peak Pumping by Transfer Period
Transfer Volume	702	acre-feet	(Apr-Jun)	234 AF/month
	598	acre-feet	(Jul-Sep)	199 AF/month
	1,300	acre-feet/year		

Table E-49. Swenson Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	1	0	0	1
Total	0	1	0	0	1

Table E-50. Swenson Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
Well 1	Colusa	Electric	unknown	300	n/a	3,500	100%	234	1,300	12	2,017
					Total	**3,500**	**100%**	**234**	**1,300**	**12**	**2,017**
					Total (Colusa County)	**3,500**	**100%**	**234**	**1,300**	**12**	**2,017**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa		
PM10	A	A	A
PM2.5	A	A	M
O3	A	A	N

Engines subject to ATCM.

Peak Month
234 AF/month
1,708 gallons/minute
49% peak pump rate

Legend
Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel t
Emission factors based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sycamore Mutual Water Company			Peak Pumping by Transfer Period
Transfer Volume	4,000 acre-feet	(Apr-Jun)		2,400 AF/month
	4,000 acre-feet	(Jul-Sep)		1,520 AF/month
	8,000 acre-feet/year			

Table E-51. Sycamore Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	5	0	0	5
Total	0	5	0	0	5

Table E-52. Sycamore Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr)
Well #11	Colusa	Electric	unknown	125	n/a	6,409	29%	696	2,320	19	1,966	n/a
Well #14	Colusa	Electric	unknown	125	n/a	3,270	15%	355	1,183	19	1,966	n/a
Well #15	Colusa	Electric	unknown	125	n/a	3,270	15%	355	1,183	19	1,966	n/a
Well #2a	Colusa	Electric	unknown	125	n/a	4,578	21%	497	1,657	19	1,966	n/a
Well #2b	Colusa	Electric	unknown	125	n/a	4,578	21%	497	1,657	19	1,966	n/a
					Total	**22,104**	**100%**	**2,400**	**8,000**	**95**	**9,828**	**0**
					Total (Colusa County)	**22,104**	**100%**	**2,400**	**8,000**	**95**	**9,828**	**0**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
2,400 AF/month
17,519 gallons/minute
79% peak pump rate

Legend
(shaded) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	T&P Farms		
Transfer Volume	650 acre-feet	(Apr-Jun)	217 AF/month
	550 acre-feet	(Jul-Sep)	183 AF/month
	1,200 acre-feet/year		

Peak Pumping by Transfer Period: 217 AF/month; 183 AF/month

Table E-53. T&P Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	0	2
Total	0	2	0	0	2

Table E-54. T&P Farms Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
NW-1	Colusa	Electric	unknown	125	n/a	3,500	58%	126	700	6	1,086
NW-2	Colusa	Electric	unknown	75	n/a	2,500	42%	90	500	6	1,086
					Total	**6,000**	**100%**	**217**	**1,200**	**13**	**2,172**
					Total (Colusa County)	**6,000**	**100%**	**217**	**1,200**	**13**	**2,172**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Colusa
PM10	A
PM2.5	A
O3	A

Engines not subject to ATCM if remotely-located.

Peak Month
217 AF/month
1,582 gallons/minute
26% peak pump rate

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Te Velde Revocable Family Trust			Peak Pumping by Transfer Period
Transfer Volume	2,700	acre-feet	(Apr-Jun)	1,605 AF/month
	4,394	acre-feet	(Jul-Sep)	1,674 AF/month
	7,094	acre-feet/year		

Table E-55. Te Velde Revocable Family Trust Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	4	0	0	4
Total	0	4	0	0	4

Table E-56. Te Velde Revocable Family Trust Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
GW1	Yolo	Electric	unknown	150	n/a	4,200	32%	533	2,257	22	2,919
GW10	Yolo	Electric	unknown	150	n/a	3,000	23%	380	1,612	22	2,919
GW11	Yolo	Electric	unknown	150	n/a	3,000	23%	380	1,612	22	2,919
GW4	Yolo	Electric	unknown	150	n/a	3,000	23%	380	1,612	22	2,919
					Total	**13,200**	**100%**	**1,674**	**7,094**	**89**	**11,675**
					Total (Yolo County)	**13,200**	**100%**	**1,674**	**7,094**	**89**	**11,675**

Note: All wells are electric; therefore, no local criteria pollutant emissions.

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Yolo
PM10	A
PM2.5	N
O3	N

Engines subject to ATCM.

Peak Month
1,674 AF/month
12,219 gallons/minute
93% peak pump rate

Legend
[shaded cell] Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Windswept Land & Livestock		
Transfer Volume	1,000 acre-feet	(Apr-Jun)	
	1,000 acre-feet	(Jul-Sep)	
	2,000 acre-feet/year		

Peak Pumping by Transfer Period
333 AF/month
333 AF/month

Table E-57. Windswept Land & Livestock Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	4	0	0	4
Total	0	4	0	0	4

Table E-58. Windswept Land & Livestock Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)
NCW-1	Sutter	Electric	2013	200	n/a	3,200	30%	100	598	5	1,015
NCW-2	Sutter	Electric	unknown	200	n/a	3,000	28%	93	561	5	1,015
NCW-3	Sutter	Electric	unknown	200	n/a	2,500	23%	78	467	5	1,015
NCW-4	Sutter	Electric	unknown	200	n/a	2,000	19%	62	374	5	1,015
					Total	**10,700**	**100%**	**333**	**2,000**	**22**	**4,060**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
333 AF/month
2,433 gallons/minute
23% peak pump rate

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Table 64. Engine Tier Matrix

HP Range	Year																			
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
hp <11	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
11<=hp<25	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
25<=hp<50	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
50<=hp<75	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
75<=hp<100	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T4I	T4I	T4I	T4
100<=hp<175	T0	T0	T0	T0	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4
175<=hp<300	T1	T1	T1	T1	T1	T1	T1	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
300<=hp<600	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
600<=hp<750	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
hp>750	T0	T0	T0	T0	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4

Key:

T0 = Tier 0 (Noncertified)
T1 = Tier 1
T2 = Tier 2
T3 = Tier 3
T4 = Tier 4
T4I = Tier 4 Interim

CARB Airborne Toxic Control Measure (ATCM) for Stationary Compression Ignition Engines

Table 59. Summary of the Emission Standards for New Stationary Diesel-Fueled CI Engines > 50 BHP used in Agricultural Operations

Horsepower Range	Diesel PM [1] (g/bhp-hr)	HC (g/bhp-hr)	NOx (g/bhp-hr)	NMHC+NOx (g/bhp-hr)	CO (g/bhp-hr)
50<HP<100	0.3				
100<=HP<175	0.22				
175<=HP	0.15				

Source: See Section 93115.8(a)
Notes:
[1] Less than or equal to the emission standard OR Off-Road CI Engine Certification Standard for an off-road engine of the maximum rated power, whichever is more stringent.

[2] Off-Road CI Engine Certification Standard for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard, or Tier 1 standards.
[3] Prior to January 1, 2008, these limits shall not apply to engines sold from one agricultural operation to another and funded under State or federal incentive.

Table 60. Emission Standards for Noncertified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower (HP) Range	Compliance Date [1]	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2011	0.3				
75<=HP<100	2011	0.3				
100<=HP<175	2010	0.22				
175<=HP<=750	2010	0.15				
750<HP	2014	0.075				

Source: See Sections 93115.8(b) (2) and (4)
Note:
[1] Compliance date on or after December 31
[2] Engine Certification Standards for off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.
[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in an agricultural operation shall not exceed Tier 1 standards in Title 13.

Table 61. Emission Standards Tier 1- and Tier 2-Certified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower Range (hp)	Compliance Date	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2015	0.02				
75<=HP<175	2015	0.01				
175<=hp<=750	2014	0.01				
750<HP	2014	0.075				

Source: See Sections 93115.8(b)(3) and (4)
Notes:
[1] Compliance date on or after December 31 or 12 years after the date of initial installation, whichever is later.
[2] Off-Road CI Engine Certification Standards for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.
[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in agricultural operation shall not exceed Tier 1 standards in Tier 13, CCR, section 2423 for an off-road engine of the same maximum rated power irrespective of model year.

Table 62. Tier 1, Tier 2, and Tier 3 Exhaust Emission Standards

Maximum Rated Power	Tier	Model Year	(g/kW-hr)					(g/hp-hr)				
			NOx	HC	NMHC+NOx	CO	PM	NOx	HC	NMHC+NOx	CO	PM
kW<8	T1	2000-2004	-	-	10.5	8.0	1	-	-	7.8	6.0	0.75
hp <11	T2	2005 -2007	-	-	7.5	8.0	0.8	-	-	5.6	6.0	0.60
8≤kW<19	T1	2000-2004	-	-	9.5	6.6	0.8	-	-	7.1	4.9	0.60
11<=hp<25	T2	2005 -2007	-	-	7.5	6.6	0.8	-	-	5.6	4.9	0.60
19≤kW<37	T1	2000-2003	-	-	9.5	5.5	0.8	-	-	7.1	4.1	0.60
25<=hp<50	T2	2004 -2007	-	-	7.5	5.5	0.6	-	-	5.6	4.1	0.45
37≤kW<56	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
50<=hp<75	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.30
	T3	2008 -2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.30
56≤kW<75	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
75<=hp<100	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.30
	T3	2008-2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.30
75≤kW<130	T1	2000-2002	9.2	-	-	-	-	6.9	-	-	-	-
100<=hp<175	T2	2003-2006	-	-	6.6	5.0	0.3	-	-	4.9	3.7	0.22
	T3	2007 -2011	-	-	4.0	5.0	0.3	-	-	3.0	3.7	0.22
130≤kW<225	T1	1996-2002	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
175<=hp<300	T2	2003-2005	-	-	6.6	3.5	0.2	-	-	4.9	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
225≤kW<450	T1	1996-2000	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
300<=hp<600	T2	2001-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
450≤kW≤560	T1	1996-2001	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
600<=hp<750	T2	2002-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
kW>560	T1	2000-2005	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
hp>750	T2	2006 -2010	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15

Source: Title 13, California Code of Regulations, Division 3, Chapter 9, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

NOx and NMHC fraction - Table B-26

NOx	95%
NMHC	5%

http://www.arb.ca.gov/msprog/moyer/guidelines/cmp_guidelines_part4.pdf

PM Size Fractions

PM10	0.96
PM2.5	0.937
Ratio	0.98

CARB PMSIZE Profile No. 116 (STAT. I.C. ENGINE-DIESEL)

Table 63. Tier 4 Exhaust Emission Standards

MAXIMUM ENGINE POWER	MODEL YEAR	TYPE	PM	NMHC+ NOx	NMHC	NOx	CO
			grams per horsepower-hour				
hp<11 11<=hp<25	2008 and later	FINAL	0.30	5.6	-	-	6.0 4.9
25<=hp<50	2008-2012 2013 and later	INTERIM FINAL	0.22 0.02	5.6 3.5	-	-	4.1
50<=hp<75	2008-2012 2013 and later	INTERIM FINAL	0.22 0.02	3.5	-	-	3.7
75<=hp<100	2012-2014 2015 and later	PHASE-IN PHASE-OUT or/ ALT NOx FINAL	0.01	- 3.5 -	0.14 - 0.14	0.3 - 2.5 0.3	3.7
100<=hp<175	2012-2014 2015 and later	PHASE-IN PHASE-OUT or/ ALT NOx FINAL	0.01	- 3.0 -	0.14 - 0.14 0.14	0.3 - 2.5 0.3	3.7
175<=hp<=750	2011-2013 2014 and later	PHASE-IN PHASE-OUT or/ ALT NOx FINAL	0.01	- 3.0 -	0.14 - 0.14	0.3 - 1.5 0.3	2.6
750 hp<GEN<=1205 hp	2011-2014 2015 and later	INTERIM FINAL	0.07 0.02	-	0.30 0.14	2.6 0.5	2.6
GEN>1205 hp	2011-2014 2015 and later	INTERIM FINAL	0.07 0.02	-	0.30 0.14	 0.5	2.6
ELSE>750 hp	2011-2014 2015 and later	INTERIM FINAL	0.07 0.03	- -	0.30 0.14	2.6	2.6

Source: Title 13, California Code of Regulations, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

AP-42 Emission Factors

Table 65. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines [a]

Pollutant	Gasoline Fuel Emission Factor (lb/hp-hr) (power output)	Gasoline Fuel Emission Factor (lb/MMBtu) (fuel input)	Diesel Fuel Emission Factor (lb/hp-hr) (power output)	Diesel Fuel Emission Factor (lb/MMBtu) (fuel input)	Emission Factor Rating
NOx	0.011	1.63	0.031	4.41	D
CO	6.96E-03 [d]	0.99 [d]	6.68E-03	0.95	D
SOx	5.91E-04	0.084	2.05E-03	0.29	D
PM-10 [b]	7.21E-04	0.1	2.20E-03	0.31	D
CO2 [c]	1.08	154	1.15	164	B
Aldehydes	4.85E-04	0.07	4.63E-04	0.07	D
TOC					
Exhaust	0.015	2.1	2.47E-03	0.35	D
Evaporative	6.61E-04	0.09	0.00	0.00	E
Crankcase	4.85E-03	0.69	4.41E-05	0.01	E
Refueling	1.08E-03	0.15	0.00	0.00	E

Source: U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.3: Gasoline and Diesel Industrial Engines.

Notes:

[a] References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kwhr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.

[b] PM-10 = particulate matter less than or equal to 10 :m aerodynamic diameter. All particulate is assumed to be 10 µm in size.

[c] Assumes 99% conversion of carbon in fuel to CO2 with 87 weight % carbon in diesel, 86 weight % carbon in gasoline, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and gasoline heating value of 20,300 Btu/lb.

[d] Instead of 0.439 lb/hp-hr (power output) and 62.7 lb/mmBtu (fuel input), the correct emissions factors values are 6.96 E-03 lb/hp-hr (power output) and 0.99 lb/mmBtu (fuel input), respectively. This is an editorial correction. March 24, 2009

For large stationary diesel engines (greater than 600 horsepower [hp]) see Chapter 3.4: Large Stationary Diesel and All Stationary Dual-Fuel Engines.

Table 66. Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines [a]

Pollutant	Emission Factor (lb/MMBtu) [b] (fuel input)	Emission Factor Rating
NOx [c] 90 - 105% Load	4.08E+00	B
NOx [c] <90% Load	8.47E-01	B
CO [c] 90 - 105% Load	3.17E-01	C
CO [c] <90% Load	5.57E-01	B
CO2 [d]	1.10E+02	A
SO2 [e]	5.88E-04	A
TOC [f]	1.47E+00	A
Methane[g]	1.25E+00	C
VOC [h]	1.18E-01	C
PM10 (filterable) [i]	7.71E-05	D
PM2.5 (filterable) [i]	7.71E-05	D
PM Condensable [j]	9.91E-03	D

Source: U.S. Environmental Protection Agency. 2000. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.2: Natural Gas-Fired Reciprocating Engines. July.

Notes:

[a] Reference 7. Factors represent uncontrolled levels. For NOx, CO, and PM10, “uncontrolled” means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, the data set may include units with control techniques used for NOx control, such as PCC“uncontrolled” means no oxidation control; and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μ) aerodynamic diameter. A “<“ sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

lb/hp-hr = (lb/MMBtu) (heat input, MMBtu/hr) (1/operating HP, 1/hp)

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO2. CO2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60EF).

[e] Based on 100% conversion of fuel sulfur to SO2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered ≤ 1 μ in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

Engine Size Summary

Table 67. Engine Power Rating Summary by Fuel Type

Fuel Type	No. Engines	Avg. HP	Max HP	Min HP
Diesel	23	170	250	60
Electric	47	125	300	30
Natural Gas	0	n/a	0	0
Propane	3	180	250	135

Table E-68. General Conformity Applicability Evaluation (Mitigated Emissions)

County/ Nonattainment Area	Emissions (tons per year)					
	VOC	NOx	CO	SOx	PM10	PM2.5
	Sacramento Metro[1]	Sacramento Metro[1]	Sacramento Area[2]	Sacramento[3,4]	Sacramento Co.	Sacramento[4]
Colusa	n/a	n/a	n/a	n/a	n/a	n/a
Glenn	n/a	n/a	n/a	n/a	n/a	n/a
Sacramento	0.3	1.6	1.4	0.6	0.0	0.0
Shasta	n/a	n/a	n/a	n/a	n/a	n/a
Sutter[5]	4.3	9.8	n/a	7.1	n/a	0.2
Tehama	n/a	n/a	n/a	n/a	n/a	n/a
Yolo	0.8	6.3	2.8	0.4	n/a	0.1
Total	5.4	17.7	4.1	8.0	0.0	0.3
Classification	Severe-15	Severe-15	Maintenance	PM2.5 Precursor	Maintenance	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100
Exceed?	No	No	No	No	No	No

Note:

[1]The Sacramento Metro 8-hour O3 nonattainment area consist of Sacramento and Yolo Counties and parts of El Dorado, Placer, Solano, and Sutter Counties. Emissions occurring within the attainment area of these counties are excluded from the total emissions.

[2]The Sacramento Area CO maintenance area is based on the Census Bureau Urbanized Area and consists of parts of Placer, Sacramento, and Yolo Counties. The general conformity applicability evaluation is based on emissions that would occur within the entire county to be conservative.

[3]All counties are designated as attainment areas for SO2; however, since SO2 is a precursor to PM2.5, its emissions must be evaluated under general conformity.

[4]The 24-hour PM2.5 nonattainment area for Sacramento includes Sacramento County and parts of El Dorado, Placer, Solano, and Yolo Counties. The general conformity applicability analysis assumes that all emissions that could occur within each county would occur within the Sacramento nonattainment area to be conservative.

[5]VOC and NOx emissions are excluded from Cranmore Farms, Pelger Mutual Water Company, and Reclamation District 1004 because they are located in areas designated as attainment for the federal 8-hour O3 NAAQS.

Table E-69. Emissions Outside of 8-Hour Ozone Nonattainment Area (tons per year)

Water Agency	County	VOC	NOx
Pelger Road 1700 LLC	Sutter	All Electric	All Electric
Pelger Mutual Water Company	Sutter	0.0	0.7
Reclamation District 1004	Sutter	No Engines	No Engines
Total		**0.0**	**0.7**

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table E-70. Daily VOC Emissions (Mitigated)

Water Agency	Daily VOC Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	1.85							1.85
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	5.85							5.85
Giusti Farms								0.00
Glenn-Colusa Irrigation District	1.62	1.94						3.56
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			1.79		7.54			9.33
Pelger Mutual Water Company					0.99			0.99
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					7.51			7.51
Princeton-Codora-Glenn Irrigation District	7.65	15.30						22.94
Provident Irrigation District	No Engines	45.45						45.45
Reclamation District 1004	31.70	2.69			No Engines			34.39
Reclamation District 108	38.97						9.02	47.99
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	2.82							2.82
Sutter Mutual Water Company	0.33				11.99			12.32
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**93.27**	**65.37**	**1.79**	**0.00**	**28.03**	**0.00**	**9.02**	**197.49**

Key:
VOC = volatile organic compounds

Table E-71. Daily NOx Emissions (Mitigated)

Water Agency	Daily NOx Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	3.70							3.70
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	49.89							49.89
Giusti Farms								0.00
Glenn-Colusa Irrigation District	20.00	23.89						43.90
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	47.10							47.10
Natomas Central Mutual Water Company			13.46		20.29			33.75
Pelger Mutual Water Company					18.76			18.76
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					21.71			21.71
Princeton-Codora-Glenn Irrigation District	94.31	188.61						282.92
Provident Irrigation District	No Engines	560.46						560.46
Reclamation District 1004	405.20	33.13			No Engines			438.33
Reclamation District 108	383.84						67.70	451.54
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	5.64							5.64
Sutter Mutual Water Company	0.69				24.66			25.35
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**1,010.37**	**806.10**	**13.46**	**0.00**	**85.41**	**0.00**	**67.70**	**1,983.04**

Key:
NOx = nitrogen oxides

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table E-72. Daily CO Emissions (Mitigated)

Water Agency	Daily CO Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	7.40							7.40
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	55.85							55.85
Giusti Farms								0.00
Glenn-Colusa Irrigation District	4.31	5.15						9.46
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	43.38							43.38
Natomas Central Mutual Water Company			7.34		38.11			45.45
Pelger Mutual Water Company					24.68			24.68
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					152.64			152.64
Princeton-Codora-Glenn Irrigation District	20.32	40.64						60.96
Provident Irrigation District	No Engines	120.77						120.77
Reclamation District 1004	115.72	7.14			No Engines			122.86
Reclamation District 108	116.11						29.63	145.74
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	11.29							11.29
Sutter Mutual Water Company	6.05				157.41			163.46
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**380.43**	**173.70**	**7.34**	**0.00**	**372.84**	**0.00**	**29.63**	**963.94**

Key:
CO = carbon monoxide

Table E-73. Daily SOx Emissions (Mitigated)

Water Agency	Daily SOx Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	24.41							24.41
Giusti Farms								0.00
Glenn-Colusa Irrigation District	1.32	1.58						2.90
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	15.44							15.44
Natomas Central Mutual Water Company			5.95		5.05			10.99
Pelger Mutual Water Company					6.15			6.15
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					40.66			40.66
Princeton-Codora-Glenn Irrigation District	6.24	12.47						18.71
Provident Irrigation District	No Engines	37.06						37.06
Reclamation District 1004	35.28	2.19			No Engines			37.47
Reclamation District 108	24.15						3.92	28.07
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	2.15				41.82			43.98
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**109.00**	**53.31**	**5.95**	**0.00**	**93.68**	**0.00**	**3.92**	**265.86**

Key:
SOx = sulfur oxides

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table E-74. Daily PM10 Emissions (Mitigated)

Water Agency	Daily PM10 Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.78							2.78
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.21	0.25						0.47
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			0.05		0.15			0.20
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.09			1.09
Princeton-Codora-Glenn Irrigation District	1.01	2.01						3.02
Provident Irrigation District	No Engines	6.69						6.69
Reclamation District 1004	6.07	0.35			No Engines			6.42
Reclamation District 108	4.00						0.68	4.68
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.03							0.03
Sutter Mutual Water Company	0.03				0.73			0.76
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**16.63**	**9.31**	**0.05**	**0.00**	**3.45**	**0.00**	**0.68**	**30.12**

Key:
PM10 = inhalable particulate matter

Table E-75. Daily PM2.5 Emissions (Mitigated)

Water Agency	Daily PM2.5 Emissions (pounds per day)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.02							0.02
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.78							2.78
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.21	0.25						0.46
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.48							2.48
Natomas Central Mutual Water Company			0.05		0.15			0.20
Pelger Mutual Water Company					1.48			1.48
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.09			1.09
Princeton-Codora-Glenn Irrigation District	0.98	1.96						2.95
Provident Irrigation District	No Engines	6.53						6.53
Reclamation District 1004	5.97	0.34			No Engines			6.32
Reclamation District 108	3.90						0.67	4.57
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.03							0.03
Sutter Mutual Water Company	0.03				0.73			0.76
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**16.42**	**9.08**	**0.05**	**0.00**	**3.45**	**0.00**	**0.67**	**29.67**

Key:
PM2.5 = fine particulate matter

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table E-76. Annual VOC Emissions (Mitigated)

Water Agency	Annual VOC Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.15							0.15
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.32							0.32
Glenn-Colusa Irrigation District	0.15	0.18						0.33
Giusti Farms								0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.34		1.41			1.76
Pelger Mutual Water Company					0.04			0.04
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.82			0.82
Princeton-Codora-Glenn Irrigation District	0.48	0.95						1.43
Provident Irrigation District	No Engines	3.52						3.52
Reclamation District 1004	1.29	0.11			No Engines			1.40
Reclamation District 108	3.62						0.84	4.46
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.24							0.24
Sutter Mutual Water Company	0.04				2.02			2.05
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**6.44**	**4.77**	**0.34**	**0.00**	**4.29**	**0.00**	**0.84**	**16.68**

Key:
VOC = volatile organic compounds

Table E-77. Annual NOx Emissions (Mitigated)

Water Agency	Annual NOx Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.30							0.30
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	2.72							2.72
Glenn-Colusa Irrigation District	1.86	2.22						4.08
Giusti Farms								0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.88							2.88
Natomas Central Mutual Water Company			1.61		3.31			4.92
Pelger Mutual Water Company					0.72			0.72
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					2.34			2.34
Princeton-Codora-Glenn Irrigation District	5.88	11.77						17.65
Provident Irrigation District	No Engines	43.44						43.44
Reclamation District 1004	16.49	1.35			No Engines			17.83
Reclamation District 108	35.70						6.30	41.99
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.49							0.49
Sutter Mutual Water Company	0.08				4.11			4.19
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**66.39**	**58.77**	**1.61**	**0.00**	**10.48**	**0.00**	**6.30**	**143.54**

Key:
NOx = nitrogen oxides

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table E-78. Annual CO Emissions (Mitigated)

Water Agency	Annual CO Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.60							0.60
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	3.04							3.04
Glenn-Colusa Irrigation District	0.40	0.48						0.88
Giusti Farms								0.00
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	2.65							2.65
Natomas Central Mutual Water Company			1.39		6.39			7.78
Pelger Mutual Water Company					0.94			0.94
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					8.13			8.13
Princeton-Codora-Glenn Irrigation District	1.27	2.54						3.80
Provident Irrigation District	No Engines	9.36						9.36
Reclamation District 1004	4.71	0.29			No Engines			5.00
Reclamation District 108	10.80						2.76	13.55
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.97							0.97
Sutter Mutual Water Company	0.69				20.58			21.27
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**25.13**	**12.66**	**1.39**	**0.00**	**36.05**	**0.00**	**2.76**	**78.00**

Key:
CO = carbon monoxide

Table E-79. Annual SOx Emissions (Mitigated)

Water Agency	Annual SOx Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	1.33							1.33
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.12	0.15						0.27
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.94							0.94
Natomas Central Mutual Water Company			0.55		0.47			1.02
Pelger Mutual Water Company					0.24			0.24
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					1.62			1.62
Princeton-Codora-Glenn Irrigation District	0.39	0.78						1.17
Provident Irrigation District	No Engines	2.87						2.87
Reclamation District 1004	1.44	0.09			No Engines			1.52
Reclamation District 108	2.25						0.36	2.61
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	0.25				4.79			5.03
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**6.71**	**3.89**	**0.55**	**0.00**	**7.11**	**0.00**	**0.36**	**18.63**

Key:
SOx = sulfur oxides

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table E-80. Annual PM10 Emissions (Mitigated)

Water Agency	Annual PM10 Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.15							0.15
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.02	0.02						0.04
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.01		0.02			0.03
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.08			0.08
Princeton-Codora-Glenn Irrigation District	0.06	0.13						0.19
Provident Irrigation District	No Engines	0.52						0.52
Reclamation District 1004	0.25	0.01			No Engines			0.26
Reclamation District 108	0.37						0.06	0.43
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	0.00				0.09			0.09
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**1.01**	**0.68**	**0.01**	**0.00**	**0.25**	**0.00**	**0.06**	**2.01**

Key:
PM10 = inhalable particulate matter

Table E-81. Annual PM2.5 Emissions (Mitigated)

Water Agency	Annual PM2.5 Emissions (tons per year)							
	Colusa	Glenn	Sacramento	Shasta	Sutter	Tehama	Yolo	Total
Anderson-Cottonwood Irrigation District				All Electric		No Engines		0.00
Baber, Jack et al.	No Groundwater Substitution							0.00
Canal Farms	0.00							0.00
Conaway Preservation Group	No Groundwater Substitution							0.00
Eastside Mutual Water Company	0.15							0.15
Giusti Farms								0.00
Glenn-Colusa Irrigation District	0.02	0.02						0.04
Henle Family LP					All Electric			0.00
Maxwell Irrigation District	0.15							0.15
Natomas Central Mutual Water Company			0.01		0.02			0.03
Pelger Mutual Water Company					0.06			0.06
Pelger Road 1700 LLC					All Electric			0.00
Pleasant Grove-Verona Mutual Water Company					0.08			0.08
Princeton-Codora-Glenn Irrigation District	0.06	0.12						0.18
Provident Irrigation District	No Engines	0.51						0.51
Reclamation District 1004	0.24	0.01			No Engines			0.26
Reclamation District 108	0.36						0.06	0.42
River Garden Farms							All Electric	0.00
Roberts Ditch Irrigation Company	0.00							0.00
Sutter Mutual Water Company	0.00				0.09			0.09
Swenson Farms	All Electric							0.00
Sycamore Mutual Water Company	All Electric							0.00
T&P Farms	All Electric							0.00
Te Velde Revocable Family Trust							All Electric	0.00
Windswept Land & Livestock					All Electric			0.00
Total	**1.00**	**0.67**	**0.01**	**0.00**	**0.25**	**0.00**	**0.06**	**1.98**

Key:
PM2.5 = fine particulate matter

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Natomas Central Mutual Water Company			Peak Pumping by Transfer Period
Transfer Volume	10,000	acre-feet	(Apr-Jun)	3,333 AF/month
	10,000	acre-feet	(Jul-Sep)	3,333 AF/month
	20,000	acre-feet/year		

Table E-82. Natomas Central Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sacramento	2	13	0	1	16
Sutter	2	15	0	4	21
Total	4	28	0	5	37

Table E-83. Natomas Central Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane: VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day): VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year): VOC	NOx	CO	SOx	PM10	PM2.5
Ameral	Sacramento	Propane	unknown	200	n/a	1,500	2%	71	428	4	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	1.76	3.53	7.05	0.00	0.02	0.02	0.34	0.68	1.37	0.00	0.00	0.00
TNBC Atkinson	Sutter	Electric	unknown	125	n/a	1,800	3%	86	514	8	1,551	n/a																		
TNBC Bennett North	Sutter	Electric	unknown	125	n/a	2,200	3%	105	628	8	1,551	n/a																		
TNBC Betts	Sacramento	Electric	unknown	125	n/a	1,500	2%	71	428	8	1,551	n/a																		
Bianchi	Sutter	Propane	unknown	200	n/a	1,500	2%	71	428	4	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	1.76	3.53	7.05	0.00	0.02	0.02	0.34	0.68	1.37	0.00	0.00	0.00
Dhaliwal	Sacramento	Electric	unknown	125	n/a	3,000	4%	143	857	8	1,551	n/a																		
Elkhorn	Sacramento	Electric	unknown	125	n/a	2,700	4%	128	771	8	1,551	n/a																		
TNBC Frazer	Sutter	Electric	unknown	125	n/a	2,000	3%	95	571	8	1,551	n/a																		
Greenbriar	Sacramento	Electric	unknown	150	n/a	3,200	5%	152	914	8	1,551	n/a																		
Kubo	Sacramento	Electric	unknown	25	n/a	1,300	2%	62	371	8	1,551	n/a																		
L-1	Sutter	Diesel	unknown	125	T0	1,600	2%	76	457	8	1,551	10,874	0.07	2.4	0.5	0.93	0.014914	0.01	0.15	5.48	1.20	2.14	0.03	0.03	0.01	0.51	0.11	0.20	0.00	0.00
L-10	Sutter	Electric	unknown	30	n/a	1,000	1%	48	286	8	1,551	n/a																		
L-11	Sutter	Electric	unknown	50	n/a	1,500	2%	71	428	8	1,551	n/a																		
L-12	Sutter	Electric	unknown	50	n/a	1,500	2%	71	428	8	1,551	n/a																		
L-13 Bolen Pasture	Sutter	Propane	unknown	200	n/a	2,800	4%	133	799	4	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	1.76	3.53	7.05	0.00	0.02	0.02	0.34	0.68	1.37	0.00	0.00	0.00
L-14 Chappell	Sutter	Electric	unknown	75	n/a	1,800	3%	86	514	8	1,551	n/a																		
L-2	Sutter	Electric	unknown	30	n/a	1,900	3%	90	542	8	1,551	n/a																		
L-3	Sutter	Electric	unknown	50	n/a	1,300	2%	62	371	8	1,551	n/a																		
L-4	Sutter	Electric	unknown	75	n/a	1,300	2%	62	371	8	1,551	n/a																		
L-6	Sutter	Electric	unknown	50	n/a	2,000	3%	95	571	8	1,551	n/a																		
L-7	Sutter	Electric	unknown	30	n/a	1,200	2%	57	343	8	1,551	n/a																		
L-8	Sutter	Electric	unknown	200	n/a	2,800	4%	133	799	8	1,551	n/a																		
L-9	Sutter	Electric	unknown	50	n/a	1,500	2%	71	428	8	1,551	n/a																		
Lauppe	Sutter	Propane	unknown	200	n/a	1,050	1%	50	300	4	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	1.76	3.53	7.05	0.00	0.02	0.02	0.34	0.68	1.37	0.00	0.00	0.00
L-MW	Sutter	Propane	unknown	200	n/a	1,800	3%	86	514	4	1,551	788	1.0	2.0	4.0	0.000588	0.009987	0.009987	1.76	3.53	7.05	0.00	0.02	0.02	0.34	0.68	1.37	0.00	0.00	0.00
TNBC Lucich North	Sutter	Diesel	2012	170	T4I	2,500	4%	119	714	8	1,551	14,788	0.1	0.2	2.8	0.93	0.01	0.01	0.33	0.70	8.69	2.91	0.03	0.03	0.03	0.06	0.81	0.27	0.00	0.00
MAP	Sacramento	Electric	unknown	125	n/a	2,000	3%	95	571	8	1,551	n/a																		
TNBC Fisherman's Lake	Sacramento	Electric	unknown	125	n/a	1,500	2%	71	428	8	1,551	n/a																		
Ose-1	Sacramento	Diesel	2013	200	T4I	1,800	3%	86	514	8	1,551	17,398	0.002	1.3	0.02	0.93	0.007457	0.01	0.01	4.66	0.08	3.42	0.03	0.03	0.00	0.43	0.01	0.32	0.00	0.00
Ose-2	Sacramento	Electric	unknown	150	n/a	2,400	3%	114	685	8	1,551	n/a																		
Perry	Sacramento	Electric	unknown	125	n/a	2,600	4%	124	742	8	1,551	n/a																		
Plant 3	Sacramento	Electric	unknown	150	n/a	2,500	4%	119	714	8	1,551	n/a																		
Pond R	Sacramento	Electric	unknown	50	n/a	2,300	3%	109	657	8	1,551	n/a																		
TNBC Silva Dairy	Sacramento	Electric	unknown	125	n/a	1,000	1%	48	286	8	1,551	n/a																		
Souza	Sacramento	Electric	unknown	40	n/a	1,200	2%	57	343	8	1,551	n/a																		
Spangler	Sutter	Electric	unknown	80	n/a	2,500	4%	119	714	8	1,551	n/a																		
Willey	Sacramento	Diesel	2012	148	T4I	2,000	3%	95	571	8	1,551	12,874	0.01	1.9	0.07	0.93	0.002237	0.002	0.02	5.27	0.20	2.53	0.01	0.01	0.00	0.49	0.02	0.24	0.00	0.00
	Total					**70,050**	**100%**	**3,333**	**20,000**	**287**	**57,371**	**59,876**							**9.33**	**33.75**	**45.45**	**10.99**	**0.20**	**0.20**	**1.76**	**4.92**	**7.78**	**1.02**	**0.03**	**0.03**
	Total (Sacramento County)					**32,500**	**46%**	**1,547**	**9,279**	**129**	**24,809**	**31,060**							**1.79**	**13.46**	**7.34**	**5.95**	**0.05**	**0.05**	**0.34**	**1.61**	**1.39**	**0.55**	**0.01**	**0.01**
	Total (Sutter County)					**37,550**	**54%**	**1,787**	**10,721**	**158**	**32,562**	**28,815**							**7.54**	**20.29**	**38.11**	**5.05**	**0.15**	**0.15**	**1.41**	**3.31**	**6.39**	**0.47**	**0.02**	**0.02**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sacramento	Sutter
PM10	M	A
PM2.5	N	M
O3	N	N

Engines subject to ATCM.

Peak Month
3,333 AF/month
24,332 gallons/minute
35% peak pump rate

Legend

(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
(pink)	Engine-specific emission factors
(yellow)	Mitigation requirement

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pleasant Grove-Verona Mutual Water Company		Peak Pumping by Transfer Period
Transfer Volume	8,000 acre-feet	(Apr-Jun)	4,757 AF/month
	7,000 acre-feet	(Jul-Sep)	2,667 AF/month
	15,000 acre-feet/year		

Table E-84. Pleasant Grove-Verona Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	11	20	0	3	34
Total	11	20	0	3	34

Table E-85. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operations (hours/day)	Operations (hours/year)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane
Kelly 190 Field Well #2	Sutter	Electric	unknown	30	n/a	2,100	3%	135	427	21	1,104	n/a
Kelly Windmill Field Well #2	Sutter	Electric	2002	62.1	n/a	2,000	3%	129	407	21	1,104	n/a
Kelly Windmill North Field Well	Sutter	Propane	2014	133	n/a	1,800	2%	116	366	2	1,104	373
Kelly306	Sutter	Electric	unknown	60	n/a	3,500	5%	226	711	21	1,104	n/a
MLF Clubhouse B Well	Sutter	Electric	unknown	300	n/a	3,600	5%	232	732	21	1,104	n/a
MLF Marsh Well	Sutter	Electric	unknown	300	n/a	3,200	4%	206	650	21	1,104	n/a
MLF Monster Well	Sutter	Electric	unknown	60	n/a	3,100	4%	200	630	21	1,104	n/a
MLF Well #1	Sutter	Electric	unknown	30	n/a	2,000	3%	129	407	21	1,104	n/a
MLF Well #16	Sutter	Electric	unknown	50	n/a	1,700	2%	110	346	21	1,104	n/a
MLF Well#11	Sutter	Diesel	2011	250	T4I	1,400	2%	90	285	13	1,104	15,482
MLF Well#12/17	Sutter	Electric	unknown	50	n/a	2,200	3%	142	447	21	1,104	n/a
MLF Well#13&#15	Sutter	Electric	2000	215	n/a	1,900	3%	122	386	21	1,104	n/a
MLF Well#2B	Sutter	Electric	2000	300	n/a	2,800	4%	180	569	21	1,104	n/a
Nicholas 72-Acre Field North	Sutter	Electric	unknown	40	n/a	1,700	2%	110	346	21	1,104	n/a
Nicholas 72-Acre Field South	Sutter	Diesel	2008	62.1	T4I	2,000	3%	129	407	5	1,104	3,846
Nicholas BBC Well	Sutter	Electric	unknown	30	n/a	2,000	3%	129	407	21	1,104	n/a
Nicholas Filipino Camp South	Sutter	Diesel	2008	62.1	T4I	800	1%	52	163	5	1,104	3,846
Nicholas Filipino Camp#2	Sutter	Electric	unknown	40	n/a	2,300	3%	148	467	21	1,104	n/a
Nicholas Johnston Field Well #2	Sutter	Electric	unknown	40	n/a	2,000	3%	129	407	21	1,104	n/a
Nicholas Sand Field Well	Sutter	Diesel	2008	62.1	T4I	2,000	3%	129	407	5	1,104	3,846
RiverRanch#19	Sutter	Diesel	2012	99	T4I	2,500	3%	161	508	17	1,104	6,131
S&O#16	Sutter	Electric	2014	159	n/a	2,000	3%	129	407	21	1,104	n/a
S&O#17	Sutter	Diesel	2012	101	T4I	3,000	4%	193	610	17	1,104	6,255
S&O#18A	Sutter	Diesel	2012	101	T4I	1,800	2%	116	366	17	1,104	6,255
S&O#19	Sutter	Diesel	2011	215	T4I	1,800	2%	116	366	14	1,104	13,314
S&O#20	Sutter	Propane	2014	154	n/a	1,800	2%	116	366	0	1,104	432
Willey#1	Sutter	Diesel	2012	168	T4I	3,000	4%	193	610	15	1,104	10,404
Willey#3	Sutter	Electric	unknown	75	n/a	1,800	2%	116	366	21	1,104	n/a
Willey#4	Sutter	Diesel	2012	150	T4I	2,000	3%	129	407	16	1,104	9,289
Willey#5	Sutter	Propane	unknown	180	n/a	2,000	3%	129	407	2	1,104	505
Will-Lee Well#31	Sutter	Electric	unknown	50	n/a	1,500	2%	97	305	21	1,104	n/a
Will-Lee Well#32	Sutter	Electric	unknown	300	n/a	2,500	3%	161	508	21	1,104	n/a
Will-Lee Well#33	Sutter	Electric	unknown	75	n/a	2,500	3%	161	508	21	1,104	n/a
Will-Lee Well#4A	Sutter	Diesel	2012	160	T4I	1,500	2%	97	305	16	1,104	9,908
					Total	**73,800**	**100%**	**4,757**	**15,000**	**564**	**37,530**	**89,883**
					Total (Sutter County)	**73,800**	**100%**	**4,757**	**15,000**	**564**	**37,530**	**89,883**

Well	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane: VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (pounds per day): VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year): VOC	NOx	CO	SOx	PM10	PM2.5
Kelly 190 Field Well #2																		
Kelly Windmill Field Well #2																		
Kelly Windmill North Field Well	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.47	0.94	1.87	0.00	0.01	0.01	0.16	0.32	0.65	0.00	0.00	0.00
Kelly306																		
MLF Clubhouse B Well																		
MLF Marsh Well																		
MLF Monster Well																		
MLF Well #1																		
MLF Well #16																		
MLF Well#11	0.14	0.30	2.61	0.93	0.01	0.01	1.02	2.15	18.81	6.70	0.11	0.11	0.04	0.09	0.79	0.28	0.00	0.00
MLF Well#12/17																		
MLF Well#13&#15																		
MLF Well#2B																		
Nicholas 72-Acre Field North																		
Nicholas 72-Acre Field South	0.18	3.33	3.73	0.93	0.22	0.22	0.12	2.26	2.53	0.63	0.15	0.15	0.01	0.25	0.28	0.07	0.02	0.02
Nicholas BBC Well																		
Nicholas Filipino Camp South	0.18	3.33	3.73	0.93	0.22	0.22	0.12	2.26	2.53	0.63	0.15	0.15	0.01	0.25	0.28	0.07	0.02	0.02
Nicholas Filipino Camp#2																		
Nicholas Johnston Field Well #2																		
Nicholas Sand Field Well	0.18	3.33	3.73	0.93	0.22	0.22	0.12	2.26	2.53	0.63	0.15	0.15	0.01	0.25	0.28	0.07	0.02	0.02
RiverRanch#19	0.14	0.30	3.73	0.93	0.01	0.01	0.54	1.13	14.17	3.53	0.06	0.06	0.02	0.04	0.45	0.11	0.00	0.00
S&O#16																		
S&O#17	0.14	0.30	3.73	0.93	0.01	0.01	0.55	1.15	14.41	3.59	0.06	0.06	0.02	0.04	0.46	0.11	0.00	0.00
S&O#18A	0.14	0.30	3.73	0.93	0.01	0.01	0.55	1.15	14.41	3.59	0.06	0.06	0.02	0.04	0.46	0.11	0.00	0.00
S&O#19	0.14	0.30	2.61	0.93	0.01	0.01	0.94	1.98	17.29	6.16	0.10	0.10	0.04	0.08	0.68	0.24	0.00	0.00
S&O#20	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.37	0.75	0.00	0.00	0.00
Willey#1	0.14	0.30	3.73	0.93	0.01	0.01	0.80	1.69	21.10	5.26	0.08	0.08	0.03	0.06	0.76	0.19	0.00	0.00
Willey#3																		
Willey#4	0.14	0.30	3.73	0.93	0.01	0.01	0.74	1.56	19.49	4.86	0.08	0.08	0.03	0.05	0.68	0.17	0.00	0.00
Willey#5	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.77	1.54	3.08	0.00	0.01	0.01	0.22	0.44	0.88	0.00	0.00	0.00
Will-Lee Well#31																		
Will-Lee Well#32																		
Will-Lee Well#33																		
Will-Lee Well#4A	0.14	0.30	3.73	0.93	0.01	0.01	0.78	1.63	20.40	5.08	0.08	0.08	0.03	0.06	0.73	0.18	0.00	0.00
Total							**7.51**	**21.71**	**152.64**	**40.66**	**1.09**	**1.09**	**0.82**	**2.34**	**8.13**	**1.62**	**0.08**	**0.08**
Total (Sutter County)							**7.51**	**21.71**	**152.64**	**40.66**	**1.09**	**1.09**	**0.82**	**2.34**	**8.13**	**1.62**	**0.08**	**0.08**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
4,757 AF/month
34,722 gallons/minute
47% peak pump rate

Legend
(blue) Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
(yellow) Mitigation requirement

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4 lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal	

Groundwater Substitution Air Quality Emissions (Mitigated)

	Sutter MWC			
Agency	Sutter Mutual Water Company		Peak Pumping by Transfer Period	
Transfer Volume	8,000 acre-feet	(Apr-Jun)	3,200	AF/month
	10,000 acre-feet	(Jul-Sep)	4,000	AF/month
	18,000 acre-feet/year			

Table E-86. Sutter Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	27	10	0	7	44
Colusa	1	0	0	0	1
Total	28	10	0	7	45

Table E-87. Sutter Mutual Water Company Criteria Pollutant Emissions

	Well Location			Power Rating	Emission	Pump Rate		Transfer Volume		Operations		Fuel Consumption	Emission Factors (g/bhp-hr) - diesel and VOC, NOx, and CO for propane (lb/MMBtu) - SOx, PM10, and PM2.5 for propane						Daily Emissions (pounds per day)						Annual Emissions (tons per year)					
Well	(County)	Fuel Type	Model Year	(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr) - diesel (MMBtu/yr) - propane	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Ag Industries - Sioux Creek	Sutter	Diesel	2012	350	T4I	2,800	2%	79	354	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
Ag Industries - Sutter Basin	Sutter	Diesel	2012	350	T4I	3,000	2%	84	379	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
BD-1	Sutter	Diesel	2012	225	T4I	2,500	2%	70	316	3	686	8,665	0.14	0.3	2.6	0.93	0.01	0.01	0.21	0.44	3.89	1.38	0.02	0.02	0.02	0.05	0.44	0.16	0.00	0.00
BD-2	Sutter	Diesel	2012	225	T4I	4,000	3%	112	506	3	686	8,665	0.14	0.3	2.6	0.93	0.01	0.01	0.21	0.44	3.89	1.38	0.02	0.02	0.02	0.05	0.44	0.16	0.00	0.00
BD-3	Sutter	Propane	unknown	250	n/a	3,000	2%	84	379	1.5	686	436	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.95	1.91	3.81	0.00	0.01	0.01	0.22	0.44	0.87	0.00	0.00	0.00
DB-1	Sutter	Diesel	2012	350	T4I	4,500	3%	126	569	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
Driver	Colusa	Diesel	2012	350	T4I	2,500	2%	70	316	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
F4N	Sutter	Diesel	2012	290	T4I	3,500	2%	98	442	3	686	11,169	0.14	0.3	2.6	0.93	0.01	0.01	0.27	0.57	5.01	1.78	0.03	0.03	0.03	0.07	0.57	0.20	0.00	0.00
FG	Sutter	Propane	unknown	250	n/a	1,500	1%	42	190	1.5	686	436	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.95	1.91	3.81	0.00	0.01	0.01	0.22	0.44	0.87	0.00	0.00	0.00
FT5	Sutter	Diesel	2012	450	T4I	5,200	4%	146	657	3	686	17,331	0.14	0.3	2.6	0.93	0.01	0.01	0.42	0.89	7.77	2.77	0.04	0.04	0.05	0.10	0.89	0.32	0.01	0.01
G-16	Sutter	Electric	unknown	250	n/a	4,200	3%	118	531	5	686	n/a																		
G-2	Sutter	Propane	unknown	125	n/a	3,500	2%	98	442	1.5	686	218	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.48	0.95	1.91	0.00	0.00	0.00	0.11	0.22	0.44	0.00	0.00	0.00
H-1	Sutter	Electric	unknown	150	n/a	2,600	2%	73	329	5	686	n/a																		
Hoppin	Sutter	Electric	unknown	250	n/a	2,500	2%	70	316	5	686	n/a																		
L&N Farms	Sutter	Diesel	2012	170	T4I	5,000	4%	140	632	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
L1-1	Sutter	Diesel	2012	350	T4I	4,000	3%	112	506	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
L1-2	Sutter	Diesel	2012	350	T4I	5,000	4%	140	632	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
L2-1	Sutter	Diesel	2012	350	T4I	5,500	4%	154	695	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
LM-11	Sutter	Electric	unknown	150	n/a	3,100	2%	87	392	5	686	n/a																		
LM-53	Sutter	Electric	unknown	150	n/a	4,000	3%	112	506	5	686	n/a																		
Matteoli	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
MB-1	Sutter	Propane	unknown	268	n/a	5,300	4%	149	670	1.5	686	468	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	1.02	2.04	4.09	0.00	0.01	0.01	0.23	0.47	0.94	0.00	0.00	0.00
ME-1	Sutter	Diesel	2012	350	T4I	1,300	1%	37	164	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
QHR	Sutter	Propane	unknown	250	n/a	5,200	4%	146	657	1.5	686	436	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.95	1.91	3.81	0.00	0.01	0.01	0.22	0.44	0.87	0.00	0.00	0.00
R-24	Sutter	Diesel	2012	350	T4I	2,500	2%	70	316	3	686	13,479	0.14	0.3	2.6	0.93	0.01	0.01	0.33	0.69	6.05	2.15	0.03	0.03	0.04	0.08	0.69	0.25	0.00	0.00
R-29	Sutter	Diesel	2012	150	T4I	2,500	2%	70	316	3	686	5,777	0.14	0.3	3.7	0.93	0.01	0.01	0.14	0.30	3.70	0.92	0.01	0.01	0.02	0.03	0.42	0.11	0.00	0.00
S-18	Sutter	Electric	unknown	100	n/a	2,700	2%	76	341	5	686	n/a																		
TVN	Sutter	Electric	unknown	75	n/a	3,000	2%	84	379	5	686	n/a																		
VR-57	Sutter	Diesel	2012	450	T4I	5,500	4%	154	695	3	686	17,331	0.14	0.3	2.6	0.93	0.01	0.01	0.42	0.89	7.77	2.77	0.04	0.04	0.05	0.10	0.89	0.32	0.01	0.01
Well #1	Sutter	Electric	unknown	250	n/a	2,500	2%	70	316	5	686	n/a																		
Well #10	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #11	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #12	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #13	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #14	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #15	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #16	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #2	Sutter	Electric	unknown	150	n/a	2,500	2%	70	316	5	686	n/a																		
Well #3	Sutter	Electric	unknown	150	n/a	2,500	2%	70	316	5	686	n/a																		
Well #4	Sutter	Propane	unknown	150	n/a	2,500	2%	70	316	1.5	686	262	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.57	1.14	2.29	0.00	0.01	0.01	0.13	0.26	0.52	0.00	0.00	0.00
Well #5	Sutter	Propane	unknown	180	n/a	2,500	2%	70	316	1.5	686	314	1.0	2.0	4.0	5.88E-04	9.99E-03	9.99E-03	0.69	1.37	2.75	0.00	0.01	0.01	0.16	0.31	0.63	0.00	0.00	0.00
Well #6	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #7	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #8	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Well #9	Sutter	Diesel	2012	170	T4I	2,500	2%	70	316	3	686	6,547	0.14	0.3	3.7	0.93	0.01	0.01	0.16	0.34	4.20	1.05	0.02	0.02	0.02	0.04	0.48	0.12	0.00	0.00
Total						**142,400**	**100%**	**4,000**	**18,000**	**144**	**30,892**	**277,935**							**12.32**	**25.35**	**163.46**	**43.98**	**0.76**	**0.76**	**2.05**	**4.19**	**21.27**	**5.03**	**0.09**	**0.09**
Total (Sutter County)						**139,900**	**98%**	**3,930**	**17,684**	**141**	**30,205**	**264,455**							**11.99**	**24.66**	**157.41**	**41.82**	**0.73**	**0.73**	**2.02**	**4.11**	**20.58**	**4.79**	**0.09**	**0.09**
Total (Colusa County)						**2,500**	**2%**	**70**	**316**	**3**	**686**	**13,479**							**0.33**	**0.69**	**6.05**	**2.15**	**0.03**	**0.03**	**0.04**	**0.08**	**0.69**	**0.25**	**0.00**	**0.00**

Key:
AF = acre-feet
CO = carbon monoxide
g/bhp-hr = grams per brake-horsepower hour
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
NOx = nitrogen oxides
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Federal Attainment Status

	Sutter
PM10	A
PM2.5	M
O3	N

Engines subject to ATCM.

Peak Month
4,000 AF/month
29,198 gallons/minute
21% peak pump rate

Legend
- Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
- Tier 4 Exhaust Emission Standards, Phase-In (100<=hp<=175, 2012-2014 model year)
- Emission factors from 40 CFR 60, Subpart JJJJ, Table 1 for Non-Emergency SI Lean Burn LPG engines, 100<=HP<500, manufactured after 7/1/2008
- Engine tier adjusted to be consistent with minimum emission standard required to meet requirements of 17 CCR 93115.
- Emission factors based on NMHC+NOx standard
- Engine information not provided and assumed to be diesel as worst-case scenario
- Mitigation requirement

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 kW =	1.34	hp
1 day =	24	hours
1 month =	31	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

CARB Airborne Toxic Control Measure (ATCM) for Stationary Compression Ignition Engines

Table E-88. Summary of the Emission Standards for New Stationary Diesel-Fueled CI Engines > 50 BHP used in Agricultural Operations

Horsepower Range	Diesel PM [1] (g/bhp-hr)	HC (g/bhp-hr)	NOx (g/bhp-hr)	NMHC+NOx (g/bhp-hr)	CO (g/bhp-hr)
50<HP<100	0.3				
100<=HP<175	0.22				
175<=HP	0.15				

Source: See Section 93115.8(a)

Notes:

[1] Less than or equal to the emission standard OR Off-Road CI Engine Certification Standard for an off-road engine of the maximum rated power, whichever is more stringent.

[2] Off-Road CI Engine Certification Standard for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard, or Tier 1 standards.

[3] Prior to January 1, 2008, these limits shall not apply to engines sold from one agricultural operation to another and funded under State or federal incentive.

Table E-89. Emission Standards for Noncertified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower (HP) Range	Compliance Date [1]	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2011	0.3				
75<=HP<100	2011	0.3				
100<=HP<175	2010	0.22				
175<=HP<=750	2010	0.15				
750<HP	2014	0.075				

Source: See Sections 93115.8(b) (2) and (4)

Note:

[1] Compliance date on or after December 31

[2] Engine Certification Standards for off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.

[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in an agricultural operation shall not exceed Tier 1 standards in Title 13.

Table E-90. Emission Standards Tier 1- and Tier 2-Certified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower Range (hp)	Compliance Date	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2015	0.02				
75<=HP<175	2015	0.01				
175<=hp<=750	2014	0.01				
750<HP	2014	0.075				

Source: See Sections 93115.8(b)(3) and (4)

Notes:

[1] Compliance date on or after December 31 or 12 years after the date of initial installation, whichever is later.

[2] Off-Road CI Engine Certification Standards for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.

[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in agricultural operation shall not exceed Tier 1 standards in Tier 13, CCR, section 2423 for an off-road engine of the same maximum rated power irrespective of model year.

Table E-91. Tier 1, Tier 2, and Tier 3 Exhaust Emission Standards

Maximum Rated Power	Tier	Model Year	(g/kW-hr)					(g/hp-hr)				
			NOx	HC	NMHC+NOx	CO	PM	NOx	HC	NMHC+NOx	CO	PM
kW<8	T1	2000-2004	-	-	10.5	8.0	1	-	-	7.8	6.0	0.7
hp <11	T2	2005 -2007	-	-	7.5	8.0	0.8	-	-	5.6	6.0	0.6
8≤kW<19	T1	2000-2004	-	-	9.5	6.6	0.8	-	-	7.1	4.9	0.6
11<=hp<25	T2	2005 -2007	-	-	7.5	6.6	0.8	-	-	5.6	4.9	0.6
19≤kW<37	T1	2000-2003	-	-	9.5	5.5	0.8	-	-	7.1	4.1	0.6
25<=hp<50	T2	2004 -2007	-	-	7.5	5.5	0.6	-	-	5.6	4.1	0.4
37≤kW<56	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
50<=hp<75	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.3
	T3	2008 -2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.3
56≤kW<75	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
75<=hp<100	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.3
	T3	2008-2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.3
75≤kW<130	T1	2000-2002	9.2	-	-	-	-	6.9	-	-	-	-
100<=hp<175	T2	2003-2006	-	-	6.6	5.0	0.3	-	-	4.9	3.7	0.2
	T3	2007 -2011	-	-	4.0	5.0	0.3	-	-	3.0	3.7	0.2
130≤kW<225	T1	1996-2002	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
175<=hp<300	T2	2003-2005	-	-	6.6	3.5	0.2	-	-	4.9	2.6	0.1
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.1
225≤kW<450	T1	1996-2000	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
300<=hp<600	T2	2001-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.1
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.1
450≤kW≤560	T1	1996-2001	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
600<=hp<750	T2	2002-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.1
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.1
kW>560	T1	2000-2005	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.4
hp>750	T2	2006 -2010	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.1

Source: Title 13, California Code of Regulations, Division 3, Chapter 9, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

NOx and NMHC fraction - Table B-26

NOx	95%
NMHC	5%

http://www.arb.ca.gov/msprog/moyer/guidelines/cmp_guidelines_part4.pdf

PM Size Fractions

PM10	0.96
PM2.5	0.937
Ratio	0.98

CARB PMSIZE Profile No. 116 (STAT. I.C. ENGINE-DIESEL)

Table E-92. Tier 4 Exhaust Emission Standards

MAXIMUM ENGINE POWER	MODEL YEAR	TYPE	PM	NMHC+NOx	NMHC	NOx	CO
			grams per horsepower-hour				
hp<11	2008 and later	FINAL	0.30	5.6	-	-	6.0
11<=hp<25							4.9
25<=hp<50	2008-2012	INTERIM	0.22	5.6	-	-	4.1
	2013 and later	FINAL	0.02	3.5			
50<=hp<75	2008-2012	INTERIM	0.22	3.5	-	-	3.7
	2013 and later	FINAL	0.02				
75<=hp<100	2012-2014	PHASE-IN	0.01	-	0.14	0.3	3.7
		PHASE-OUT		3.5	-	-	
		or/ ALT NOx			0.14	2.5	
	2015 and later	FINAL		-		0.3	
100<=hp<175	2012-2014	PHASE-IN	0.01	-	0.14	0.3	3.7
		PHASE-OUT		3.0	-	-	
		or/ ALT NOx		-	0.14	2.5	
	2015 and later	FINAL			0.14	0.3	
175<=hp<=750	2011-2013	PHASE-IN	0.01	-	0.14	0.3	2.6
	2014 and later	PHASE-OUT		3.0	-	-	
		or/ ALT NOx		-	0.14	1.5	
		FINAL				0.3	
750 hp<GEN<=1205 hp	2011-2014	INTERIM	0.07	-	0.30	2.6	2.6
	2015 and later	FINAL	0.02		0.14	0.5	
GEN>1205 hp	2011-2014	INTERIM	0.07	-	0.30		2.6
	2015 and later	FINAL	0.02		0.14	0.5	
ELSE>750 hp	2011-2014	INTERIM	0.07	-	0.30	2.6	2.6
	2015 and later	FINAL	0.03	-	0.14		

Source: Title 13, California Code of Regulations, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

Table E-93. Engine Tier Matrix

HP Range	Year																			
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
hp <11	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
11<=hp<25	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
25<=hp<50	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
50<=hp<75	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
75<=hp<100	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T4I	T4I	T4I	T4
100<=hp<175	T0	T0	T0	T0	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4
175<=hp<300	T1	T1	T1	T1	T1	T1	T1	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
300<=hp<600	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
600<=hp<750	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
hp>750	T0	T0	T0	T0	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4

Key:

T0 = Tier 0 (Noncertified)
T1 = Tier 1
T2 = Tier 2
T3 = Tier 3
T4 = Tier 4
T4I = Tier 4 Interim

AP-42 Emission Factors

Table E-94. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines [a]

Pollutant	Gasoline Fuel Emission Factor (lb/hp-hr) (power output)	Gasoline Fuel Emission Factor (lb/MMBtu) (fuel input)	Diesel Fuel Emission Factor (lb/hp-hr) (power output)	Diesel Fuel Emission Factor (lb/MMBtu) (fuel input)	Emission Factor Rating
NOx	0.011	1.63	0.031	4.41	D
CO	6.96E-03 [d]	0.99 [d]	6.68E-03	0.95	D
SOx	5.91E-04	0.084	2.05E-03	0.29	D
PM-10 [b]	7.21E-04	0.1	2.20E-03	0.31	D
CO2 [c]	1.08	154	1.15	164	B
Aldehydes	4.85E-04	0.07	4.63E-04	0.07	D
TOC					
Exhaust	0.015	2.1	2.47E-03	0.35	D
Evaporative	6.61E-04	0.09	0.00	0.00	E
Crankcase	4.85E-03	0.69	4.41E-05	0.01	E
Refueling	1.08E-03	0.15	0.00	0.00	E

Source: U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.3: Gasoline and Diesel Industrial Engines.

Notes:

[a] References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kwhr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.

[b] PM-10 = particulate matter less than or equal to 10 :m aerodynamic diameter. All particulate is assumed to be 10 µm in size.

[c] Assumes 99% conversion of carbon in fuel to CO2 with 87 weight % carbon in diesel, 86 weight % carbon in gasoline, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and gasoline heating value of 20,300 Btu/lb.

[d] Instead of 0.439 lb/hp-hr (power output) and 62.7 lb/mmBtu (fuel input), the correct emissions factors values are 6.96 E-03 lb/hp-hr (power output) and 0.99 lb/mmBtu (fuel input), respectively. This is an editorial correction. March 24, 2009

For large stationary diesel engines (greater than 600 horsepower [hp]) see Chapter 3.4: Large Stationary Diesel and All Stationary Dual-Fuel Engines.

Table E-95. Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines [a]

Pollutant	Emission Factor (lb/MMBtu) [b] (fuel input)	Emission Factor Rating
NOx [c] 90 - 105% Load	4.08E+00	B
NOx [c] <90% Load	8.47E-01	B
CO [c] 90 - 105% Load	3.17E-01	C
CO [c] <90% Load	5.57E-01	B
CO2 [d]	1.10E+02	A
SO2 [e]	5.88E-04	A
TOC [f]	1.47E+00	A
Methane[g]	1.25E+00	C
VOC [h]	1.18E-01	C
PM10 (filterable) [i]	7.71E-05	D
PM2.5 (filterable) [i]	7.71E-05	D
PM Condensable [j]	9.91E-03	D

Source: U.S. Environmental Protection Agency. 2000. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.2: Natural Gas-Fired Reciprocating Engines. July.

Notes:

[a] Reference 7. Factors represent uncontrolled levels. For NOx, CO, and PM10, “uncontrolled” means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, the data set may include units with control techniques used for NOx control, such as PCC“uncontrolled” means no oxidation control; and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μ) aerodynamic diameter. A “<“ sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

lb/hp-hr = (lb/MMBtu) (heat input, MMBtu/hr) (1/operating HP, 1/hp)

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO2. CO2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60EF).

[e] Based on 100% conversion of fuel sulfur to SO2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered ≤ 1 μ in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

Engine Size Summary

Table E-96. Engine Power Rating Summary by Fuel Type

Fuel Type	No. Engines	Avg. HP	Max HP	Min HP
Diesel	23	170	250	60
Electric	47	125	300	30
Natural Gas	0	n/a	0	0
Propane	3	180	250	135

Appendix F

Greenhouse Gas Emissions Calculations

Summary of Annual Greenhouse Gas Emissions

Table F-1. GHG Emissions from Groundwater Substitution

Water Agency	Emissions (MTCO2e/year)			
	CO2	CH4	N2O	Total
Anderson-Cottonwood Irrigation District	70	0	0	71
Baber, Jack et al.	No Groundwater Substitution			0
Canal Farms	31	0	0	31
Conaway Preservation Group	No Groundwater Substitution			0
Eastside Mutual Water Company	341	0	1	342
Giusti Farms	41	0	0	41
Glenn-Colusa Irrigation District	38	0	0	38
Henle Family LP	15	0	0	15
Maxwell Irrigation District	528	1	1	530
Natomas Central Mutual Water Company	1,226	2	4	1,232
Pelger Mutual Water Company	171	0	1	172
Pelger Road 1700 LLC	127	0	1	128
Pleasant Grove-Verona Mutual Water Company	1,161	2	3	1,167
Princeton-Cordora-Glenn Irrigation District	711	1	2	714
Provident Irrigation District	1,632	2	4	1,638
Reclamation District 1004	897	1	2	900
Reclamation District 108	1,820	2	5	1,828
River Garden Farms	250	1	1	252
Roberts Ditch Irrigation Company	185	1	1	187
Sutter Mutual Water Company	3,053	3	8	3,064
Swenson Farms	42	0	0	43
Sycamore Mutual Water Company	86	0	0	87
T&P Farms	15	0	0	15
Te Velde Revocable Family Trust	122	0	1	123
Windswept Land & Livestock	57	0	0	57
Total	**12,620**	**18**	**37**	**12,675**

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Anderson-Cottonwood Irrigation District
Transfer Volume 4,800 acre-feet/year

Table F-2. Anderson-Cottonwood Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Shasta	0	2	0	0	2
Tehama	0	0	0	0	0
Total	0	2	0	0	2

Table F-3. Anderson-Cottonwood Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	GHG Emissions (MTCO2e per year) CO2	CH4	N2O	Total
Barney Street	Shasta	Electric	2012	200	5,500	85%	4,062	4,010	598,578	n/a	56	0.0087	0.0011	56	0.22	0.32	57
Crowley Gulch	Shasta	Electric	2012	50	1,000	15%	738	4,010	149,645	n/a	14	0.0022	0.0003	14	0.05	0.08	14
				Total	**6,500**	**100%**	**4,800**	**8,021**	**748,223**	**0**	**70**	**0.0109**	**0.0014**	**70**	**0.27**	**0.40**	**71**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Canal Farms
Transfer Volume 1,000 acre-feet/year

Table F-4. Canal Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	1	3
Total	0	2	0	1	3

Table F-5. Canal Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (MMBtu/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	GHG Emissions (MTCO2e per year) CO2	CH4	N2O	Total
Dennis Well North	Colusa	Electric	unknown	125	2,500	25%	250	543	50,661	n/a	5	0.0007	0.0001	5	0.02	0.03	5
Dennis Well South	Colusa	Electric	unknown	125	2,500	25%	250	543	50,661	n/a	5	0.0007	0.0001	5	0.02	0.03	5
East Well	Colusa	Propane	unknown	250	5,000	50%	500	543	n/a	345	22	0.0010	0.0002	22	0.03	0.06	22
				Total	**10,000**	**100%**	**1,000**	**1,629**	**101,322**	**345**	**31**	**0.0025**	**0.0004**	**31**	**0.06**	**0.12**	**31**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Eastside Mutual Water Company
Transfer Volume 2,230 acre-feet/year

Table F-6. Eastside Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	3	0	0	0	3
Total	3	0	0	0	3

Table F-7. Eastside Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	GHG Emissions (MTCO2e per year) CO2	CH4	N2O	Total
ATW-1	Colusa	Diesel	2006	150	4,720	37%	827	952	n/a	8,012	82	0.003	0.0007	82	0.08	0.20	82
ATW-2	Colusa	Diesel	2002	275	4,000	31%	701	952	n/a	14,689	150	0.006	0.0012	150	0.15	0.36	150
ATW-3	Colusa	Diesel	2010	200	4,000	31%	701	952	n/a	10,683	109	0.004	0.0009	109	0.11	0.26	109
				Total	**12,720**	**100%**	**2,230**	**2,856**	**0**	**33,384**	**341**	**0.014**	**0.0028**	**341**	**0.35**	**0.82**	**342**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Giusti Farms
Transfer Volume 1,000 acre-feet/year

Table F-8. Giusti Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	0	0	2	2
	0	0	0	0	0
	0	0	0	0	0
Total	0	0	0	2	2

Table F-9. Giusti Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (MMBtu/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
Giusti Well 1	Sutter	Propane	2015	150	3,200	50%	500	849	n/a	324	20	0.0010	0.0002	20	0.02	0.06	20
Giusti Well 2	Sutter	Propane	2015	150	3,200	50%	500	849	n/a	324	20	0.0010	0.0002	20	0.02	0.06	20
				Total	**6,400**	**100%**	**1,000**	**1,697**	**0**	**647**	**41**	**0.0019**	**0.0004**	**41**	**0.05**	**0.12**	**41**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors
1 bhp-hr = 2,542.5 Btu
1 lb = 453.6 g
1 tonne = 1,000 kg
1 tonne = 1,000,000 g
1 MWh = 1,000 kWh
1 GWh = 1,000,000 kWh
1 kW = 1.34 hp
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential
CO2 1
CH4 25
N2O 298

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Glenn-Colusa Irrigation District
Transfer Volume 11,495 acre-feet/year

Table F-10. Glenn-Colusa Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	20	7	0	0	27
Colusa	8	6	0	0	14
Total	28	13	0	0	41

Table F-11. Glenn-Colusa Irrigation District GHG Emissions

	Well						Transfer			Fuel	GHG Emissions						
	Location			Power Rating	Pump Rate		Volume	Operation		Consumption	(tonnes per year)			(MTCO2e per year)			
Well	(County)	Fuel Type	Model Year	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
33	Glenn	Diesel	unknown	185	3,000	3%	368	667	n/a	6,921	71	0.0029	0.0006	71	0.07	0.17	71
34	Glenn	Diesel	unknown	140	4,000	4%	491	667	n/a	5,237	53	0.0022	0.0004	53	0.05	0.13	54
62	Glenn	Diesel	unknown	145	3,000	3%	368	667	n/a	5,424	55	0.0022	0.0004	55	0.06	0.13	56
80	Glenn	Diesel	unknown	200	2,000	2%	246	667	n/a	7,482	76	0.0031	0.0006	76	0.08	0.18	77
81	Glenn	Diesel	unknown	200	2,000	2%	246	667	n/a	7,482	76	0.0031	0.0006	76	0.08	0.18	77
83	Glenn	Diesel	unknown	75	1,500	2%	184	667	n/a	2,806	29	0.0012	0.0002	29	0.03	0.07	29
165	Glenn	Diesel	unknown	160	3,000	3%	368	667	n/a	5,985	61	0.0025	0.0005	61	0.06	0.15	61
185	Glenn	Diesel	unknown	150	3,000	3%	368	667	n/a	5,611	57	0.0023	0.0005	57	0.06	0.14	57
187	Glenn	Diesel	unknown	200	3,500	4%	430	667	n/a	7,482	76	0.0031	0.0006	76	0.08	0.18	77
15-3-22H-3	Colusa	Diesel	unknown	121	630	1%	77	667	n/a	4,527	46	0.0019	0.0004	46	0.05	0.11	46
17-2-6B-1	Colusa	Electric	unknown	121	2,050	2%	252	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
322N	Colusa	Diesel	unknown	250	2,000	2%	246	667	n/a	9,352	95	0.0039	0.0008	95	0.10	0.23	96
GRS-22H-1	Glenn	Electric	unknown	121	2,300	2%	282	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
GRS-34N-1	Glenn	Diesel	unknown	121	1,500	2%	184	667	n/a	4,527	46	0.0019	0.0004	46	0.05	0.11	46
GRS-35A-2	Glenn	Electric	unknown	121	3,600	4%	442	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
GRS-84A-1	Glenn	Electric	unknown	121	3,000	3%	368	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Haymen	Colusa	Diesel	unknown	121	2,000	2%	246	667	n/a	4,527	46	0.0019	0.0004	46	0.05	0.11	46
LaCroix 1	Glenn	Electric	unknown	121	600	1%	74	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
LaCroix 2	Glenn	Electric	unknown	121	600	1%	74	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
LaCroix 3	Glenn	Electric	unknown	121	600	1%	74	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Lagrande	Colusa	Diesel	unknown	121	2,900	3%	356	667	n/a	4,527	46	0.0019	0.0004	46	0.05	0.11	46
Reister 1	Colusa	Electric	unknown	121	850	1%	104	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Reister 2	Colusa	Electric	unknown	121	850	1%	104	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Reister 3	Colusa	Electric	unknown	121	850	1%	104	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Reister 4	Colusa	Electric	unknown	121	890	1%	109	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
S2-36T	Glenn	Electric	unknown	121	2,800	3%	344	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Vann 1	Colusa	Diesel	unknown	121	1,500	2%	184	667	n/a	4,527	46	0.0019	0.0004	46	0.05	0.11	46
Vann 2	Colusa	Electric	unknown	121	3,500	4%	430	667	60,213	n/a	6	0.0009	0.0001	6	0.02	0.03	6
8	Glenn	Diesel	unknown	100	1,100	1%	135	667	n/a	3,741	38	0.0015	0.0003	38	0.04	0.09	38
2	Colusa	Diesel	unknown	215	3,500	4%	430	667	n/a	8,043	82	0.0033	0.0007	82	0.08	0.20	82
19	Colusa	Diesel	unknown	180	2,500	3%	307	667	n/a	6,734	69	0.0028	0.0006	69	0.07	0.17	69
38	Glenn	Diesel	unknown	100	2,500	3%	307	667	n/a	3,741	38	0.0015	0.0003	38	0.04	0.09	38
42	Glenn	Diesel	unknown	162	3,500	4%	430	667	n/a	6,060	62	0.0025	0.0005	62	0.06	0.15	62
43	Glenn	Diesel	unknown	200	3,500	4%	430	667	n/a	7,482	76	0.0031	0.0006	76	0.08	0.18	77
45	Glenn	Diesel	unknown	160	4,000	4%	491	667	n/a	5,985	61	0.0025	0.0005	61	0.06	0.15	61
46	Glenn	Diesel	unknown	155	3,000	3%	368	667	n/a	5,798	59	0.0024	0.0005	59	0.06	0.14	59
47	Glenn	Diesel	unknown	125	3,000	3%	368	667	n/a	4,676	48	0.0019	0.0004	48	0.05	0.12	48
51	Glenn	Diesel	unknown	125	1,500	2%	184	667	n/a	4,676	48	0.0019	0.0004	48	0.05	0.12	48
190	Glenn	Diesel	unknown	160	3,000	3%	368	667	n/a	5,985	61	0.0025	0.0005	61	0.06	0.15	61
191	Glenn	Diesel	unknown	200	2,500	3%	307	667	n/a	7,482	76	0.0031	0.0006	76	0.08	0.18	77
196	Colusa	Diesel	unknown	250	2,000	2%	246	667	n/a	9,352	95	0.0039	0.0008	95	0.10	0.23	96
				Total	**93,620**	**100%**	**11,495**	**27,340**	**782,766**	**166,172**	**1,770**	**0.0802**	**0.0152**	**1,770**	**2.00**	**4.52**	**1,776**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Henle Family LP
Transfer Volume 700 acre-feet/year

Table F-12. Henle Family LP Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	1	0	0	1
Total	0	1	0	0	1

Table F-13. Henle Family LP GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
Well #2	Sutter	Electric	unknown	200	3,600	100%	700	1,056	157,612	n/a	15	0.0023	0.0003	15	0.06	0.09	15
				Total	**3,600**	**100%**	**700**	**1,056**	**157,612**	**0**	**15**	**0.0023**	**0.0003**	**15**	**0.06**	**0.09**	**15**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Maxwell Irrigation District
Transfer Volume 3,000 acre-feet/year

Table F-14. Maxwell Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	2	0	0	0	2
Total	2	0	0	0	2

Table F-15. Maxwell Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
MainWell	Colusa	Diesel	2006	215	3,800	50%	1,500	2,144	n/a	25,857	264	0.0107	0.0021	264	0.27	0.64	265
TuttleWell	Colusa	Diesel	2006	215	3,800	50%	1,500	2,144	n/a	25,857	264	0.0107	0.0021	264	0.27	0.64	265
				Total	**7,600**	**100%**	**3,000**	**4,288**	**0**	**51,715**	**528**	**0.0214**	**0.0043**	**528**	**0.54**	**1.28**	**530**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Natomas Central Mutual Water Company
Transfer Volume 20,000 acre-feet/year

Table F-16. Natomas Central Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sacramento	2	13	0	1	16
Sutter	2	15	0	4	21
Total	4	28	0	5	37

Table F-17. Natomas Central Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
Ameral	Sacramento	Propane	unknown	200	1,500	2%	428	1,551	n/a	788	50	0.0024	0.0005	50	0.06	0.14	50
TNBC Atkinson	Sutter	Electric	unknown	125	1,800	3%	514	1,551	144,642	n/a	14	0.0021	0.0003	14	0.05	0.08	14
TNBC Bennett North	Sutter	Electric	unknown	125	2,200	3%	628	1,551	144,642	n/a	14	0.0021	0.0003	14	0.05	0.08	14
TNBC Betts	Sacramento	Electric	unknown	125	1,500	2%	428	1,551	144,642	n/a	25	0.0021	0.0003	25	0.05	0.08	25
Bianchi	Sutter	Propane	unknown	200	1,500	2%	428	1,551	n/a	788	50	0.0024	0.0005	50	0.06	0.14	50
Dhaliwal	Sacramento	Electric	unknown	125	3,000	4%	857	1,551	144,642	n/a	25	0.0021	0.0003	25	0.05	0.08	25
Elkhorn	Sacramento	Electric	unknown	125	2,700	4%	771	1,551	144,642	n/a	25	0.0021	0.0003	25	0.05	0.08	25
TNBC Frazer	Sutter	Electric	unknown	125	2,000	3%	571	1,551	144,642	n/a	14	0.0021	0.0003	14	0.05	0.08	14
Greenbriar	Sacramento	Electric	unknown	150	3,200	5%	914	1,551	173,571	n/a	30	0.0025	0.0003	30	0.06	0.09	30
Kubo	Sacramento	Electric	unknown	25	1,300	2%	371	1,551	28,928	n/a	5	0.0004	0.0001	5	0.01	0.02	5
L-1	Sutter	Diesel	unknown	125	1,600	2%	457	1,551	n/a	10,874	111	0.0045	0.0009	111	0.11	0.27	111
L-10	Sutter	Electric	unknown	30	1,000	1%	286	1,551	34,714	n/a	3	0.0005	0.0001	3	0.01	0.02	3
L-11	Sutter	Electric	unknown	50	1,500	2%	428	1,551	57,857	n/a	5	0.0008	0.0001	5	0.02	0.03	5
L-12	Sutter	Electric	unknown	50	1,500	2%	428	1,551	57,857	n/a	5	0.0008	0.0001	5	0.02	0.03	5
L-13 Bolen Pasture	Sutter	Propane	unknown	200	2,800	4%	799	1,551	n/a	788	50	0.0024	0.0005	50	0.06	0.14	50
L-14 Chappell	Sutter	Electric	unknown	75	1,800	3%	514	1,551	86,785	n/a	8	0.0013	0.0002	8	0.03	0.05	8
L-2	Sutter	Electric	unknown	30	1,900	3%	542	1,551	34,714	n/a	3	0.0005	0.0001	3	0.01	0.02	3
L-3	Sutter	Electric	unknown	50	1,300	2%	371	1,551	57,857	n/a	5	0.0008	0.0001	5	0.02	0.03	5
L-4	Sutter	Electric	unknown	75	1,300	2%	371	1,551	86,785	n/a	8	0.0013	0.0002	8	0.03	0.05	8
L-6	Sutter	Electric	unknown	50	2,000	3%	571	1,551	57,857	n/a	5	0.0008	0.0001	5	0.02	0.03	5
L-7	Sutter	Electric	unknown	30	1,200	2%	343	1,551	34,714	n/a	3	0.0005	0.0001	3	0.01	0.02	3
L-8	Sutter	Electric	unknown	200	2,800	4%	799	1,551	231,427	n/a	22	0.0034	0.0004	22	0.08	0.13	22
L-9	Sutter	Electric	unknown	50	1,500	2%	428	1,551	57,857	n/a	5	0.0008	0.0001	5	0.02	0.03	5
Lauppe	Sutter	Propane	unknown	200	1,050	1%	300	1,551	n/a	788	50	0.0024	0.0005	50	0.06	0.14	50
L-MW	Sutter	Propane	unknown	200	1,800	3%	514	1,551	n/a	788	50	0.0024	0.0005	50	0.06	0.14	50
TNBC Lucich North	Sutter	Diesel	unknown	170	2,500	4%	714	1,551	n/a	14,788	151	0.0061	0.0012	151	0.15	0.36	152
MAP	Sacramento	Electric	unknown	125	2,000	3%	571	1,551	144,642	n/a	25	0.0021	0.0003	25	0.05	0.08	25
TNBC Fisherman's Lake	Sacramento	Electric	unknown	125	1,500	2%	428	1,551	144,642	n/a	25	0.0021	0.0003	25	0.05	0.08	25
Ose-1	Sacramento	Diesel	2013	200	1,800	3%	514	1,551	n/a	17,398	178	0.0072	0.0014	178	0.18	0.43	178
Ose-2	Sacramento	Electric	unknown	150	2,400	3%	685	1,551	173,571	n/a	30	0.0025	0.0003	30	0.06	0.09	30
Perry	Sacramento	Electric	unknown	125	2,600	4%	742	1,551	144,642	n/a	25	0.0021	0.0003	25	0.05	0.08	25
Plant 3	Sacramento	Electric	unknown	150	2,500	4%	714	1,551	173,571	n/a	30	0.0025	0.0003	30	0.06	0.09	30
Pond R	Sacramento	Electric	unknown	50	2,300	3%	657	1,551	57,857	n/a	10	0.0008	0.0001	10	0.02	0.03	10
TNBC Silva Dairy	Sacramento	Electric	unknown	125	1,000	1%	286	1,551	144,642	n/a	25	0.0021	0.0003	25	0.05	0.08	25
Souza	Sacramento	Electric	unknown	40	1,200	2%	343	1,551	46,285	n/a	8	0.0007	0.0001	8	0.02	0.03	8
Spangler	Sutter	Electric	unknown	80	2,500	4%	714	1,551	92,571	n/a	9	0.0013	0.0002	9	0.03	0.05	9
Willey	Sacramento	Diesel	2012	148	2,000	3%	571	1,551	n/a	12,874	131	0.0053	0.0011	131	0.13	0.32	132
				Total	**70,050**	**100%**	**20,000**	**57,371**	**2,991,200**	**59,876**	**1,226**	**0.0784**	**0.0124**	**1,226**	**2**	**4**	**1,232**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to max horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Pelger Mutual Water Company
Transfer Volume 4,670 acre-feet/year

Table F-18. Pelger Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	1	3	0	0	4
Total	1	3	0	0	4

Table F-19. Pelger Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
PMWC#1	Sutter	Electric	unknown	150	4,800	33%	1,546	1,749	195,796	n/a	18	0.0028	0.0004	18	0.07	0.11	18
Well 1 Tucker	Sutter	Electric	unknown	75	3,100	21%	998	1,749	97,898	n/a	9	0.0014	0.0002	9	0.04	0.05	9
Well 2 Flopet	Sutter	Diesel	2008	125	2,300	16%	741	1,749	n/a	12,266	125	0.0051	0.0010	125	0.13	0.30	126
Well 3 Klein	Sutter	Electric	unknown	150	4,300	30%	1,385	1,749	195,796	n/a	18	0.0028	0.0004	18	0.07	0.11	18
				Total	**14,500**	**100%**	**4,670**	**6,996**	**489,489**	**12,266**	**171**	**0.0122**	**0.0019**	**171**	**0.30**	**0.57**	**172**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Pelger Road 1700 LLC
Transfer Volume 5,200 acre-feet/year

Table F-20. Pelger Road 1700 LLC Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	6	0	0	6
Total	0	6	0	0	6

Table F-21. Pelger Road 1700 LLC GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
North Well	Sutter	Electric	unknown	200	3,500	19%	973	1,510	225,400	n/a	21	0.0033	0.0004	21	0.08	0.12	21
North Well B	Sutter	Electric	unknown	200	3,000	16%	834	1,510	225,400	n/a	21	0.0033	0.0004	21	0.08	0.12	21
South Well	Sutter	Electric	unknown	200	3,000	16%	834	1,510	225,400	n/a	21	0.0033	0.0004	21	0.08	0.12	21
South Well B	Sutter	Electric	unknown	200	3,000	16%	834	1,510	225,400	n/a	21	0.0033	0.0004	21	0.08	0.12	21
Well #3	Sutter	Electric	unknown	200	3,100	17%	862	1,510	225,400	n/a	21	0.0033	0.0004	21	0.08	0.12	21
Well #4	Sutter	Electric	unknown	200	3,100	17%	862	1,510	225,400	n/a	21	0.0033	0.0004	21	0.08	0.12	21
				Total	**18,700**	**100%**	**5,200**	**9,061**	**1,352,403**	**0**	**127**	**0.0196**	**0.0025**	**127**	**0.49**	**0.73**	**128**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency	Pleasant Grove-Verona Mutual Water Company
Transfer Volume	15,000 acre-feet/year

Table F-22. Pleasant Grove-Verona Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	11	20	0	3	34
Total	11	20	0	3	34

Table F-23. Pleasant Grove-Verona Mutual Water Company GHG Emissions

	Well Location			Power Rating	Pump Rate		Transfer Volume	Operation		Fuel Consumption	GHG Emissions (tonnes per year)			GHG Emissions (MTCO2e per year)			
Well	(County)	Fuel Type	Model Year	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr) - diesel (MMBtu/yr) - propane	CO2	CH4	N2O	CO2	CH4	N2O	Total
Kelly 190 Field Well #2	Sutter	Electric	unknown	30	2,100	3%	427	1,104	24,713	n/a	2	0.0004	0.0000	2	0.01	0.01	2
Kelly Windmill Field Well #2	Sutter	Electric	2002	62.1	2,000	3%	407	1,104	51,155	n/a	5	0.0007	0.0001	5	0.02	0.03	5
Kelly Windmill North Field Well	Sutter	Propane	2014	133	1,800	2%	366	1,104	n/a	373	23	0.0011	0.0002	23	0.03	0.07	24
Kelly306	Sutter	Electric	unknown	60	3,500	5%	711	1,104	49,425	n/a	5	0.0007	0.0001	5	0.02	0.03	5
MLF Clubhouse B Well	Sutter	Electric	unknown	300	3,600	5%	732	1,104	247,126	n/a	23	0.0036	0.0004	23	0.09	0.13	23
MLF Marsh Well	Sutter	Electric	unknown	300	3,200	4%	650	1,104	247,126	n/a	23	0.0036	0.0004	23	0.09	0.13	23
MLF Monster Well	Sutter	Electric	unknown	60	3,100	4%	630	1,104	49,425	n/a	5	0.0007	0.0001	5	0.02	0.03	5
MLF Well #1	Sutter	Electric	unknown	30	2,000	3%	407	1,104	24,713	n/a	2	0.0004	0.0000	2	0.01	0.01	2
MLF Well #16	Sutter	Electric	unknown	50	1,700	2%	346	1,104	41,188	n/a	4	0.0006	0.0001	4	0.01	0.02	4
MLF Well#11	Sutter	Diesel	2004	250	1,400	2%	285	1,104	n/a	15,482	158	0.0064	0.0013	158	0.16	0.38	159
MLF Well#12/17	Sutter	Electric	unknown	50	2,200	3%	447	1,104	41,188	n/a	4	0.0006	0.0001	4	0.01	0.02	4
MLF Well#13&#15	Sutter	Electric	2000	215	1,900	3%	386	1,104	177,107	n/a	17	0.0026	0.0003	17	0.06	0.10	17
MLF Well#2B	Sutter	Electric	2000	300	2,800	4%	569	1,104	247,126	n/a	23	0.0036	0.0004	23	0.09	0.13	23
Nicholas 72-Acre Field North	Sutter	Electric	unknown	40	1,700	2%	346	1,104	32,950	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Nicholas 72-Acre Field South	Sutter	Diesel	2002	62.1	2,000	3%	407	1,104	n/a	3,846	39	0.0016	0.0003	39	0.04	0.09	39
Nicholas BBC Well	Sutter	Electric	unknown	30	2,000	3%	407	1,104	24,713	n/a	2	0.0004	0.0000	2	0.01	0.01	2
Nicholas Filipino Camp South	Sutter	Diesel	2002	62.1	800	1%	163	1,104	n/a	3,846	39	0.0016	0.0003	39	0.04	0.09	39
Nicholas Filipino Camp#2	Sutter	Electric	unknown	40	2,300	3%	467	1,104	32,950	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Nicholas Johnston Field Well #2	Sutter	Electric	unknown	40	2,000	3%	407	1,104	32,950	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Nicholas Sand Field Well	Sutter	Diesel	2002	62.1	2,000	3%	407	1,104	n/a	3,846	39	0.0016	0.0003	39	0.04	0.09	39
RiverRanch#19	Sutter	Diesel	2008	99	2,500	3%	508	1,104	n/a	6,131	63	0.0025	0.0005	63	0.06	0.15	63
S&O#16	Sutter	Electric	2014	159	2,000	3%	407	1,104	130,977	n/a	12	0.0019	0.0002	12	0.05	0.07	12
S&O#17	Sutter	Diesel	1999	101	3,000	4%	610	1,104	n/a	6,255	64	0.0026	0.0005	64	0.06	0.15	64
S&O#18A	Sutter	Diesel	1999	101	1,800	2%	366	1,104	n/a	6,255	64	0.0026	0.0005	64	0.06	0.15	64
S&O#19	Sutter	Diesel	2007	215	1,800	2%	366	1,104	n/a	13,314	136	0.0055	0.0011	136	0.14	0.33	136
S&O#20	Sutter	Propane	2014	154	1,800	2%	366	1,104	n/a	432	27	0.0013	0.0003	27	0.03	0.08	27
Willey#1	Sutter	Diesel	2000	168	3,000	4%	610	1,104	n/a	10,404	106	0.0043	0.0009	106	0.11	0.26	107
Willey#3	Sutter	Electric	unknown	75	1,800	2%	366	1,104	61,782	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Willey#4	Sutter	Diesel	1974	150	2,000	3%	407	1,104	n/a	9,289	95	0.0038	0.0008	95	0.10	0.23	95
Willey#5	Sutter	Propane	unknown	180	2,000	3%	407	1,104	n/a	505	32	0.0015	0.0003	32	0.04	0.09	32
Will-Lee Well#31	Sutter	Electric	unknown	50	1,500	2%	305	1,104	41,188	n/a	4	0.0006	0.0001	4	0.01	0.02	4
Will-Lee Well#32	Sutter	Electric	unknown	300	2,500	3%	508	1,104	247,126	n/a	23	0.0036	0.0004	23	0.09	0.13	23
Will-Lee Well#33	Sutter	Electric	unknown	75	2,500	3%	508	1,104	61,782	n/a	6	0.0009	0.0001	6	0.02	0.03	6
Will-Lee Well#4A	Sutter	Diesel	2000	160	1,500	2%	305	1,104	n/a	9,908	101	0.0041	0.0008	101	0.10	0.24	102
				Total	**73,800**	**100%**	**15,000**	**37,530**	**1,866,711**	**n/a**	**1,161**	**0.0677**	**0.0115**	**1,161**	**1.69**	**3.43**	**1,167**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency	Princeton-Codora-Glenn Irrigation District	
Transfer Volume	6,600	acre-feet/year

Table F-24. Princeton-Codora-Glenn Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	2	1	0	0	3
Colusa	1	1	0	0	2
Total	3	2	0	0	5

Table F-25. Princeton-Codora-Glenn Irrigation District GHG Emissions

	Well						Transfer			Fuel	GHG Emissions						
	Location			Power Rating	Pump Rate		Volume	Operation		Consumption	(tonnes per year)			(MTCO2e per year)			
Well	(County)	Fuel Type	Model Year	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
J. Southam	Colusa	Electric	unknown	200	4,000	24%	1,553	2,108	314,694	n/a	29	0.0046	0.0006	29	0.11	0.17	30
Joel Mann	Glenn	Diesel	unknown	180	3,500	21%	1,359	2,108	n/a	21,291	217	0.0088	0.0018	217	0.22	0.53	218
Jones Well	Glenn	Electric	2012	200	3,500	21%	1,359	2,108	314,694	n/a	29	0.0046	0.0006	29	0.11	0.17	30
M. Cota	Colusa	Diesel	unknown	180	3,000	18%	1,165	2,108	n/a	21,291	217	0.0088	0.0018	217	0.22	0.53	218
Zoller A	Glenn	Diesel	unknown	180	3,000	18%	1,165	2,108	n/a	21,291	217	0.0088	0.0018	217	0.22	0.53	218
				Total	**17,000**	**100%**	**6,600**	**10,542**	**629,387**	**63,874**	**711**	**0.0356**	**0.0064**	**711**	**0.89**	**1.92**	**714**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Agency Provident Irrigation District
Transfer Volume 10,000 acre-feet/year

Table F-26. Provident Irrigation District Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	13	3	0	0	16
Colusa	0	0	0	0	0
Total	13	3	0	0	16

Table F-27. Provident Irrigation District GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
Calvert	Glenn	Diesel	unknown	150	3,000	6%	600	1,086	n/a	9,140	93	0.0038	0.0008	93	0.09	0.23	94
D. Alves	Glenn	Diesel	unknown	165	3,000	6%	600	1,086	n/a	10,054	103	0.0042	0.0008	103	0.10	0.25	103
D. Kennedy	Glenn	Electric	unknown	120	3,000	6%	600	1,086	97,269	n/a	9	0.0014	0.0002	9	0.04	0.05	9
E Weller	Glenn	Diesel	unknown	200	2,500	5%	500	1,086	n/a	12,187	124	0.0050	0.0010	124	0.13	0.30	125
G. Clark #1	Glenn	Diesel	unknown	200	3,000	6%	600	1,086	n/a	12,187	124	0.0050	0.0010	124	0.13	0.30	125
K Hansen#1	Glenn	Diesel	unknown	200	2,600	5%	520	1,086	n/a	12,187	124	0.0050	0.0010	124	0.13	0.30	125
K Hansen#2	Glenn	Electric	unknown	120	3,500	7%	700	1,086	97,269	n/a	9	0.0014	0.0002	9	0.04	0.05	9
L Hansen#1	Glenn	Diesel	unknown	200	3,800	8%	760	1,086	n/a	12,187	124	0.0050	0.0010	124	0.13	0.30	125
L Hansen#2	Glenn	Diesel	unknown	200	4,500	9%	900	1,086	n/a	12,187	124	0.0050	0.0010	124	0.13	0.30	125
M. Jones #1	Glenn	Diesel	unknown	275	3,000	6%	600	1,086	n/a	16,757	171	0.0069	0.0014	171	0.17	0.41	172
M. Jones #2	Glenn	Diesel	unknown	250	3,000	6%	600	1,086	n/a	15,234	156	0.0063	0.0013	156	0.16	0.38	156
Perez and Perez	Glenn	Diesel	unknown	200	3,200	6%	640	1,086	n/a	12,187	124	0.0050	0.0010	124	0.13	0.30	125
S. Jones #1	Glenn	Diesel	unknown	170	3,200	6%	640	1,086	n/a	10,359	106	0.0043	0.0009	106	0.11	0.26	106
S. Jones #2	Glenn	Diesel	unknown	170	3,200	6%	640	1,086	n/a	10,359	106	0.0043	0.0009	106	0.11	0.26	106
Weller#4	Glenn	Electric	unknown	120	3,500	7%	700	1,086	97,269	n/a	9	0.0014	0.0002	9	0.04	0.05	9
Weller62V	Glenn	Diesel	unknown	200	2,000	4%	400	1,086	n/a	12,187	124	0.0050	0.0010	124	0.13	0.30	125
				Total	**50,000**	**100%**	**10,000**	**17,379**	**291,807**	**157,213**	**1,632**	**0.0693**	**0.0135**	**1,632**	**1.73**	**4.04**	**1,638**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors
1 lb = 453.6 g
1 tonne = 1,000 kg
1 tonne = 1,000,000 g
1 MWh = 1,000 kWh
1 GWh = 1,000,000 kWh
1 kW = 1.34 hp
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential
CO2 1
CH4 25
N2O 298

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Reclamation District 108
Transfer Volume 15,000 acre-feet/year

Table F-28. Reclamation District 108 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	5	7	0	3	15
Yolo	1	3	0	1	5
Total	6	10	0	4	20

Table F-29. Reclamation District 108 GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr) - diesel (MMBtu/yr) - propane	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
Field 1	Colusa	Propane	unknown	105	3,420	6%	896	1,423	n/a	380	24	0.0011	0.0002	24	0.03	0.07	24
Field 100H	Colusa	Diesel	unknown	250	2,385	4%	625	1,423	n/a	19,952	204	0.0083	0.0017	204	0.21	0.49	204
Field 100L1 East	Colusa	Electric	unknown	125	1,950	3%	511	1,423	132,701	n/a	12	0.0019	0.0002	12	0.05	0.07	13
Field 93A	Colusa	Propane	unknown	250	3,500	6%	917	1,423	n/a	904	57	0.0027	0.0005	57	0.07	0.16	57
Field 100M	Colusa	Diesel	unknown	240	2,200	4%	576	1,423	n/a	19,154	196	0.0079	0.0016	196	0.20	0.47	196
Field 107F	Colusa	Electric	unknown	200	3,195	6%	837	1,423	212,322	n/a	20	0.0031	0.0004	20	0.08	0.11	20
Field 125A	Colusa	Propane	unknown	200	2,800	5%	733	1,423	n/a	723	45	0.0022	0.0004	45	0.05	0.13	46
Field 4	Colusa	Electric	unknown	200	3,150	6%	825	1,423	212,322	n/a	20	0.0031	0.0004	20	0.08	0.11	20
Field 53E	Yolo	Propane	unknown	250	2,295	4%	601	1,423	n/a	904	57	0.0027	0.0005	57	0.07	0.16	57
Field 65E	Yolo	Diesel	unknown	250	3,195	6%	837	1,423	n/a	19,952	204	0.0083	0.0017	204	0.21	0.49	204
Field 66C	Yolo	Electric	unknown	150	1,620	3%	424	1,423	159,242	n/a	15	0.0023	0.0003	15	0.06	0.09	15
Field 81D	Colusa	Diesel	unknown	400	4,250	7%	1,113	1,423	n/a	31,923	326	0.0132	0.0026	326	0.33	0.79	327
Field 81E	Colusa	Diesel	unknown	400	4,250	7%	1,113	1,423	n/a	31,923	326	0.0132	0.0026	326	0.33	0.79	327
Field 90B	Colusa	Electric	unknown	125	2,295	4%	601	1,423	132,701	n/a	12	0.0019	0.0002	12	0.05	0.07	13
Field 92C	Colusa	Diesel	unknown	250	1,440	3%	377	1,423	n/a	19,952	204	0.0083	0.0017	204	0.21	0.49	204
Well#1	Colusa	Electric	unknown	100	2,550	4%	668	1,423	106,161	n/a	10	0.0015	0.0002	10	0.04	0.06	10
Well #4	Colusa	Electric	unknown	150	1,250	2%	327	1,423	159,242	n/a	15	0.0023	0.0003	15	0.06	0.09	15
Well #5	Colusa	Electric	unknown	250	4,950	9%	1,297	1,423	265,403	n/a	25	0.0039	0.0005	25	0.10	0.14	25
Well #6	Yolo	Electric	unknown	250	3,375	6%	884	1,423	265,403	n/a	25	0.0039	0.0005	25	0.10	0.14	25
Well#7	Yolo	Electric	unknown	250	3,195	6%	837	1,423	265,403	n/a	25	0.0039	0.0005	25	0.10	0.14	25
				Total	**57,265**	**100%**	**15,000**	**28,451**	**1,910,898**	**145,766**	**1,820**	**0.0956**	**0.0170**	**1,820**	**2.39**	**5.08**	**1,828**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency	Reclamation District 1004
Transfer Volume	7,175 acre-feet/year

Table F-30. Reclamation District 1004 Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Glenn	1	7	0	0	8
Colusa	17	5	0	0	22
Sutter	0	0	0	0	0
Total	18	12	0	0	30

Table F-31. Reclamation District 1004 GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
Barale Well	Colusa	Diesel	TBD	225	4,000	4%	285	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch 10 Field Well No. 496441	Colusa	Diesel	2008	225	5,800	6%	413	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch Club House Well No.496461	Colusa	Electric	unknown	125	3,400	3%	242	387	36,061	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Behring Ranch Nursery Well No. 17N1W10H1	Colusa	Diesel	TBD	225	1,000	1%	71	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch Pearl Well No. 20094	Colusa	Diesel	TBD	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch West Well No.97863	Colusa	Electric	unknown	125	2,300	2%	164	387	36,061	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Drumheller Well No.7	Colusa	Diesel	TBD	225	4,000	4%	285	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
East Morgan Well #1 No. 374667 17N01W14N001M	Colusa	Diesel	TBD	225	2,600	3%	185	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
East Morgan Well#2 No. 498195 17N01W15Q001M	Colusa	Diesel	TBD	225	1,300	1%	93	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Gardener No. 374672	Colusa	Diesel	2008	215	3,500	3%	249	387	n/a	4,663	48	0.0019	0.0004	48	0.05	0.12	48
Gardener No. 498178	Colusa	Diesel	2009	215	3,500	3%	249	387	n/a	4,663	48	0.0019	0.0004	48	0.05	0.12	48
Hall Well No. X	Glenn	Electric	TBD	125	4,500	4%	320	387	36,061	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Hall Well No.369428	Glenn	Electric	2011	125	4,500	4%	320	387	36,061	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Mohammad No.e0084085 17N01W02D001M	Colusa	Electric	TBD	125	4,500	4%	320	387	36,061	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Myers Well #1 No.3457	Glenn	Electric	2006	40	2,200	2%	157	387	11,539	n/a	1	0.0002	0.0000	1	0.00	0.01	1
Myers Well #2 No. 340884	Glenn	Electric	1982	100	4,100	4%	292	387	28,849	n/a	3	0.0004	0.0001	3	0.01	0.02	3
Rancho Caleta No. 726883	Colusa	Diesel	2004	170	4,500	4%	320	387	n/a	3,687	38	0.0015	0.0003	38	0.04	0.09	38
Sikes & Parachini Well #1 WS No.93124	Colusa	Diesel	2006	173	4,000	4%	285	387	n/a	3,752	38	0.0016	0.0003	38	0.04	0.09	38
Sikes & Parachini Well #2 WS No. 374682	Colusa	Diesel	2008	150	4,000	4%	285	387	n/a	3,253	33	0.0013	0.0003	33	0.03	0.08	33
Southam Sartain Well 18N01W26D001M	Glenn	Diesel	TBD	225	4,800	5%	342	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Stone Well #6 No.11334	Colusa	Electric	2006	40	1,800	2%	128	387	11,539	n/a	1	0.0002	0.0000	1	0.00	0.01	1
Wilder Farms Well	Glenn	Electric	unknown	125	2,500	2%	178	387	36,061	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Dan Charter Well#1	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Dan Charter Well#2	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
GVL Well#1	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Behring Ranch Well	Colusa	Electric	unknown	125	4,000	4%	285	387	36,061	n/a	3	0.0005	0.0001	3	0.01	0.02	3
Claudia Charter	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
GVL Well#2	Colusa	Diesel	unknown	225	2,500	2%	178	387	n/a	4,880	50	0.0020	0.0004	50	0.05	0.12	50
Glenn West	Glenn	Electric	unknown	300	4,500	4%	320	387	86,546	n/a	8	0.0013	0.0002	8	0.03	0.05	8
Glenn East	Glenn	Electric	unknown	300	4,500	4%	320	387	86,546	n/a	8	0.0013	0.0002	8	0.03	0.05	8
				Total	**100,800**	**100%**	**7,175**	**11,597**	**477,444**	**83,452**	**897**	**0.041**	**0.008**	**897**	**1.04**	**2.32**	**900**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency River Garden Farms
Transfer Volume 10,000 acre-feet/year

Table F-32. River Garden Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	10	0	0	10
Total	0	10	0	0	10

Table F-33. River Garden Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	GHG Emissions (MTCO2e per year) CO2	CH4	N2O	Total
F-1	Yolo	Electric	unknown	150	3,400	11%	1,147	1,832	205,105	n/a	19	0.0030	0.0004	19	0.07	0.11	19
Field 104 PW	Yolo	Electric	2008	200	2,800	9%	945	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Field 104-09 PW	Yolo	Electric	2009	200	3,276	11%	1,105	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Field 117 PW	Yolo	Electric	2009	200	2,800	9%	945	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Field 65 PW	Yolo	Electric	2008	200	3,200	11%	1,080	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Field 71 PW	Yolo	Electric	2001	200	2,200	7%	742	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Field 91-09 PW	Yolo	Electric	2009	200	3,300	11%	1,113	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Field 93 PW	Yolo	Electric	unknown	200	2,200	7%	742	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Field 98 PW	Yolo	Electric	1963	200	3,177	11%	1,072	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
Shop PW	Yolo	Electric	2009	200	3,287	11%	1,109	1,832	273,473	n/a	26	0.0040	0.0005	26	0.10	0.15	26
				Total	**29,640**	**100%**	**10,000**	**18,323**	**2,666,365**	**0**	**250**	**0.0387**	**0.0048**	**250**	**0.97**	**1.44**	**252**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Information on engine not available; engine assumed to be electric based on other engines used by water agency.
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Roberts Ditch Irrigation Company
Transfer Volume 4,100 acre-feet/year

Table F-34. Roberts Ditch Irrigation Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	7	0	1	8
Total	0	7	0	1	8

Table F-35. Roberts Ditch Irrigation Company GHG Emissions

	Well Location			Power Rating	Pump Rate		Transfer Volume	Operation		Fuel Consumption	GHG Emissions (tonnes per year)			GHG Emissions (MTCO2e per year)			
Well	(County)	Fuel Type	Model Year	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr) - diesel (MMBtu/yr) - propane	CO2	CH4	N2O	CO2	CH4	N2O	Total
Andreotti	Colusa	Propane	unknown	200	2,200	11%	447	1,102	n/a	561	35	0.0017	0.0003	35	0.04	0.10	35
Ash	Colusa	Electric	unknown	250	1,500	7%	304	1,102	205,653	n/a	19	0.0030	0.0004	19	0.07	0.11	19
Hickel	Colusa	Electric	unknown	250	1,300	6%	264	1,102	205,653	n/a	19	0.0030	0.0004	19	0.07	0.11	19
Stegals	Colusa	Electric	unknown	250	1,800	9%	365	1,102	205,653	n/a	19	0.0030	0.0004	19	0.07	0.11	19
Well #1	Colusa	Electric	unknown	350	4,500	22%	913	1,102	287,915	n/a	27	0.0042	0.0005	27	0.10	0.16	27
Well #2	Colusa	Electric	unknown	350	4,500	22%	913	1,102	287,915	n/a	27	0.0042	0.0005	27	0.10	0.16	27
Yearxa North	Colusa	Electric	unknown	250	2,200	11%	447	1,102	205,653	n/a	19	0.0030	0.0004	19	0.07	0.11	19
Yearxa South	Colusa	Electric	unknown	250	2,200	11%	447	1,102	205,653	n/a	19	0.0030	0.0004	19	0.07	0.11	19
				Total	**20,200**	**100%**	**4,100**	**8,818**	**1,604,095**	**561**	**185**	**0.0250**	**0.0032**	**185**	**0.62**	**0.97**	**187**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Information on engine not available; engine assumed to be electric based on other engines used by water agency.
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors
1 bhp-hr = 2,542.5 Btu
1 lb = 453.6 g
1 tonne = 1,000 kg
1 tonne = 1,000,000 g
1 MWh = 1,000 kWh
1 GWh = 1,000,000 kWh
1 kW = 1.34 hp
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential
CO2 1
CH4 25
N2O 298

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Sutter Mutual Water Company
Transfer Volume 18,000 acre-feet/year

Table F-36. Sutter Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	27	10	0	7	44
Total	27	10	0	7	44

Table F-37. Sutter Mutual Water Company GHG Emissions

	Well Location			Power Rating	Pump Rate		Transfer Volume	Operation		Fuel Consumption	GHG Emissions (tonnes per year)			GHG Emissions (MTCO2e per year)			
Well	(County)	Fuel Type	Model Year	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr) - diesel (MMBtu/yr) - propane	CO2	CH4	N2O	CO2	CH4	N2O	Total
Ag Industries - Sioux Creek	Sutter	Diesel	unknown	350	2,800	2%	354	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
Ag Industries - Sutter Basin	Sutter	Diesel	unknown	350	3,000	2%	379	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
BD-1	Sutter	Diesel	unknown	225	2,500	2%	316	686	n/a	8,665	88	0.0036	0.0007	88	0.09	0.21	89
BD-2	Sutter	Diesel	unknown	225	4,000	3%	506	686	n/a	8,665	88	0.0036	0.0007	88	0.09	0.21	89
BD-3	Sutter	Propane	unknown	250	3,000	2%	379	686	n/a	436	27	0.0013	0.0003	27	0.03	0.08	28
DB-1	Sutter	Diesel	unknown	350	4,500	3%	569	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
Driver	Colusa	Diesel	unknown	350	2,500	2%	316	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
F4N	Sutter	Diesel	unknown	290	3,500	2%	442	686	n/a	11,169	114	0.0046	0.0009	114	0.12	0.28	114
FG	Sutter	Propane	unknown	250	1,500	1%	190	686	n/a	436	27	0.0013	0.0003	27	0.03	0.08	28
FT5	Sutter	Diesel	unknown	450	5,200	4%	657	686	n/a	17,331	177	0.0072	0.0014	177	0.18	0.43	178
G-16	Sutter	Electric	unknown	250	4,200	3%	531	686	128,075	n/a	12	0.0019	0.0002	12	0.05	0.07	12
G-2	Sutter	Propane	unknown	125	3,500	2%	442	686	n/a	218	14	0.0007	0.0001	14	0.02	0.04	14
H-1	Sutter	Electric	unknown	150	2,600	2%	329	686	76,845	n/a	7	0.0011	0.0001	7	0.03	0.04	7
Hoppin	Sutter	Electric	unknown	250	2,500	2%	316	686	128,075	n/a	12	0.0019	0.0002	12	0.05	0.07	12
L&N Farms	Sutter	Diesel	unknown	170	5,000	4%	632	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
L1-1	Sutter	Diesel	unknown	350	4,000	3%	506	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
L1-2	Sutter	Diesel	unknown	350	5,000	4%	632	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
L2-1	Sutter	Diesel	unknown	350	5,500	4%	695	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
LM-11	Sutter	Electric	unknown	150	3,100	2%	392	686	76,845	n/a	7	0.0011	0.0001	7	0.03	0.04	7
LM-53	Sutter	Electric	unknown	150	4,000	3%	506	686	76,845	n/a	7	0.0011	0.0001	7	0.03	0.04	7
Matteoli	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
MB-1	Sutter	Propane	unknown	268	5,300	4%	670	686	n/a	468	29	0.0014	0.0003	29	0.04	0.08	30
ME-1	Sutter	Diesel	unknown	350	1,300	1%	164	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
QHR	Sutter	Propane	unknown	250	5,200	4%	657	686	n/a	436	27	0.0013	0.0003	27	0.03	0.08	28
R-24	Sutter	Diesel	unknown	350	2,500	2%	316	686	n/a	13,479	138	0.0056	0.0011	138	0.14	0.33	138
R-29	Sutter	Diesel	unknown	150	2,500	2%	316	686	n/a	5,777	59	0.0024	0.0005	59	0.06	0.14	59
S-18	Sutter	Electric	unknown	100	2,700	2%	341	686	51,230	n/a	5	0.0007	0.0001	5	0.02	0.03	5
TVN	Sutter	Electric	unknown	75	3,000	2%	379	686	38,423	n/a	4	0.0006	0.0001	4	0.01	0.02	4
VR-57	Sutter	Diesel	unknown	450	5,500	4%	695	686	n/a	17,331	177	0.0072	0.0014	177	0.18	0.43	178
Well #1	Sutter	Electric	unknown	250	2,500	2%	316	686	128,075	n/a	12	0.0019	0.0002	12	0.05	0.07	12
Well #10	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #11	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #12	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #13	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #14	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #15	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #16	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #2	Sutter	Electric	unknown	150	2,500	2%	316	686	76,845	n/a	7	0.0011	0.0001	7	0.03	0.04	7
Well #3	Sutter	Electric	unknown	150	2,500	2%	316	686	76,845	n/a	7	0.0011	0.0001	7	0.03	0.04	7
Well #4	Sutter	Propane	unknown	150	2,500	2%	316	686	n/a	262	16	0.0008	0.0002	16	0.02	0.05	17
Well #5	Sutter	Propane	unknown	180	2,500	2%	316	686	n/a	314	20	0.0009	0.0002	20	0.02	0.06	20
Well #6	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #7	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #8	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
Well #9	Sutter	Diesel	unknown	170	2,500	2%	316	686	n/a	6,547	67	0.0027	0.0005	67	0.07	0.16	67
				Total	**142,400**	**100%**	**18,000**	**30,892**	**858,105**	**277,935**	**3,053**	**0.1342**	**0.0259**	**3,053**	**3.35**	**7.72**	**3,064**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 bhp-hr =	2,542.5	Btu
1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Sheet Name Swenson

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Swenson Farms
Transfer Volume 1,300 acre-feet/year

Table F-38. Swenson Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	0	0	0	0
Total	0	0	0	0	0

Table F-39. Swenson Farms GHG Emissions

	Well						Transfer			Fuel	GHG Emissions						
	Location			Power Rating	Pump Rate		Volume	Operation		Consumption	(tonnes per year)			(MTCO2e per year)			
Well	**(County)**	**Fuel Type**	**Model Year**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(gal/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
Well 1	Colusa	Electric	unknown	300	3,500	100%	1,300	2,017	451,606	n/a	42	0.0066	0.0008	42	0.16	0.24	43
				Total	**3,500**	**100%**	**1,300**	**2,017**	**451,606**	**0**	**42**	**0.0066**	**0.0008**	**42**	**0.16**	**0.24**	**43**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors
1 bhp-hr = 2,542.5 Btu
1 lb = 453.6 g
1 tonne = 1,000 kg
1 tonne = 1,000,000 g
1 MWh = 1,000 kWh
1 GWh = 1,000,000 kWh
1 kW = 1.34 hp
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential
CO2 1
CH4 25
N2O 298

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Sycamore Mutual Water Company
Transfer Volume 8,000 acre-feet/year

Table F-40. Sycamore Mutual Water Company Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	5	0	0	5
Total	0	5	0	0	5

Table F-41. Sycamore Mutual Water Company GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	CH4	N2O	GHG Emissions (MTCO2e per year) CO2	CH4	N2O	Total
Well #11	Colusa	Electric	unknown	125	6,409	29%	2,320	1,966	183,356	n/a	17	0.0027	0.0003	17	0.07	0.10	17
Well #14	Colusa	Electric	unknown	125	3,270	15%	1,183	1,966	183,356	n/a	17	0.0027	0.0003	17	0.07	0.10	17
Well #15	Colusa	Electric	unknown	125	3,270	15%	1,183	1,966	183,356	n/a	17	0.0027	0.0003	17	0.07	0.10	17
Well #2a	Colusa	Electric	unknown	125	4,578	21%	1,657	1,966	183,356	n/a	17	0.0027	0.0003	17	0.07	0.10	17
Well #2b	Colusa	Electric	unknown	125	4,578	21%	1,657	1,966	183,356	n/a	17	0.0027	0.0003	17	0.07	0.10	17
				Total	**22,104**	**100%**	**8,000**	**9,828**	**916,778**	**0**	**86**	**0.0133**	**0.0017**	**86**	**0.33**	**0.50**	**87**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors
1 lb = 453.6 g
1 tonne = 1,000 kg
1 tonne = 1,000,000 g
1 MWh = 1,000 kWh
1 GWh = 1,000,000 kWh
1 kW = 1.34 hp
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential
CO2 1
CH4 25
N2O 298

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

Agency	T&P Farms	
Transfer Volume	1,200	acre-feet/year

Table F-42. T&P Farms Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Colusa	0	2	0	0	2
Total	0	2	0	0	2

Table F-43. T&P Farms GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
NW-1	Colusa	Electric	unknown	125	3,500	58%	700	1,086	101,322	n/a	9	0.0015	0.0002	9	0.04	0.05	10
NW-2	Colusa	Electric	unknown	75	2,500	42%	500	1,086	60,793	n/a	6	0.0009	0.0001	6	0.02	0.03	6
				Total	**6,000**	**100%**	**1,200**	**2,172**	**162,115**	**0**	**15**	**0.0024**	**0.0003**	**15**	**0.06**	**0.09**	**15**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Te Velde Revocable Family Trust
Transfer Volume 7,094 acre-feet/year

Table F-44. Te Velde Revocable Family Trust Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Yolo	0	4	0	0	4
Total	0	4	0	0	4

Table F-45. Te Velde Revocable Family Trust GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
GW1	Yolo	Electric	unknown	150	4,200	32%	2,257	2,919	326,717	n/a	31	0.0047	0.0006	31	0.12	0.18	31
GW10	Yolo	Electric	unknown	150	3,000	23%	1,612	2,919	326,717	n/a	31	0.0047	0.0006	31	0.12	0.18	31
GW11	Yolo	Electric	unknown	150	3,000	23%	1,612	2,919	326,717	n/a	31	0.0047	0.0006	31	0.12	0.18	31
GW4	Yolo	Electric	unknown	150	3,000	23%	1,612	2,919	326,717	n/a	31	0.0047	0.0006	31	0.12	0.18	31
				Total	**13,200**	**100%**	**7,094**	**11,675**	**1,306,867**	**0**	**122**	**0.0190**	**0.0024**	**122**	**0.47**	**0.71**	**123**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend
Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Greenhouse Gas Emissions (Unmitigated)

Agency Windswept Land & Livestock
Transfer Volume 2,000 acre-feet/year

Table F-46. Windswept Land & Livestock Summary of Engines by Fuel Type and Location

County	Diesel	Electric	Natural Gas	Propane	Total
Sutter	0	4	0	0	4
Total	0	4	0	0	4

Table F-47. Windswept Land & Livestock GHG Emissions

Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (tonnes per year) CO2	GHG Emissions (tonnes per year) CH4	GHG Emissions (tonnes per year) N2O	GHG Emissions (MTCO2e per year) CO2	GHG Emissions (MTCO2e per year) CH4	GHG Emissions (MTCO2e per year) N2O	GHG Emissions (MTCO2e per year) Total
NCW-1	Sutter	Electric	2013	200	3,200	30%	598	1,015	151,509	n/a	14	0.0022	0.0003	14	0.05	0.08	14
NCW-2	Sutter	Electric	unknown	200	3,000	28%	561	1,015	151,509	n/a	14	0.0022	0.0003	14	0.05	0.08	14
NCW-3	Sutter	Electric	unknown	200	2,500	23%	467	1,015	151,509	n/a	14	0.0022	0.0003	14	0.05	0.08	14
NCW-4	Sutter	Electric	unknown	200	2,000	19%	374	1,015	151,509	n/a	14	0.0022	0.0003	14	0.05	0.08	14
				Total	**10,700**	**100%**	**2,000**	**4,060**	**606,037**	**0**	**57**	**0.0088**	**0.0011**	**57**	**0.22**	**0.33**	**57**

Key:
AF = acre-feet
CH4 = methane
CO2 = carbon dioxide
gal/yr = gallons per year
GHG = greenhouse gas
gpm = gallons per minute
hp = horsepower
kW/yr = kilowatt hours per year
MTCO2e = metric tons carbon dioxide equivalent
N2O = nitrous oxide

Legend

Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Engine Size Summary

Table F-48. Engine Power Rating Summary by Fuel Type

Fuel Type	No. Engines	Avg. HP	Max HP	Min HP
Diesel	23	170	250	60
Electric	47	125	300	30
Natural Gas	0	n/a	0	0
Propane	3	180	250	135

GHG Emission Factors

Table F-49. GHG Emission Factors for Electric Pumps

County	Utility Company	Emission Factors CO2 (lbs/MWh)	CH4 (lbs/GWh)	N2O (lbs/GWh)
Colusa	Pacific Gas & Electric	206.29	32.0	4.0
Glenn	Pacific Gas & Electric	206.29	32.0	4.0
Sacramento	Sacramento Municipal Utility District	374.85	32.0	4.0
Shasta	Pacific Gas & Electric	206.29	32.0	4.0
Sutter	Pacific Gas & Electric	206.29	32.0	4.0
Tehama	Pacific Gas & Electric	206.29	32.0	4.0
Yolo	Pacific Gas & Electric	206.29	32.0	4.0
Yuba	Pacific Gas & Electric	206.29	32.0	4.0

Table F-50. Utility-Specific CO2 Emission Factors

Emission Rates			
Utility	Factor Type	Emission Factor (lbs CO_2/MWh)	Emission Rate Year
Sacramento Municipal Utility District	Retail Power	374.85	2019
	Self-Consumed Power	527.64	2019
	Wholesale Power	632.60	2019
Pacific Gas & Electric	System average	206.29	2018

Source:

The Climate Registry. 2021. Utility-Specific Emission Factors. Accessed on: December 12, 2021. Available at: https://www.theclimateregistry.org/our-members/cris-public-reports/

Table F-51. Diesel Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	10.21	kg/gallon	Table 1.1, Distillate Fuel Oil No. 2
CH4	3.00E-03	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
N2O	6.00E-04	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
Heat Content	0.138	MMBtu/gallon	Table 1.1, Distillate Fuel Oil No. 2

Source: The Climate Registry. 2022. 2022 Climate Registry Default Emission Factors. Accessed on: December 23, 2022. https://theclimateregistry.org/wp-content/uploads/2022/11/2022-Default-Emission-Factors-Final.pdf

Table F-52. Natural Gas Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	53.06	kg/MMBtu	Table 1.1, US Weighted Average
CH4	1.00E-03	kg/MMBtu	Table 1.9, Natural Gas, Industrial
N2O	1.00E-04	kg/MMBtu	Table 1.9, Natural Gas, Industrial
Heat Content	1,026	Btu/scf	Table 1.1, US Weighted Average

Source: The Climate Registry. 2022. 2022 Climate Registry Default Emission Factors. Accessed on: December 23, 2022. https://theclimateregistry.org/wp-content/uploads/2022/11/2022-Default-Emission-Factors-Final.pdf

Table F-53. Propane Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	62.87	kg/MMBtu	Table 1.1, Propane (liquid)
CH4	3.00E-03	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
N2O	6.00E-04	kg/MMBtu	Table 1.9, Petroleum Products, Industrial
Heat Content	0.091	MMBtu/gal	Table 1.1, Propane (liquid)

Source: The Climate Registry. 2022. 2022 Climate Registry Default Emission Factors. Accessed on: December 23, 2022. https://theclimateregistry.org/wp-content/uploads/2022/11/2022-Default-Emission-Factors-Final.pdf

Table 54. Subregion Output Emission Rates (eGRID2019)

		Total output emission rate (lb/MWh)							Non-baseload output emission rates (lb/MWh)							
eGRID subregion acronym	**eGRID subregion name**	**CO2**	**CH4**	**N2O**	**CO2e**	**Annual NOx**	**Ozone Season NOx**	**SO2**	**CO2**	**CH4**	**N2O**	**CO2e**	**Annual NOx**	**Ozone Season NOx**	**SO2**	**Grid Gross Loss (%)**
AKGD	ASCC Alaska Grid	1,097.6	0.100	0.014	1,104.2	6.0	5.9	0.6	1,315.1	0.126	0.017	1,323.4	6.8	7.0	0.7	5.5%
AKMS	ASCC Miscellaneous	534.1	0.027	0.005	536.1	8.3	8.0	0.7	1,517.7	0.066	0.012	1,522.8	24.2	24.8	2.1	5.5%
AZNM	WECC Southwest	846.6	0.054	0.007	850.2	0.5	0.5	0.2	1,368.6	0.090	0.013	1,374.6	0.8	0.8	0.2	5.3%
CAMX	WECC California	513.5	0.032	0.004	515.5	0.5	0.5	0.0	1,006.5	0.053	0.007	1,009.9	0.9	0.9	0.1	5.3%
ERCT	ERCOT All	818.6	0.052	0.007	822.0	0.5	0.5	0.5	1,296.6	0.086	0.012	1,302.3	0.8	0.7	0.9	5.2%
FRCC	FRCC All	835.1	0.049	0.006	838.2	0.3	0.3	0.2	1,011.0	0.052	0.007	1,014.4	0.3	0.3	0.2	5.3%
HIMS	HICC Miscellaneous	1,143.2	0.110	0.017	1,151.1	7.5	7.3	3.9	1,542.1	0.134	0.022	1,551.8	11.4	11.4	5.0	5.6%
HIOA	HICC Oahu	1,653.0	0.178	0.027	1,665.5	3.8	3.8	6.8	1,753.5	0.175	0.027	1,766.0	4.5	4.5	7.9	5.6%
MROE	MRO East	1,526.4	0.139	0.020	1,535.8	1.0	1.0	0.4	1,628.9	0.143	0.021	1,638.5	1.1	1.1	0.4	5.3%
MROW	MRO West	979.5	0.104	0.015	986.6	0.7	0.8	0.9	1,810.0	0.185	0.027	1,822.5	1.3	1.3	1.6	5.3%
NEWE	NPCC New England	528.2	0.074	0.010	533.0	0.4	0.4	0.1	882.5	0.070	0.009	886.9	0.4	0.4	0.1	5.3%
NWPP	WECC Northwest	600.0	0.056	0.008	603.8	0.5	0.5	0.3	1,653.0	0.159	0.023	1,663.8	1.5	1.5	0.8	5.3%
NYCW	NPCC NYC/Westchester	634.6	0.022	0.003	636.0	0.2	0.2	0.0	970.2	0.021	0.002	971.4	0.4	0.4	0.0	5.3%
NYLI	NPCC Long Island	1,203.9	0.138	0.018	1,212.7	0.9	0.8	0.1	1,260.6	0.034	0.004	1,262.6	0.8	0.8	0.1	5.3%
NYUP	NPCC Upstate NY	233.5	0.016	0.002	234.5	0.1	0.1	0.0	877.9	0.042	0.005	880.5	0.4	0.4	0.1	5.3%
PRMS	Puerto Rico Miscellaneous	1,602.2	0.085	0.014	1,608.5	3.9	3.9	4.3	1,673.3	0.070	0.013	1,678.8	4.6	4.5	5.5	0.0%
RFCE	RFC East	652.5	0.045	0.006	655.4	0.3	0.3	0.3	1,233.4	0.085	0.012	1,239.1	0.7	0.7	0.7	5.3%
RFCM	RFC Michigan	1,153.1	0.101	0.014	1,159.8	0.6	0.7	0.8	1,725.7	0.163	0.023	1,736.5	1.1	1.1	1.6	5.3%
RFCW	RFC West	985.0	0.086	0.012	990.8	0.6	0.6	0.7	1,810.4	0.173	0.025	1,822.2	1.2	1.1	1.3	5.3%
RMPA	WECC Rockies	1,144.8	0.101	0.014	1,151.6	0.6	0.6	0.3	1,651.9	0.131	0.019	1,660.8	0.9	0.9	0.4	5.3%
SPNO	SPP North	954.0	0.100	0.014	960.8	0.5	0.5	0.2	1,969.9	0.205	0.030	1,983.9	1.0	1.0	0.4	5.3%
SPSO	SPP South	931.8	0.060	0.009	935.8	0.6	0.7	0.6	1,514.1	0.100	0.014	1,520.8	1.2	1.2	1.1	5.3%
SRMV	SERC Mississippi Valley	740.4	0.032	0.004	742.4	0.6	0.7	0.5	1,137.4	0.055	0.008	1,141.0	0.9	1.1	1.0	5.3%
SRMW	SERC Midwest	1,480.7	0.156	0.023	1,491.4	1.1	1.2	2.6	1,866.5	0.194	0.028	1,879.6	1.6	1.6	2.9	5.3%
SRSO	SERC South	860.2	0.060	0.009	864.2	0.4	0.4	0.2	1,336.9	0.094	0.013	1,343.2	0.7	0.6	0.3	5.3%
SRTV	SERC Tennessee Valley	834.2	0.075	0.011	839.2	0.4	0.4	0.5	1,511.8	0.135	0.019	1,521.0	0.7	0.6	0.9	5.3%
SRVC	SERC Virginia/Carolina	623.1	0.050	0.007	626.3	0.3	0.3	0.2	1,323.9	0.114	0.016	1,331.3	0.7	0.8	0.4	5.3%
U.S.		**818.3**	**0.065**	**0.009**	**822.6**	**0.5**	**0.5**	**0.5**	**1,399.6**	**0.109**	**0.015**	**1,406.8**	**0.9**	**0.9**	**0.8**	**5.3%**

Source: U.S. Environmental Protection Agency. 2022. eGRID Summary Tables 2020. Released January 27, 2022. Available online at: https://www.epa.gov/sites/default/files/2021-02/documents/egrid2019_summary_tables.pdf [Accessed on December 12, 2021].

Table F-55. Reduced Exhaust Emissions from Cropland Idling

Water Agency	Groundwater Substitution	Cropland Idling/ Crop Shifting	GW Pumping Equivalent	Annual Emission (MT/year)			Annual Emissions (MTCO2e/year)			
	(acre-feet/year)	(acre-feet/year)	(acre-feet/year)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Anderson-Cottonwood Irrigation District	4,800	0	0	--	--	--	--	--	--	--
Baber, Jack et al.	0	2,310	544	156	0.01	0.00	156	0	1	157
Canal Farms	1,000	635	149	43	0.00	0.00	43	0	0	43
Conaway Preservation Group	0	21,350	5,024	1,439	0.10	0.02	1,439	3	5	1,447
Eastside Mutual Water Company	2,230	1,800	424	121	0.01	0.00	121	0	0	122
Giusti Farms	1,000	0	0	--	--	--	--	--	--	--
Glenn-Colusa Irrigation District	11,495	60,000	14,118	4,045	0.29	0.05	4,045	7	13	4,065
Henle Family LP	700	0	0	--	--	--	--	--	--	--
Maxwell Irrigation District	3,000	5,000	1,176	337	0.02	0.00	337	1	1	339
Natomas Central Mutual Water Company	20,000	0	0	--	--	--	--	--	--	--
Pelger Mutual Water Company	4,670	2,538	597	171	0.01	0.00	171	0	1	172
Pelger Road 1700 LLC	5,200	0	0	--	--	--	--	--	--	--
Pleasant Grove-Verona Mutual Water Company	15,000	12,000	2,824	809	0.06	0.01	809	1	3	813
Princeton-Codora-Glenn Irrigation District	6,600	6,600	1,553	445	0.03	0.00	445	1	1	447
Provident Irrigation District	10,000	9,900	2,329	667	0.05	0.01	667	1	2	671
Reclamation District 1004	7,175	20,000	4,706	1,348	0.10	0.02	1,348	2	4	1,355
Reclamation District 108	15,000	40,000	9,412	2,696	0.19	0.03	2,696	5	9	2,710
River Garden Farms	10,000	10,000	2,353	674	0.05	0.01	674	1	2	678
Roberts Ditch Irrigation Company	4,100	1,800	424	121	0.01	0.00	121	0	0	122
Sutter Mutual Water Company	18,000	18,000	4,235	1,213	0.09	0.01	1,213	2	4	1,219
Swenson Farms	1,300	1,300	306	88	0.01	0.00	88	0	0	88
Sycamore Mutual Water Company	8,000	10,000	2,353	674	0.05	0.01	674	1	2	678
T&P Farms	1,200	890	209	60	0.00	0.00	60	0	0	60
Te Velde Revocable Family Trust	7,094	6,975	1,641	470	0.03	0.01	470	1	2	473
Windswept Land & Livestock	2,000	0	0	--	--	--	--	--	--	--
Total	**159,564**	**231,098**	**54,377**	**15,579**	**1.11**	**0.17**	**15,579**	**28**	**52**	**15,658**

Notes:
Pelger Mutual Water District used to estimate emissions for other water agencies.
Engine power rating equal to 250 hp for Pelger Mutual Water District engines.
The Byron Buck memo is based on diesel-fueled engines with sizes ranging from 121 to 225 hp; all engines are noncertified (Tier 0).
Pelger Mutual Water District engines are therefore determined to be a sufficient proxy to estimate the difference in emissions between groundwater substitution and cropland idling.

1 acre-foot of groundwater pumped = 4.25 acre-feet produced by fallowing

Source: Byron Buck & Associates. 2009. "Comparison of Summertime Emission Credits from Land Fallowing Versus Groundwater Pumping."

Appendix G
Important Giant Garter Snake Populations

IMPORTANT GIANT GARTER SNAKE POPULATIONS

American Basin Recovery Unit

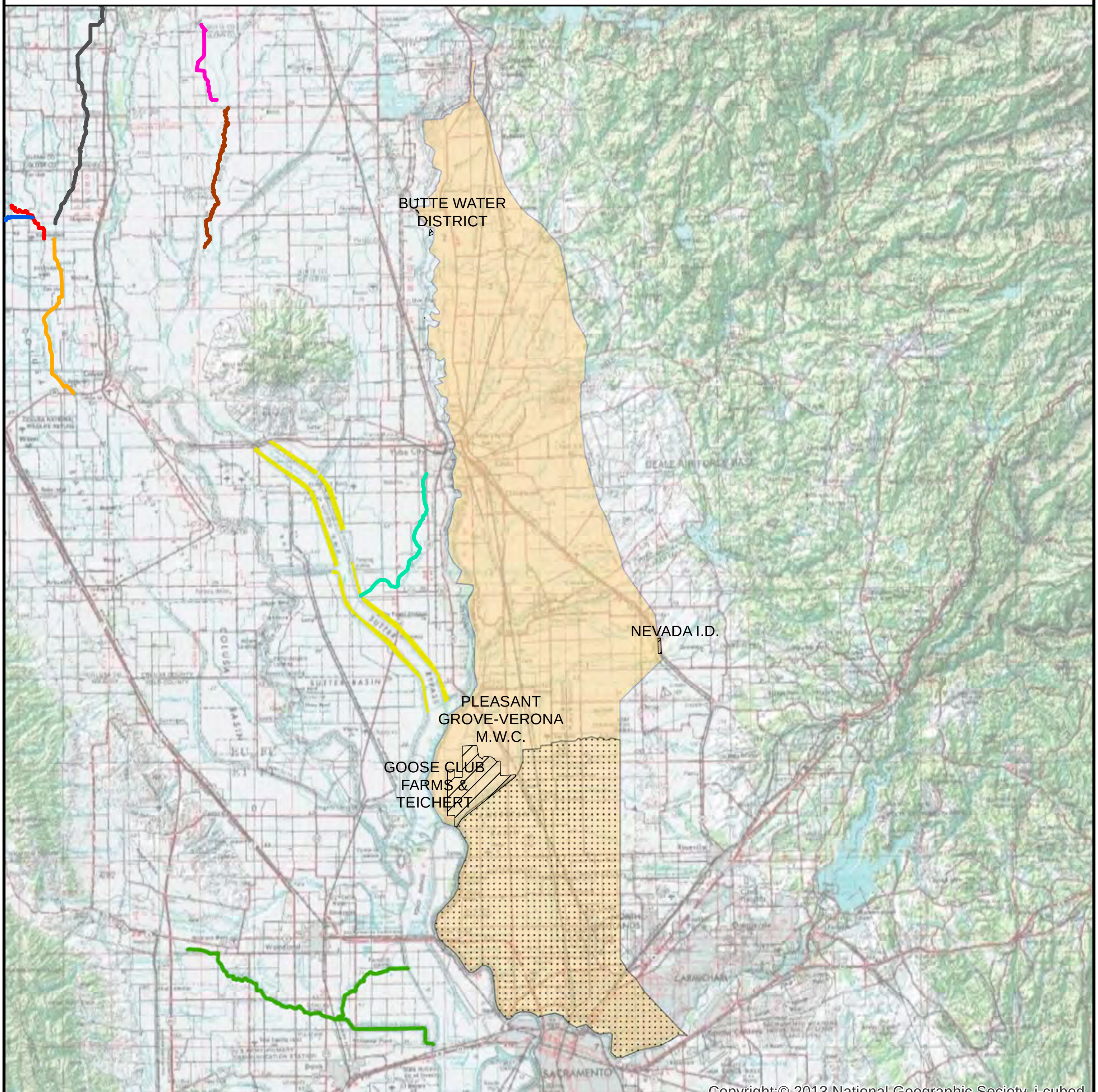
N

- Seller Areas in American Basin
- American Basin (376,104 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Logan Creek Selection
- Little Butte Creek
- Natomas Basin
- Sutter Bypass Toe Drain
- Willow Slough & Bypass

SELLER AREAS IN AMERICAN BASIN (acres)	
BUTTE WATER DISTRICT	55
GOOSE CLUB FARMS & TEICHERT	4
NEVADA IRRIGATION DISTRICT	132
PLEASANT-GROVE-VERONA MUTUAL WATER COMPANY	7429

Datum: NAD 1983

0 2.75 5.5 11 Miles



IMPORTANT GIANT GARTER SNAKE POPULATIONS
Butte Basin Recovery Unit

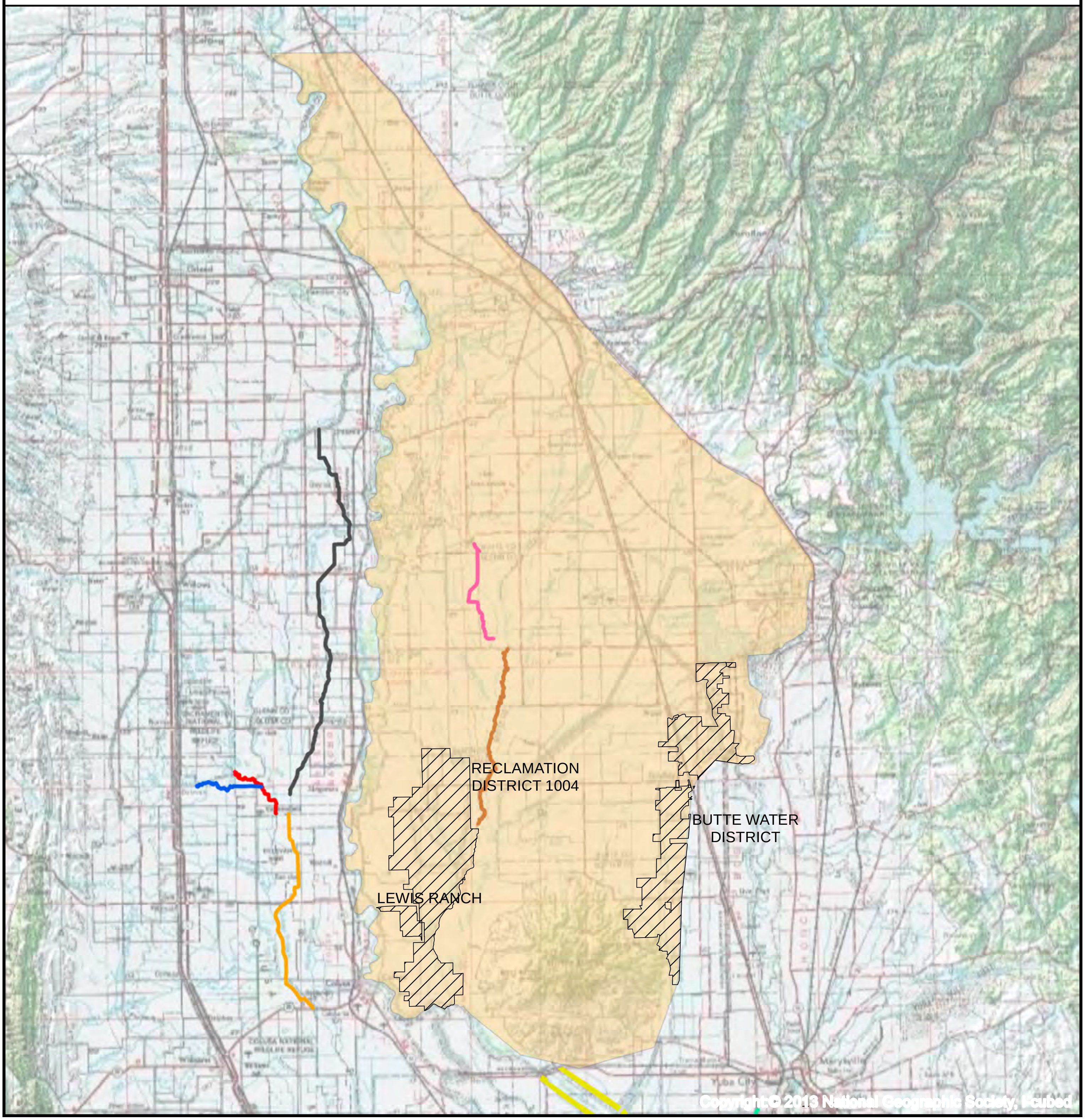
N

- Seller Areas in Butte Basin
- Butte Basin (479,117 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Willow Slough & Bypass
- Sutter Bypass Toe Drain

SELLER AREAS IN BUTTE BASIN (acres)	
BUTTE WATER DISTRICT	17656
LEWIS RANCH	1172
RECLAMATION DISTRICT 1004	23159

Datum: NAD 1983

0 2.25 4.5 9 Miles



IMPORTANT GIANT GARTER SNAKE POPULATIONS

Colusa Basin Recovery Unit

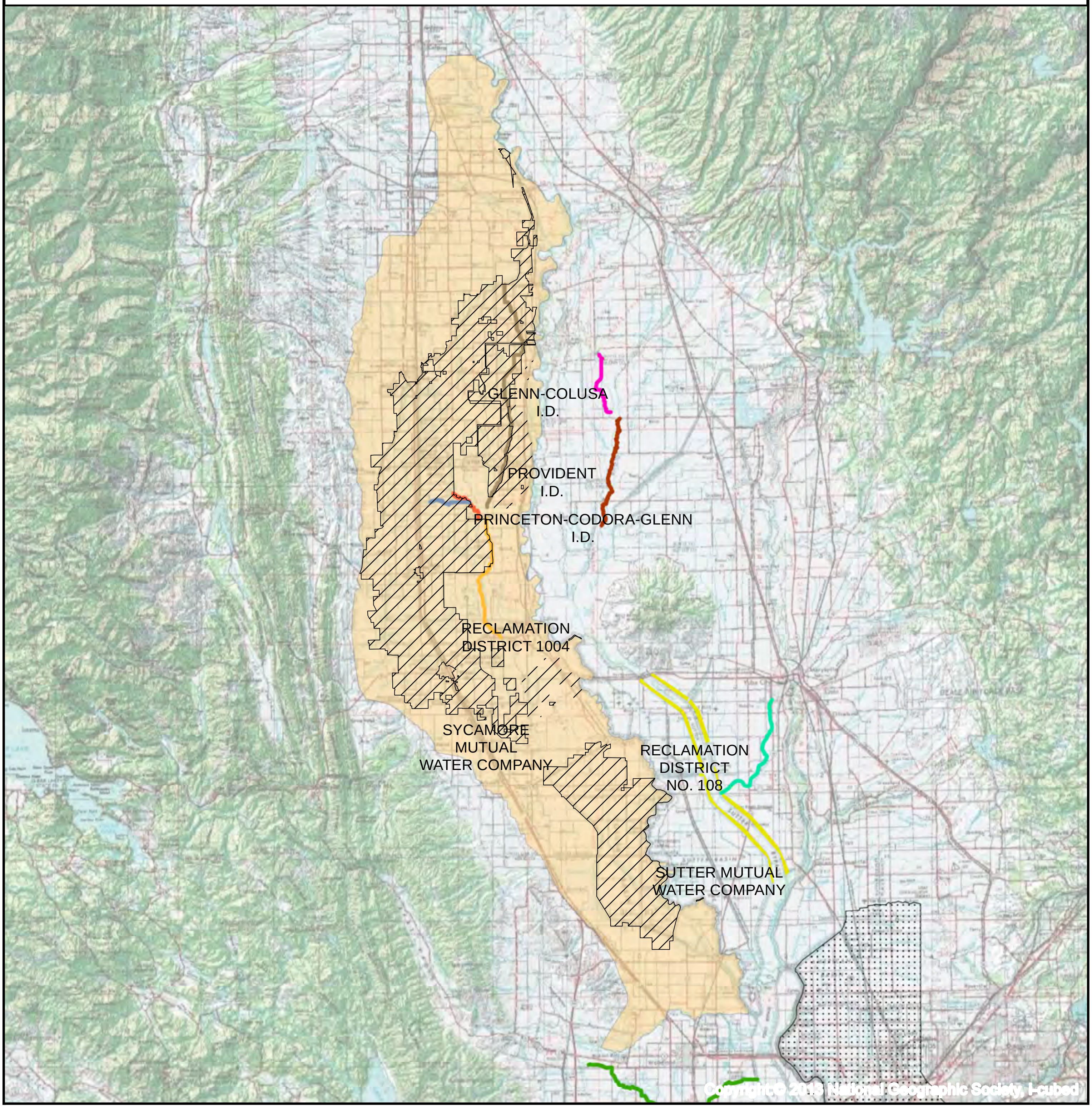
N

- Seller Areas in Colusa Basin
- Colusa Basin (686,096 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Sutter Bypass Toe Drain
- Willow Slough & Bypass

SELLER AREAS IN COLUSA BASIN (acres)	
GLENN-COLUSA IRRIGATION DISTRICT	174886
PRINCETON-CORDORA-GLENN IRRIGATION DISTRCIT	12112
PROVIDENT IRRIGATION DISTRICT	17019
RECLAMATION DISTRICT 1004	54
RECLAMATION DISTRICT 108	58821
SUTTER MUTUAL WATER COMPANY	33
SYCAMORE MUTUAL WATER COMPANY	8431

Datum: NAD 1983

0 3.75 7.5 15 Miles



IMPORTANT GIANT GARTER SNAKE POPULATIONS

Delta Basin Recovery Unit

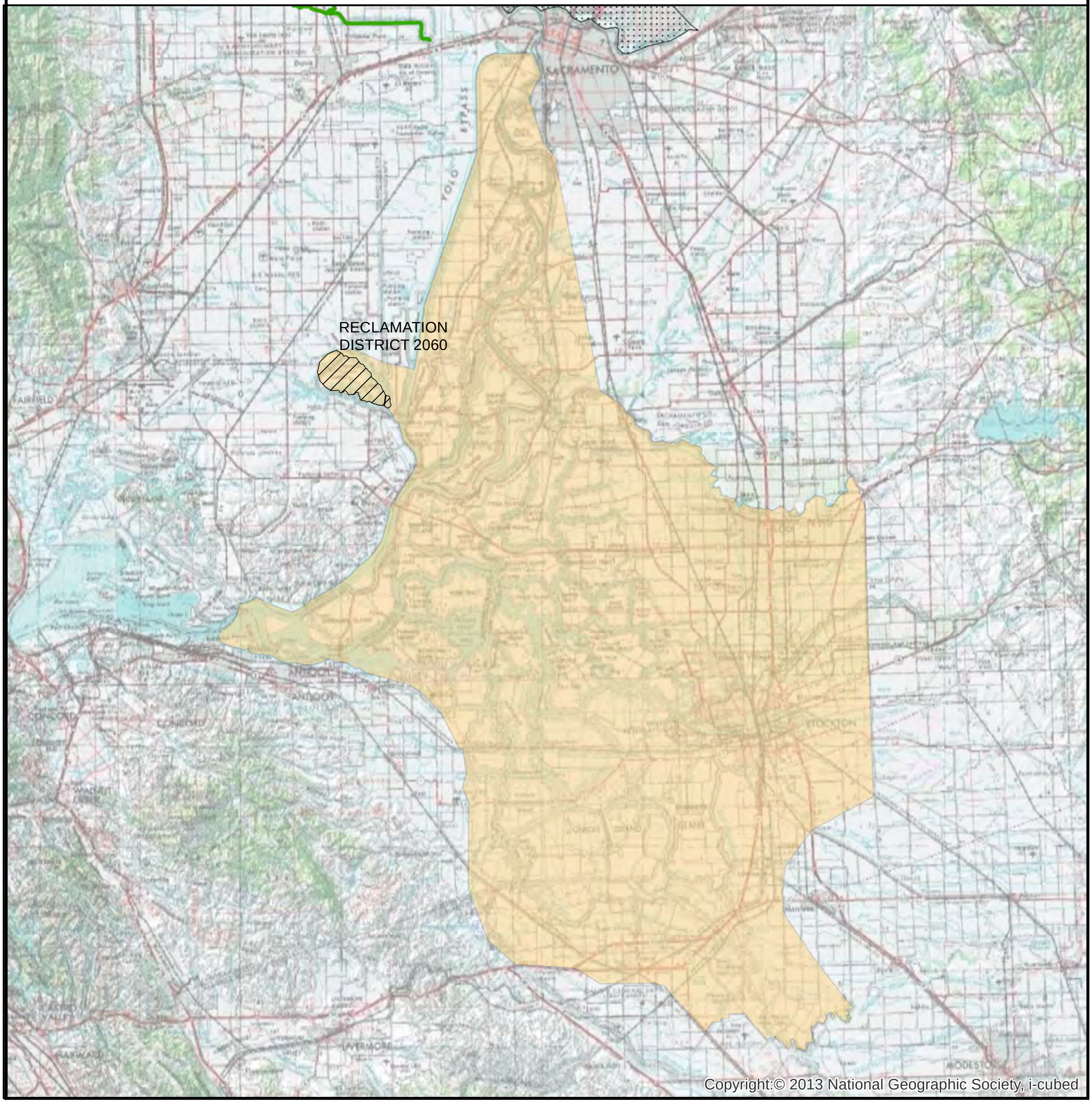
N

- Seller Areas in Delta Basin
- Delta Basin (786,268 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Willow Slough & Bypass
- Sutter Bypass Toe Drain

SELLER AREAS IN DELTA BASIN (acres)	
RECLAMATION DISTRICT 2060	5232

Datum: NAD 1983

0 2.75 5.5 11 Miles



IMPORTANT GIANT GARTER SNAKE POPULATIONS

Sutter Basin Recovery Unit

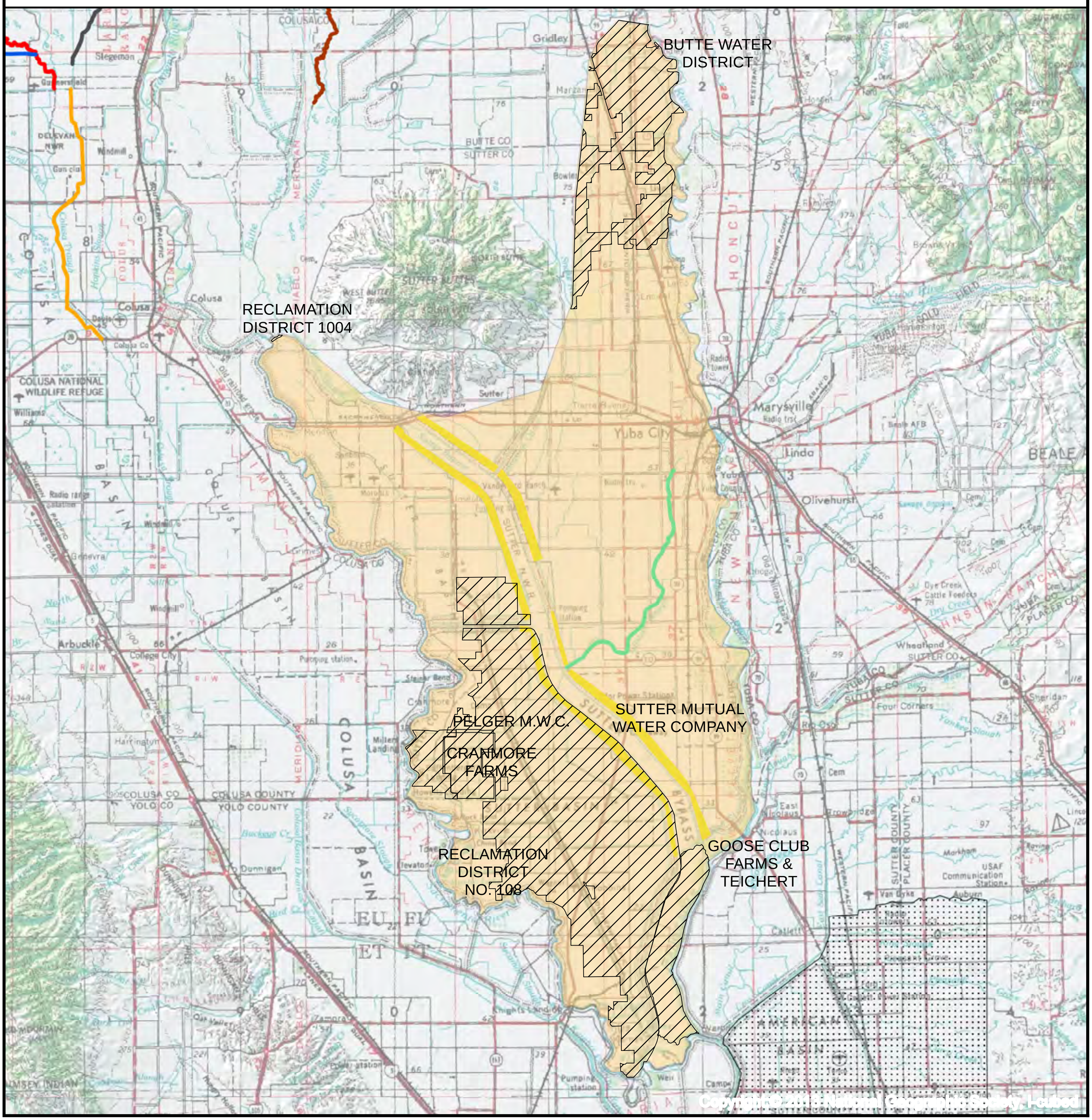
- Seller Areas in Sutter Basin
- Sutter Basin (239,927 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Willow Slough & Bypass
- Sutter Bypass Toe Drain

SELLER AREAS IN SUTTER BASIN (acres)	
BUTTE WATER DISTRICT	14508
CRANMORE FARMS	2219
GOOSE CLUB FARMS & TEICHERT	5724
PELGER MUTUAL WATER COMPANY	2970
RECLAMATION DISTRICT 1004	23
RECLAMATION DISTRICT 108	0.02
SUTTER MUTUAL WATER COMPANY	51085

Datum: NAD 1983

0 1.75 3.5 7 Miles

N



IMPORTANT GIANT GARTER SNAKE POPULATIONS

Yolo Basin Recovery Unit

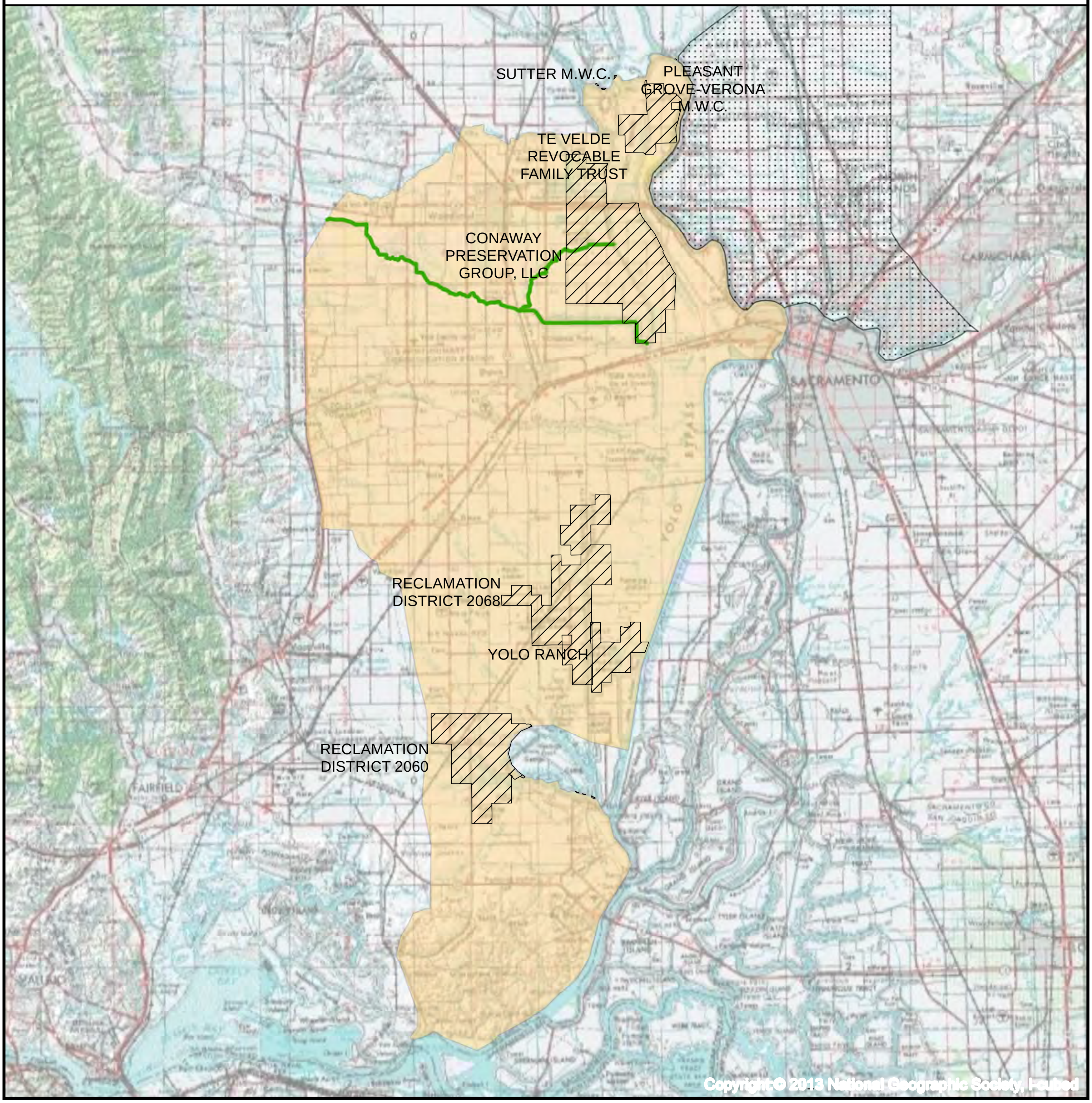
- Seller Areas in Yolo Basin
- Yolo Basin (410,915 acres)
- Butte Creek Selection
- Colusa Basin Drainage Canal Selection
- Colusa Drainage Canal
- Gilsizer Slough
- Hunters Creek Selection
- Little Butte Creek
- Logan Creek Selection
- Natomas Basin
- Sutter Bypass Toe Drain
- Willow Slough & Bypass

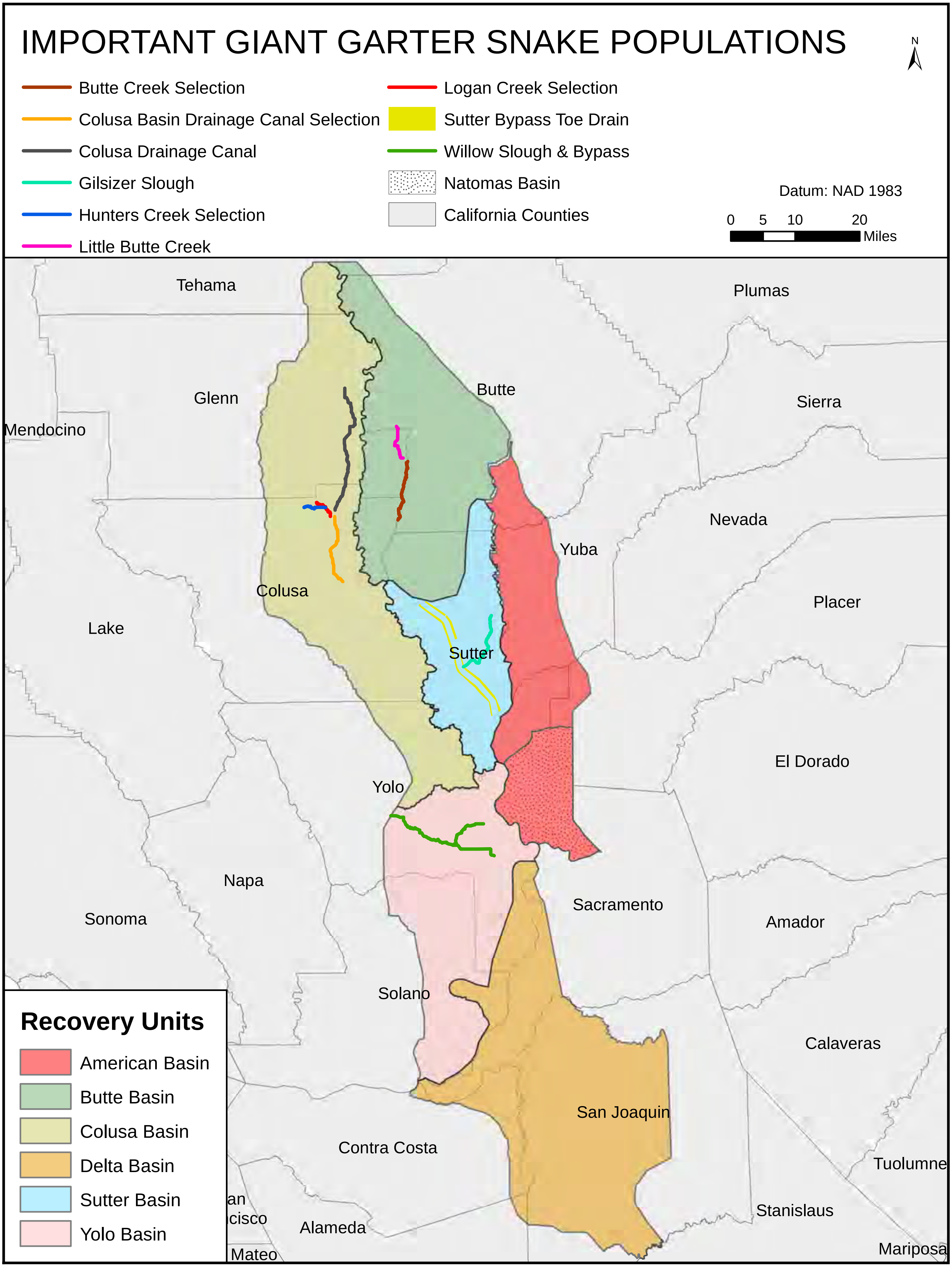
SELLER AREAS IN YOLO BASIN (acres)	
CONAWAY PRESERVATION GROUP, LLC	20463
PLEASANT-GROVE-VERONA MUTUAL WATER COMPANY	3
RECLAMATION DISTRICT 2060	9982
RECLAMATION DISTRICT 2068	13262
TE VELDE REVOCABLE FAMILY TRUST	4406
SUTTER MUTUAL WATER COMPANY	21
YOLO RANCH	3350

Datum: NAD 1983

0 2.25 4.5 9 Miles

N





IMPORTANT GIANT GARTER SNAKE POPULATIONS
N
Butte Creek Selection
Colusa Basin Drainage Canal Selection
Colusa Drainage Canal
Gilsizer Slough
Hunters Creek Selection
Little Butte Creek
Logan Creek Selection
Sutter Bypass Toe Drain
Willow Slough & Bypass
Natomas Basin
California Counties
Datum: NAD 1983
0 5 10 20
Miles
Tehama
Plumas
Glenn
Butte
Sierra
Mendocino
Nevada
Yuba
Colusa
Placer
Lake
Sutter
El Dorado
Yolo
Napa
Sacramento
Sonoma
Amador
Solano
Calaveras
San Joaquin
Contra Costa
Tuolumne
an
cisco
Alameda
Stanislaus
Mateo
Mariposa
Recovery Units
American Basin
Butte Basin
Colusa Basin
Delta Basin
Sutter Basin
Yolo Basin

Appendix H1

Groundwater Modeling Results

Appendix H1
Groundwater Modeling Results

H.1 Numerical Groundwater Modeling Analysis

Numerical groundwater modeling analysis was performed using the Sacramento Valley Finite Element Groundwater Model (SACFEM2013) developed to simulate groundwater conditions in the Sacramento Valley Groundwater Basin. SACFEM2013 was selected as the numerical modeling tool for this analysis based on the state of the model and its capabilities to simulate groundwater conditions at a greater level of detail than other potential modeling tools within the Seller Service Area. Reclamation commissioned a peer review of the SACFEM2013 model in 2010 (WRIME 2011). Revisions were made to the model and the revised model was used for the impacts analysis described here.

SACFEM2013 uses the MicroFEM finite-element numerical modeling code. MicroFEM is capable of simulating multiple aquifer systems in both steady state and transient conditions. The model is capable of simulating groundwater conditions and groundwater/surface water interactions in the valley. SACFEM2013 was also used to estimate how groundwater pumping and recharge affects surface water.

SACFEM2013 covers the entire Sacramento Valley Groundwater Basin from just north of Red Bluff to the Cosumnes River in the south (see Figure H-1). The model was calibrated to historic conditions from Water Years (WY) 1970 through WY 2009. This SACFEM2013 model simulation, which includes highly variable hydrology (from very wet periods to very dry periods), was used as a basis for simulating groundwater substitution pumping. Potential water transfers for 2023 were simulated in SACFEM2013 using September 1977 hydrologic conditions because this year represents the driest condition available during the SACFEM2013 simulation period (WY 1970 to WY 2003).

Groundwater drawdown impacts were assessed based on SACFEM2013 model simulations of the contemplated 2022 TCCA Water Transfers (i.e., groundwater substitution locations and pumping volumes). These simulation results were used to determine the effects to groundwater resources. Most of the 278 well locations used in the modeled 2022 transfer pumping are the same well locations that would be proposed for a potential 2023 water transfer. A potential 2023 water transfer would include the addition of 14 transfer wells and the removal of one well compared to 2022. Figure H-2 shows the location of the modeled 2022 groundwater substitution pumping locations and groundwater substitution pumping locations for a potential 2023 water transfer.

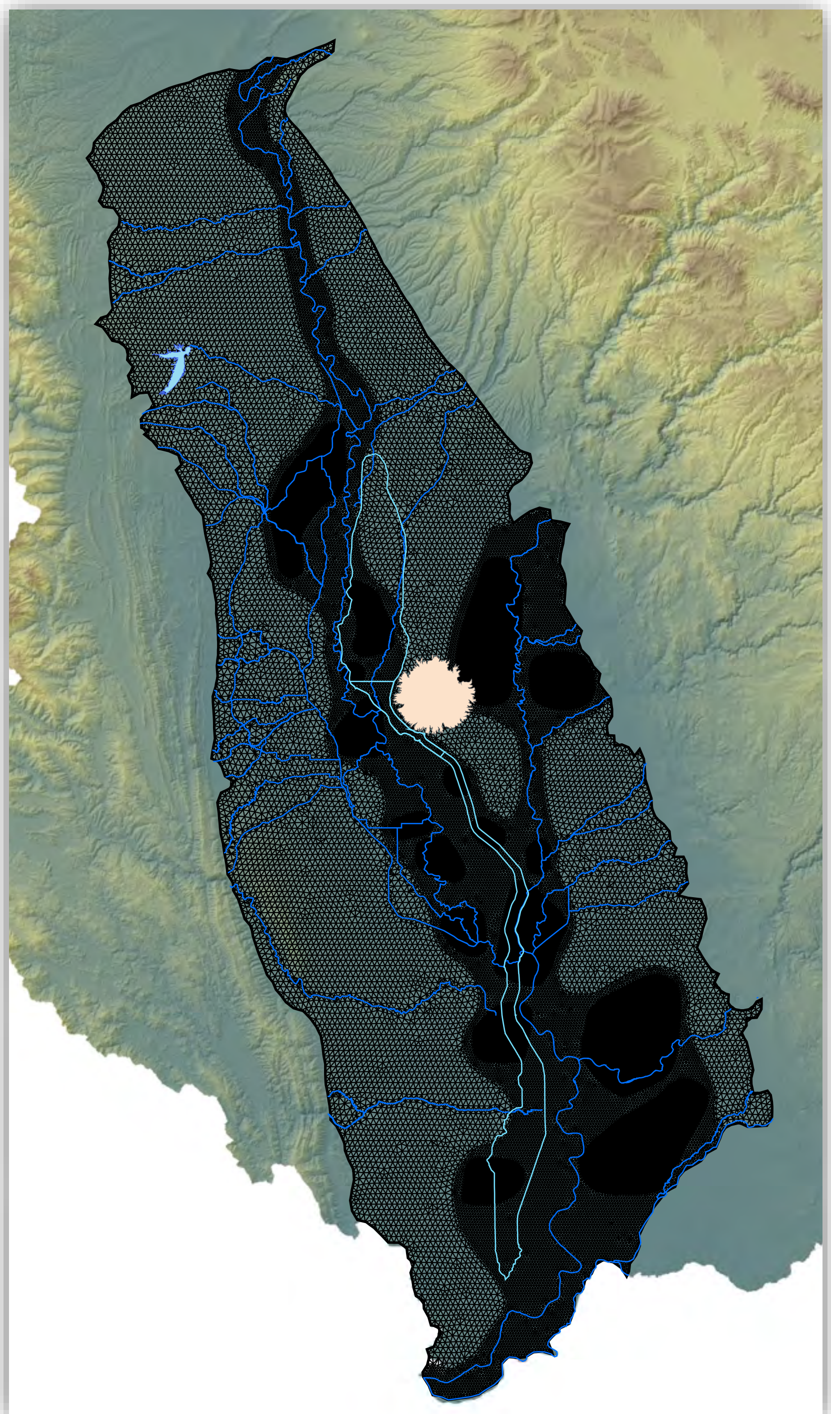


Figure H-1. SACFEM Model Domain

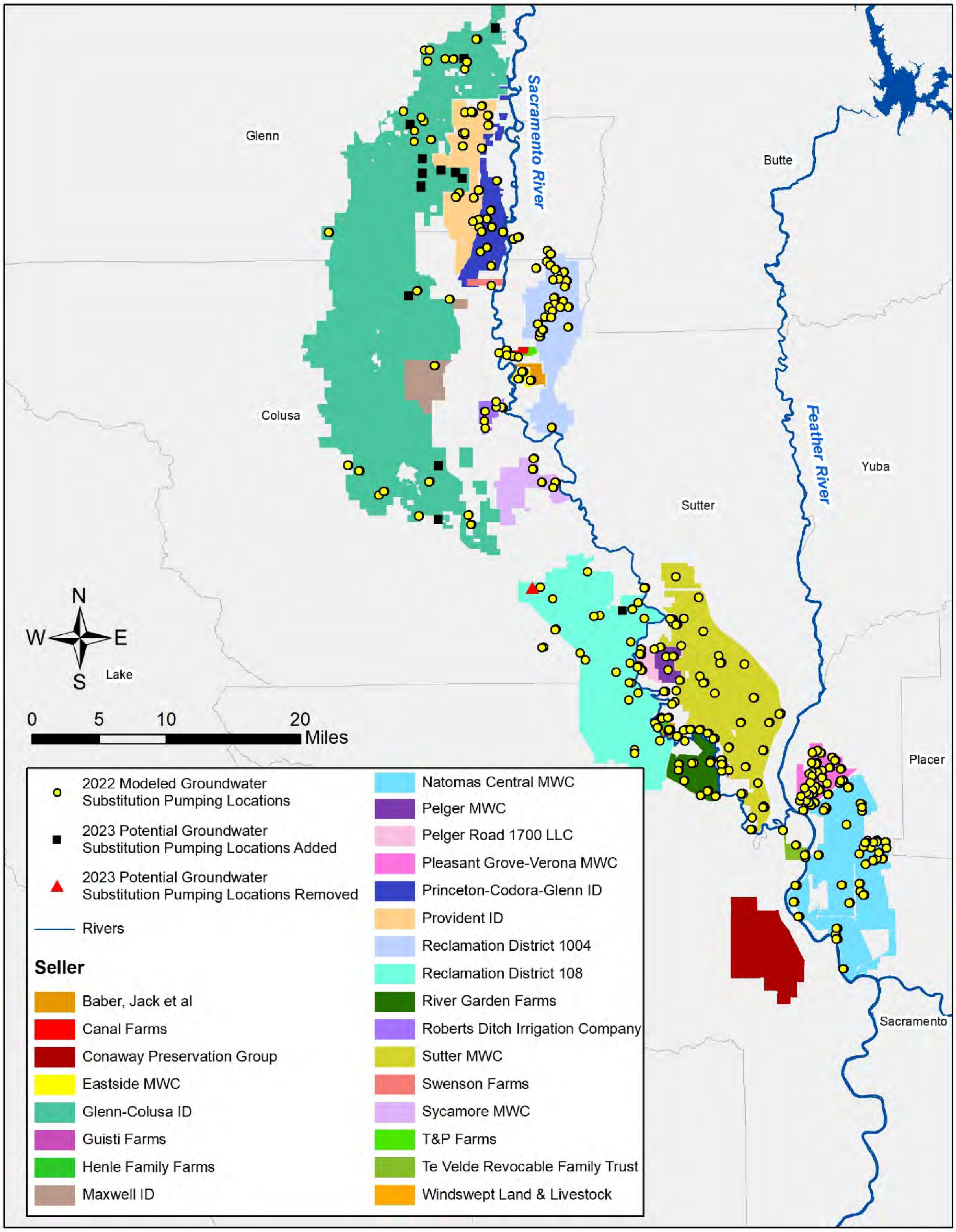


Figure H-2. 2022 Modeled Groundwater Substitution Pumping Well Locations and Potential 2023 Groundwater Substitution Pumping Well Locations

Table H-1 summarizes the number of groundwater substitution pumping wells, pumping rates, and range of screened intervals modeled for the contemplated 2022 groundwater substitution transfers. The locations and depths of these wells are specified in the model based on data collected from the potential groundwater substitution sellers. Table H-2 summarizes the pumping details of the potential 2023 groundwater substitution pumping wells for comparison. Table H-3 summarizes the difference between the number of 2022 pumping wells and the number of pumping wells for a potential 2023 water transfer shown in Table H-1 and Table H-2.

Table H-1. Water Transfers through Groundwater Substitution under the Contemplated 2022 TCCA Water Transfers (2022 Modeled Wells)

Potential Seller	Number of Wells	Pumping Rate or Range of Rates (gpm)	Range of Screened Interval(s) (feet bgs)
Redding Area Groundwater Basin[1]			
Anderson- Cottonwood Irrigation District	2	1,000-5,500	150-455
Sacramento Valley Groundwater Basin			
Canal Farms	3	2,500-5,000	210-660
Eastside Mutual Water Company	3	4,000-4,720	160-450
Giusti Farms	2	3,200	160-400
Glenn-Colusa Irrigation District	28	600-4,000	605-945
Henle Family Farms	1	3,600	155-480
Maxwell Irrigation District	2	3,800	150-240
Natomas Central Mutual Water Company	37	1,000-3,200	310-952
Pelger Mutual Water Company	4	2,300-4,800	140-485
Pelger Road 1700 LLC	6	3,000-3,500	340-820
Pleasant Grove-Verona Mutual Water Company	34	800-3,600	205-520
Princeton-Codora- Glenn Irrigation District	13	1,000-4,000	220-380
Provident Irrigation District	16	2,000-4,500	200-450
Reclamation District 108	20	1,250-4,950	358-1,020
Reclamation District 1004	30	1,000-5,800	410-730
River Garden Farms	10	2,200-3,400	365-686
Roberts Ditch Irrigation Company	8	1,300-4,500	150-500
Sutter Mutual Water Company	45	1,300-5,500	270-620
Swenson Farms	1	3,500	100-400
Sycamore Mutual Water Company	5	3,270-6,409	256-906
T&P Farms	2	3,000	185-660
Te Velde Revocable Family Trust	4	3,000-4,200	200-455
Windswept Land & Livestock	4	2,000-3,200	320-580

Note: [1] Anderson-Cottonwood ID's proposed transfer was not simulated in the Sacramento Valley Finite Element Groundwater Model (SACFEM2013) because the model area does not include the Redding Area Groundwater Basin.
Key: gpm = gallons per minute
bgs = below ground surface

Table H-2. Water Transfers through Groundwater Substitution under the Proposed Action (Potential 2023 Wells)

Potential Seller	Number of Wells	Pumping Rate or Range of Rates (gpm)	Range of Screened Interval(s)(feet bgs)
Redding Area Groundwater Basin[1]			
Anderson- Cottonwood Irrigation District	2	1,000-5,500	150-455
Sacramento Valley Groundwater Basin			
Canal Farms	3	2,500-5,000	210-660
Eastside Mutual Water Company	3	4,000-4,720	160-450
Giusti Farms	2	3,200	160-400
Glenn-Colusa Irrigation District	41	600-4,000	605-945
Henle Family Farms	1	3,600	155-480
Maxwell Irrigation District	2	3,800	150-240
Natomas Central Mutual Water Company	37	1,000-3,200	310-952
Pelger Mutual Water Company	4	2,300-4,800	140-485
Pelger Road 1700 LLC	6	3,000-3,500	340-820
Pleasant Grove-Verona Mutual Water Company	34	800-3,600	205-520
Princeton-Codora- Glenn Irrigation District	13	1,000-4,000	220-380
Provident Irrigation District	16	2,000-4,500	200-450
Reclamation District 108	20	1,250-4,950	358-1,020
Reclamation District 1004	30	1,000-5,800	410-730
River Garden Farms	10	2,200-3,400	365-686
Roberts Ditch Irrigation Company	8	1,300-4,500	150-500
Sutter Mutual Water Company	45	1,300-5,500	270-620
Swenson Farms	1	3,500	100-400
Sycamore Mutual Water Company	5	3,270-6,409	256-906
T&P Farms	2	3,000	185-660
Te Velde Revocable Family Trust	4	3,000-4,200	200-455
Windswept Land & Livestock	4	2,000-3,200	320-580

Note: [1] Anderson-Cottonwood ID's proposed transfer was not simulated in the Sacramento Valley Finite Element Groundwater Model (SACFEM2013) because the model area does not include the Redding Area Groundwater Basin.

Key: gpm = gallons per minute
bgs = below ground surface

Table H-3. Change in Number of Potential 2023 Groundwater Substitution Wells Compared to the Number of 2022 Groundwater Substitution Wells

Potential Seller	Total Number of 2022 Wells	Number of Wells Removed	Number of Wells Added	Total Number of 2023 Wells
Redding Area Groundwater Basin[1]				
Anderson- Cottonwood Irrigation District	2	--	--	2
Sacramento Valley Groundwater Basin				
Canal Farms	3	--	--	3
Eastside Mutual Water Company	3	--	--	3
Giusti Farms	2	--	--	2
Glenn-Colusa Irrigation District	28	--	13	41
Henle Family Farms	1	--	--	1
Maxwell Irrigation District	2	--	--	2
Natomas Central Mutual Water Company	37	--	--	37
Pelger Mutual Water Company	4	--	--	4
Pelger Road 1700 LLC	6	--	--	6
Pleasant Grove-Verona Mutual Water Company	34	--	--	34
Princeton-Codora- Glenn Irrigation District	13	--	--	13
Provident Irrigation District	16	--	--	16
Reclamation District 108	20	1	1	20
Reclamation District 1004	30	--	--	30
River Garden Farms	10	--	--	10
Roberts Ditch Irrigation Company	8	--	--	8
Swenson Farms	45	--	--	45
Sutter Mutual Water Company	1	--	--	1
Sycamore Mutual Water Company	5	--	--	5
T&P Farms	2	--	--	2
Te Velde Revocable Family Trust	4	--	--	4
Windswept Land & Livestock	4	--	--	4
Total Number of Wells	**278**	**1**	**14**	**291**

Note: [1] Anderson-Cottonwood ID's proposed transfer was not simulated in the Sacramento Valley Finite Element Groundwater Model (SACFEM2013) because the model area does not include the Redding Area Groundwater Basin.

Figures H-3 through H-9 show the simulated drawdown due to the contemplated 2022 groundwater substitution transfers under September 1977 hydrologic conditions. During dry years, surface water resources are limited and users have historically increased groundwater pumping to address shortages. Simulating transfers during this period illustrates the potential to compound impacts from dry-year pumping as compared to the No Action Alternative.

- Figures H-3a through H-3c show the simulated drawdown due to the contemplated 2022 groundwater substitution transfers at the water table based on results from the top layer of the SACFEM2013 model. This layer has a depth of up to 35 feet below ground surface (bgs).

- Figures H-4a through H-4c show simulated drawdown due to the contemplated 2022 groundwater substitution transfers at approximately 35 to 200 feet bgs.
- Figures H-5a through H-5c show simulated drawdown due to the contemplated 2022 groundwater substitution transfers at approximately 200 to 300 feet bgs.
- Figures H-6a through H-6c present the simulated drawdown due to the contemplated 2022 groundwater substitution transfers at approximately 300 to 400 feet bgs.
- Figures H-7a through H-7c present the simulated drawdown due to the contemplated 2022 groundwater substitution transfers at approximately 500 to 700 feet bgs.
- Figures H-8a through H-8c present the simulated drawdown due to the contemplated 2022 groundwater substitution transfers at approximately 700 to 900 feet bgs.
- Figures H-9a through H-9c show simulated drawdown due to the contemplated 2022 groundwater substitution transfers at approximately 900 to 1,300 feet bgs.
- Figure H-10 overlays the Indian Trust Assets (ITAs) within the Sacramento Valley Groundwater Basin over the simulated drawdown due to the contemplated 2022 groundwater substitution transfers at the water table.

Drawdown at the water table (Figures H-3, H-4, and H-10) represents the estimated decline in the groundwater surface within the shallow, unconfined portion of the aquifer (i.e., the height of water within a shallow groundwater well). The drawdown in the deeper portions of the aquifer (Figures H-5 through H-9) represents a change in hydraulic head (i.e., water pressure) in a well that is screened in this deeper portion of the aquifer.

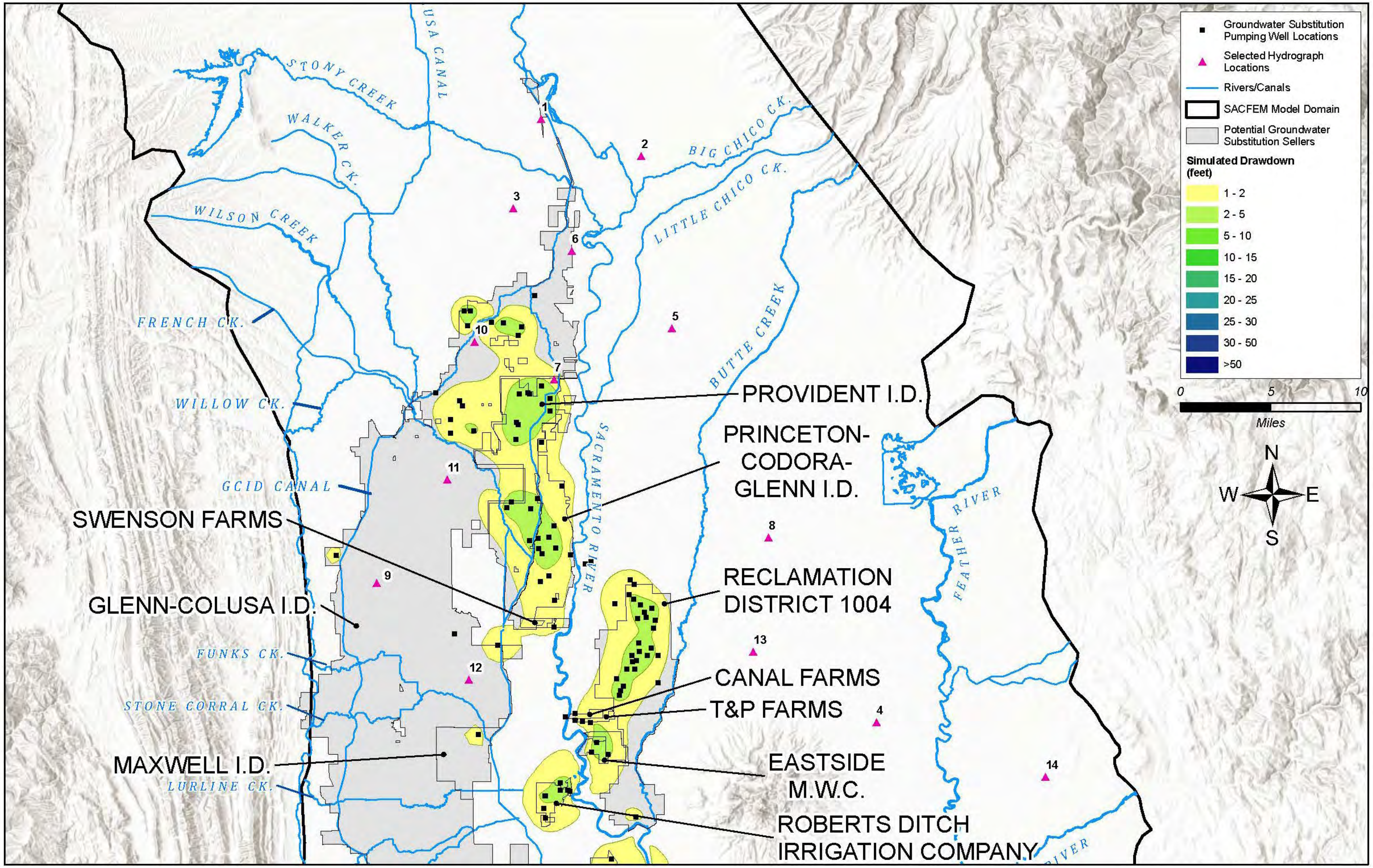


Figure H-3a. Simulated Drawdown in Water Table Elevation (0 to approximately 35 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

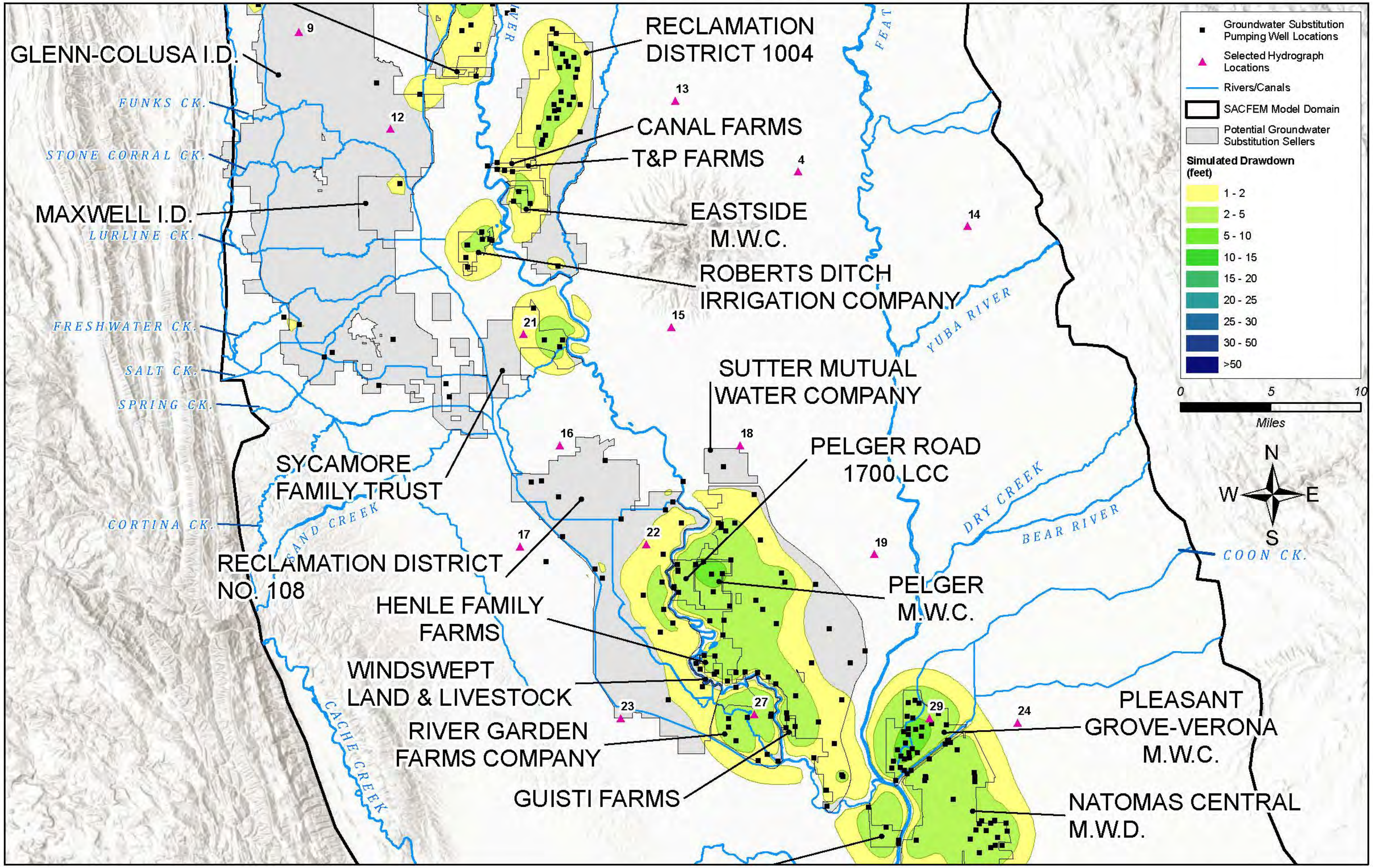


Figure H-3b. Simulated Drawdown in Water Table Elevation (0 to approximately 35 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

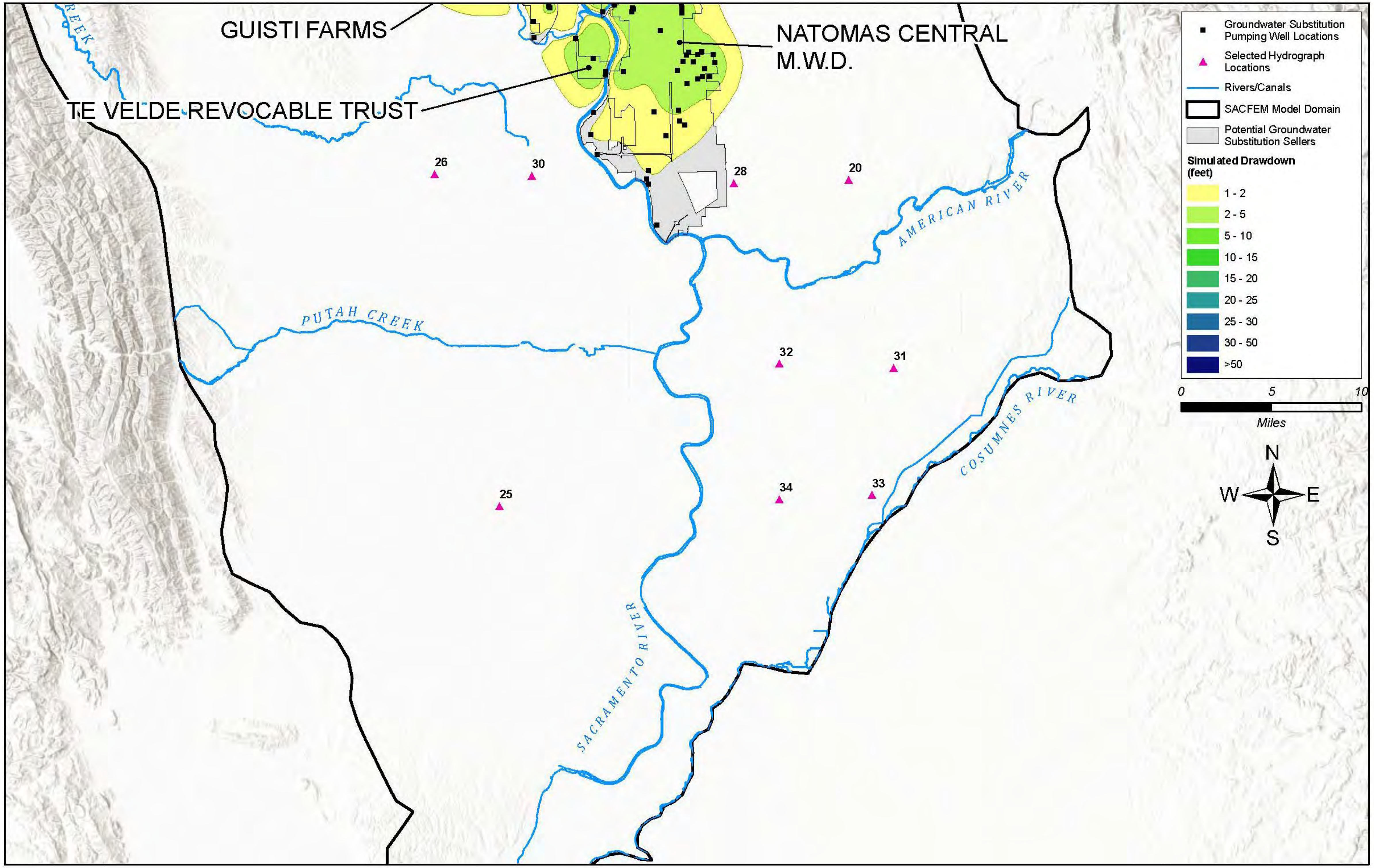


Figure H-3c. Simulated Drawdown in Water Table Elevation (0 to approximately 35 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

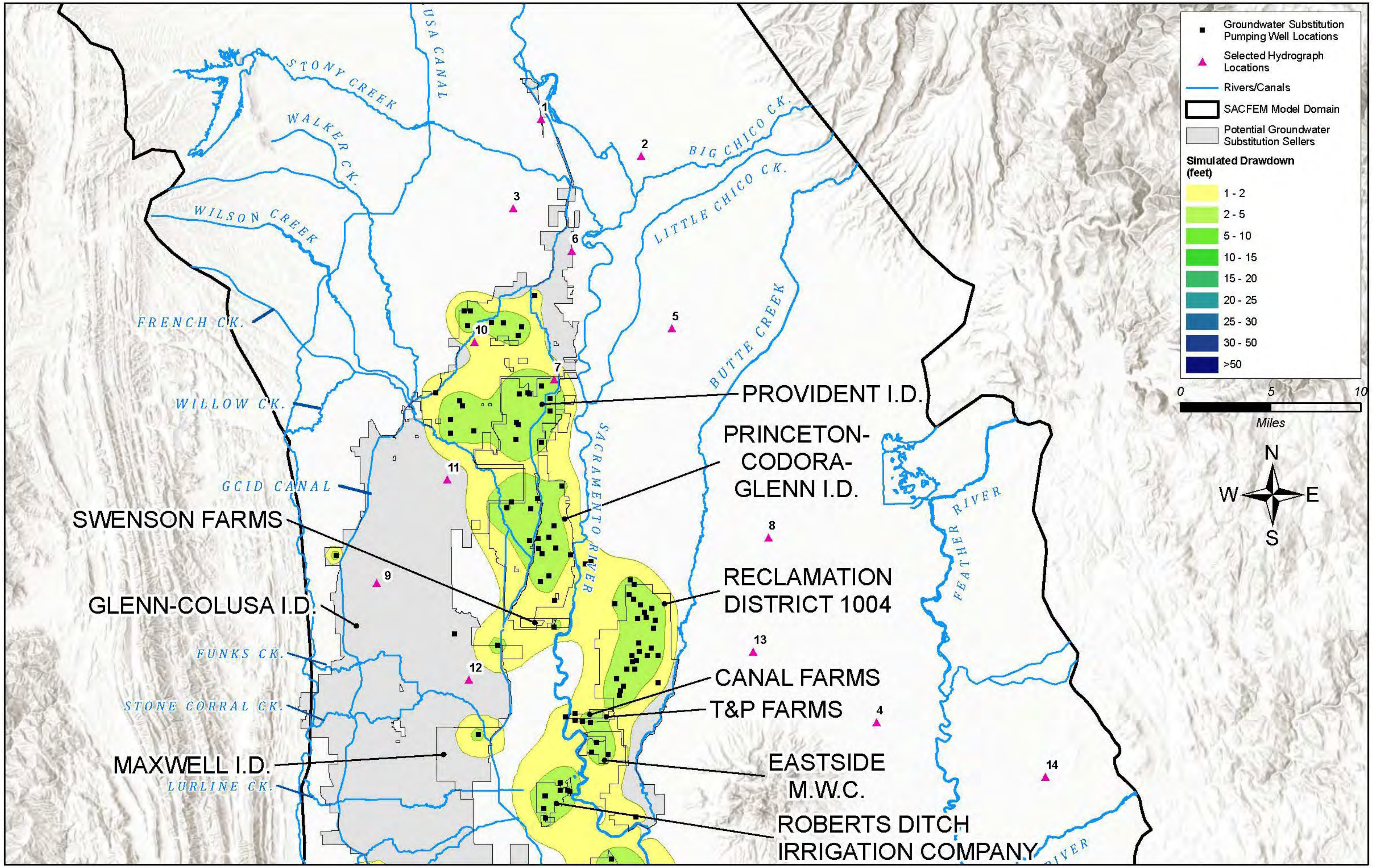


Figure H-4a. Simulated Drawdown in Water Table Elevation (approximately 35 to 200 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

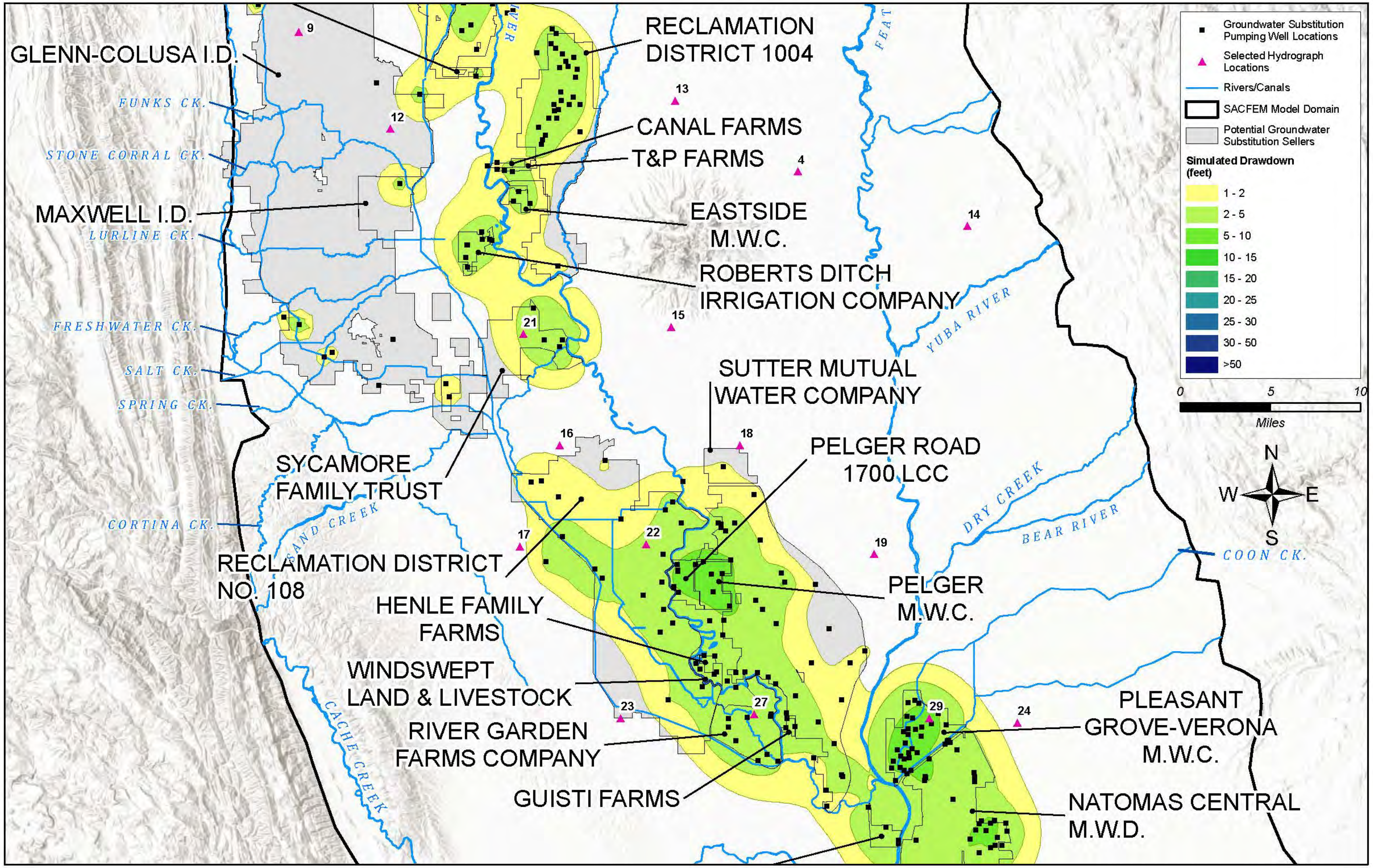


Figure H-4b. Simulated Drawdown in Water Table Elevation (approximately 35 to 200 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

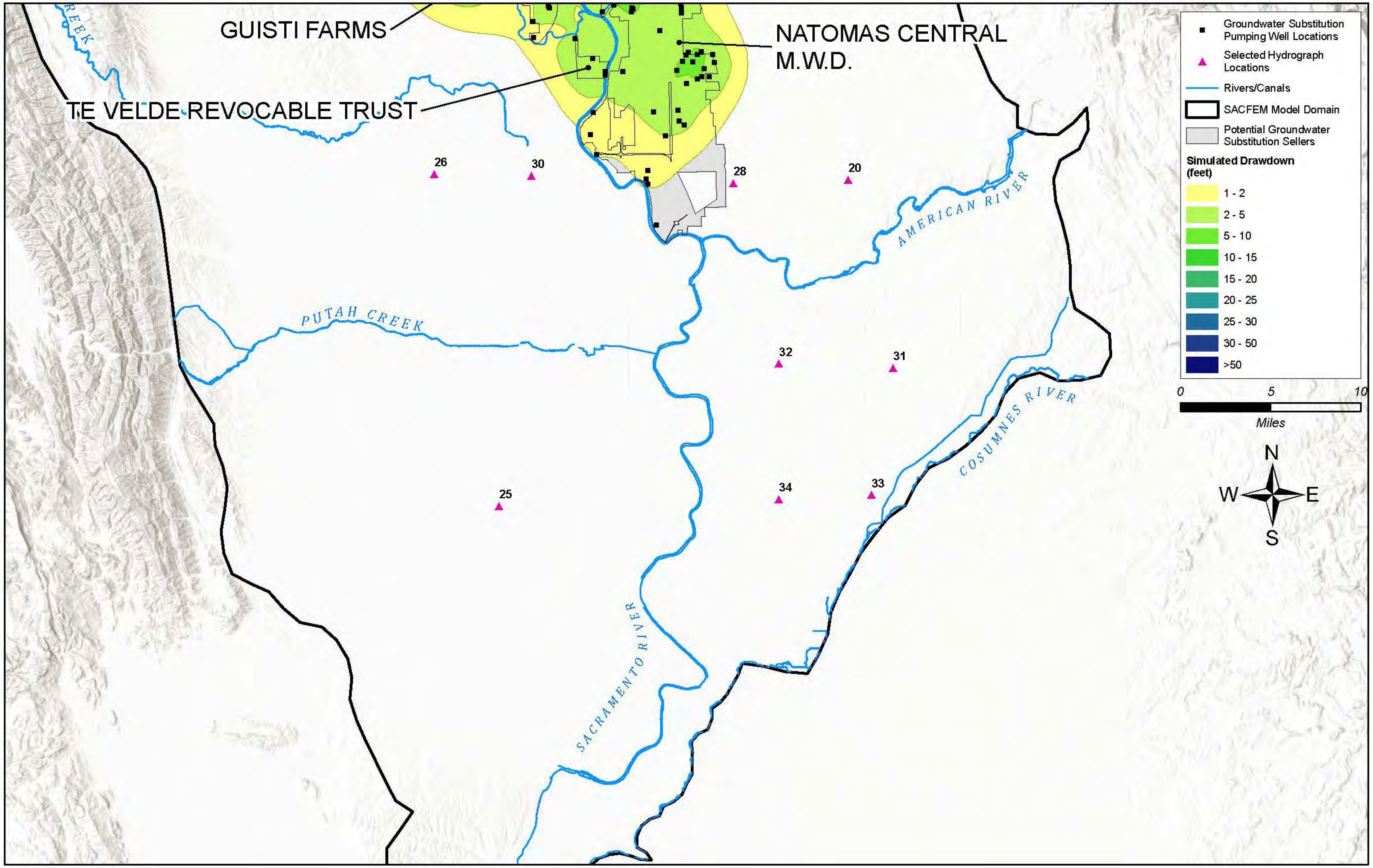


Figure H-4c. Simulated Drawdown in Water Table Elevation (approximately 35 to 200 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

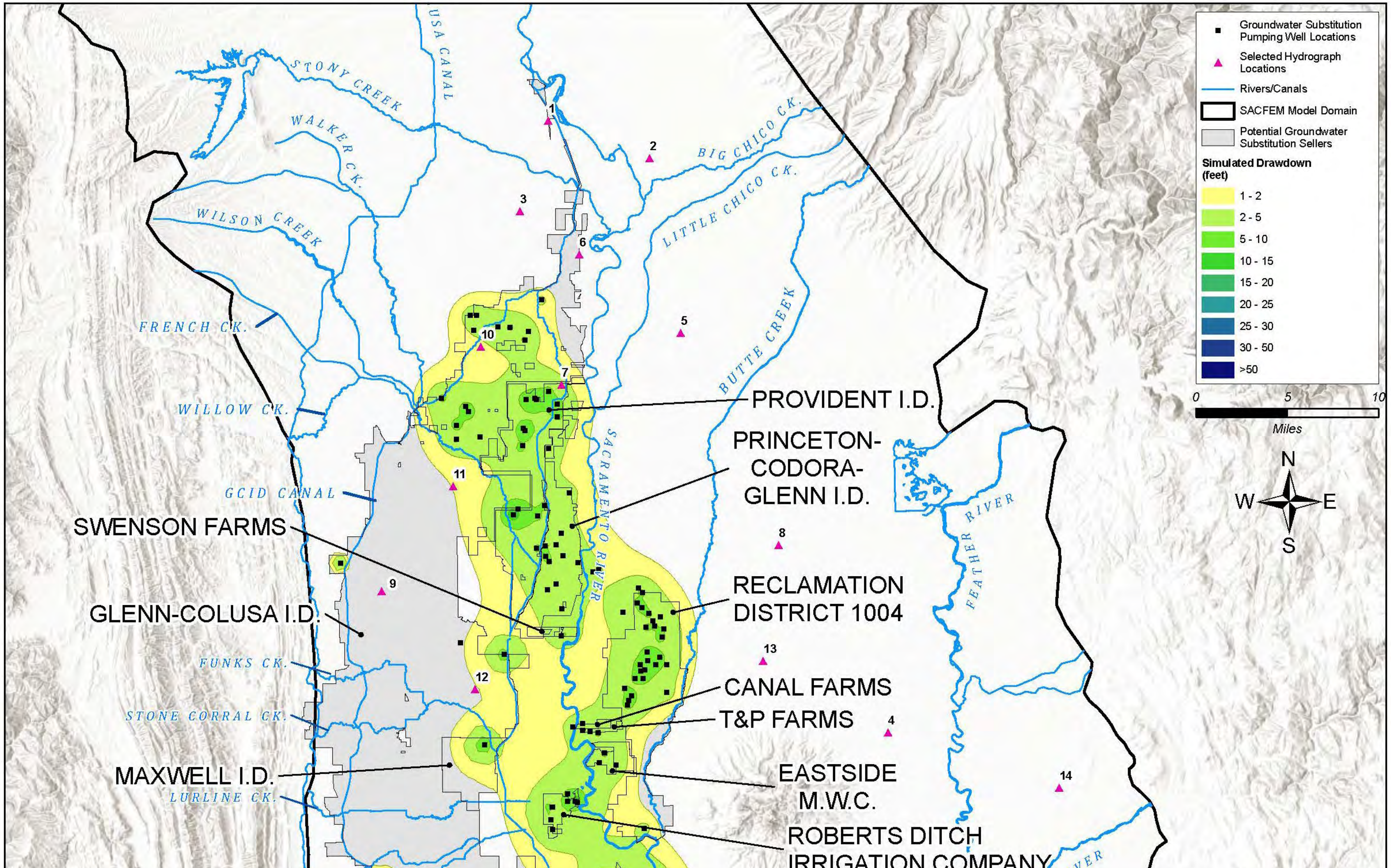


Figure H-5a. Simulated Drawdown in Groundwater Head (approximately 200 to 300 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

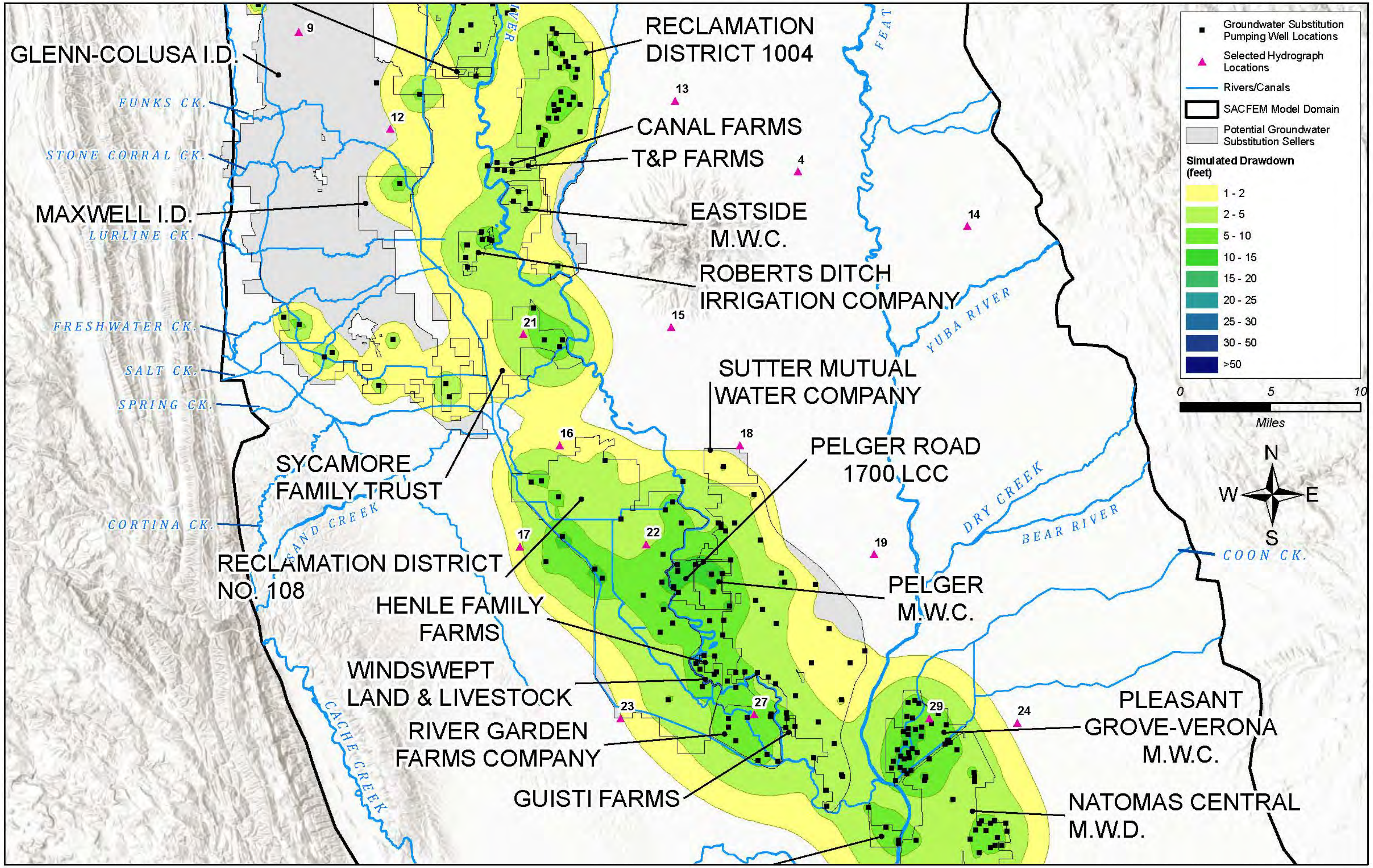


Figure H-5b. Simulated Drawdown in Groundwater Head (approximately 200 to 300 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

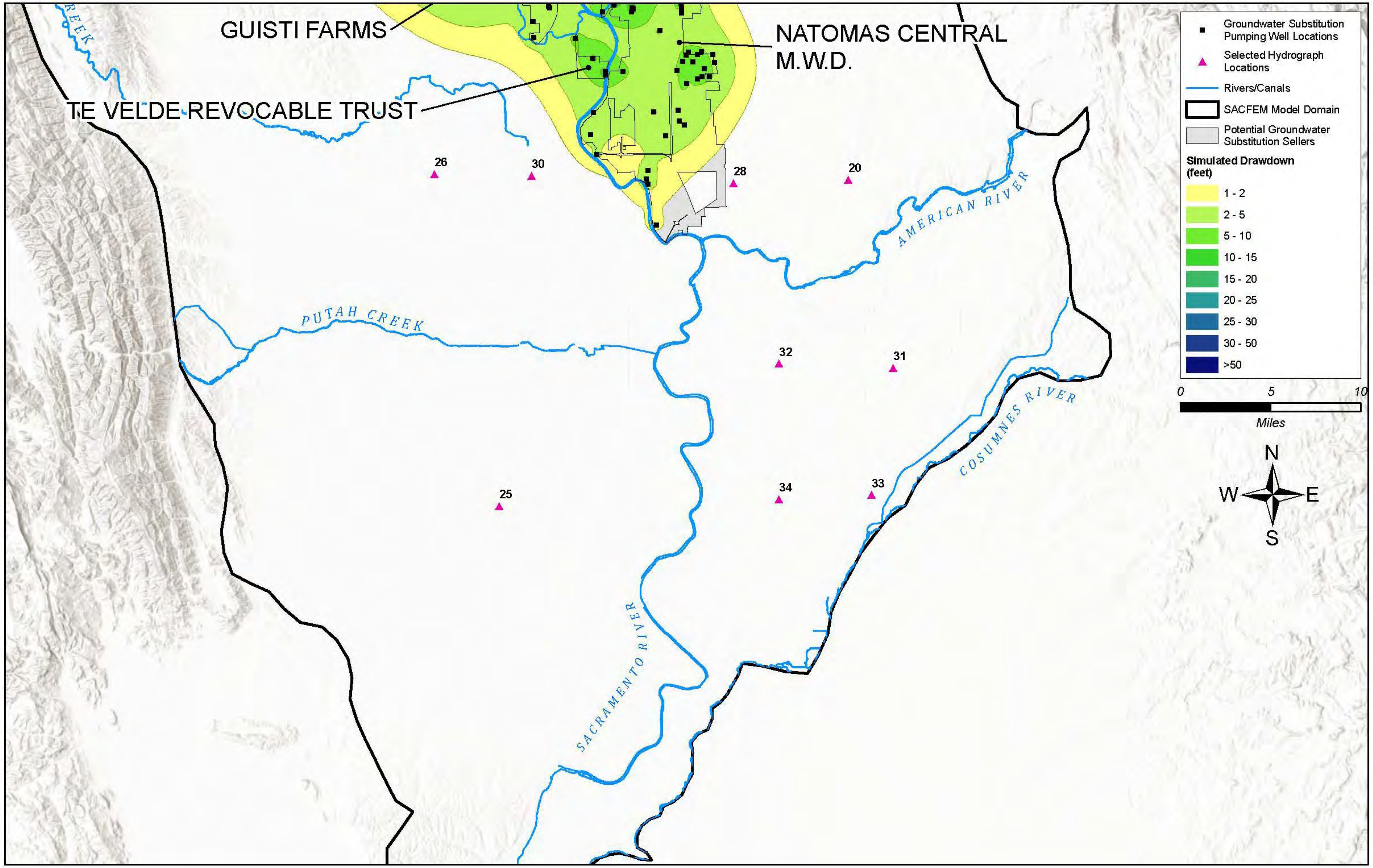


Figure H-5c. Simulated Drawdown in Groundwater Head (approximately 200 to 300 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

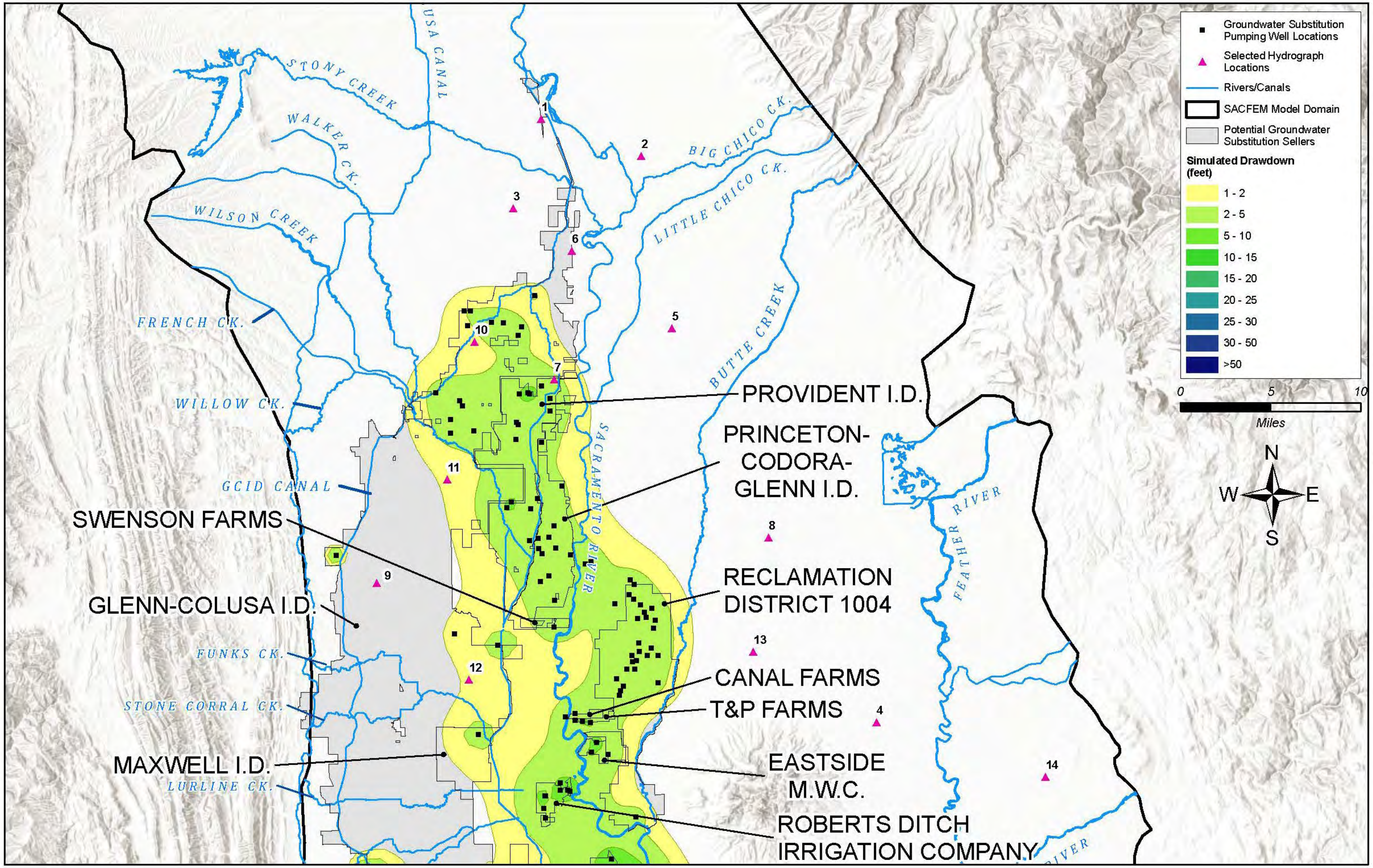


Figure H-6a. Simulated Drawdown in Groundwater Head (approximately 300 to 400 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

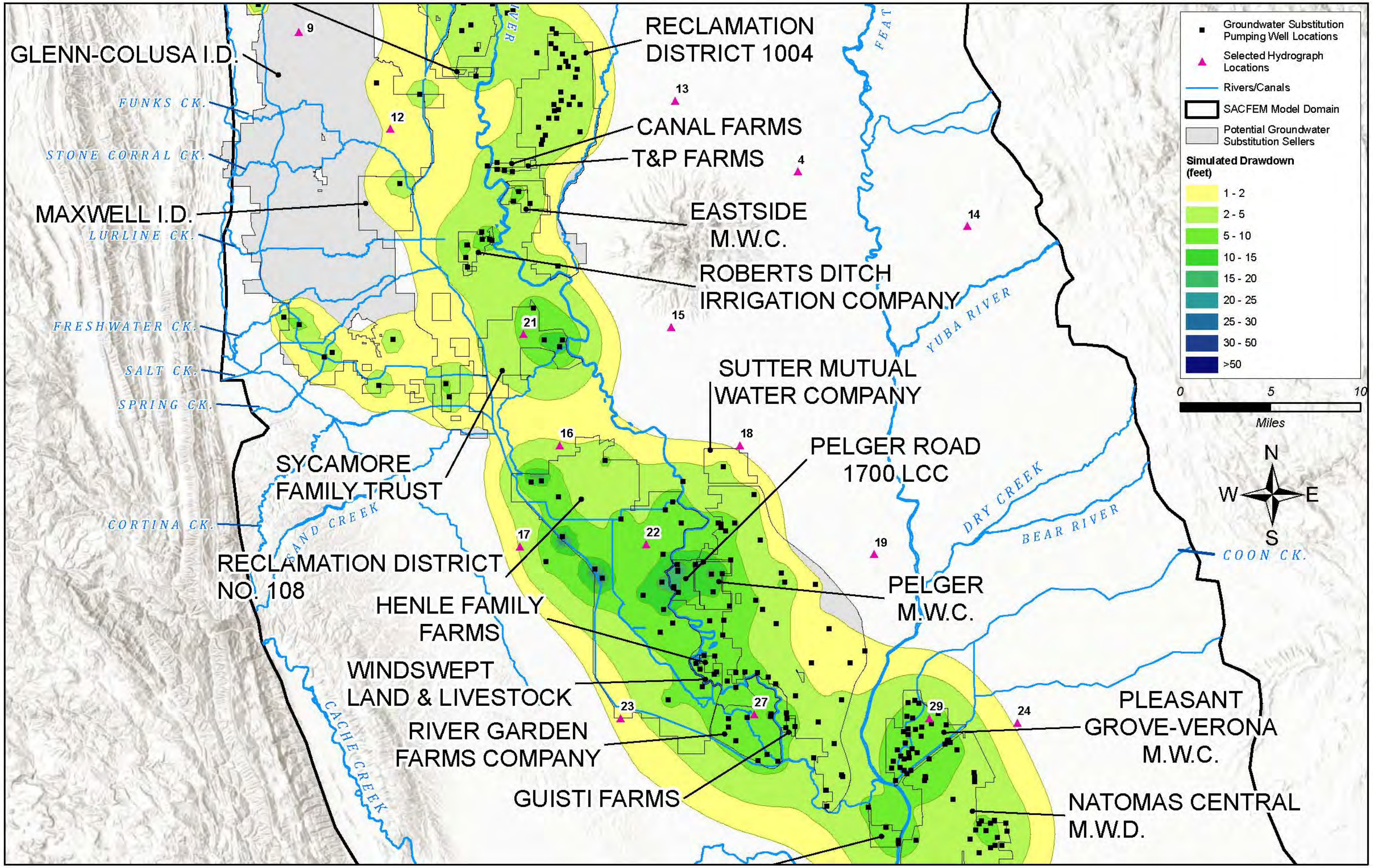


Figure H-6b. Simulated Drawdown in Groundwater Head (approximately 300 to 400 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

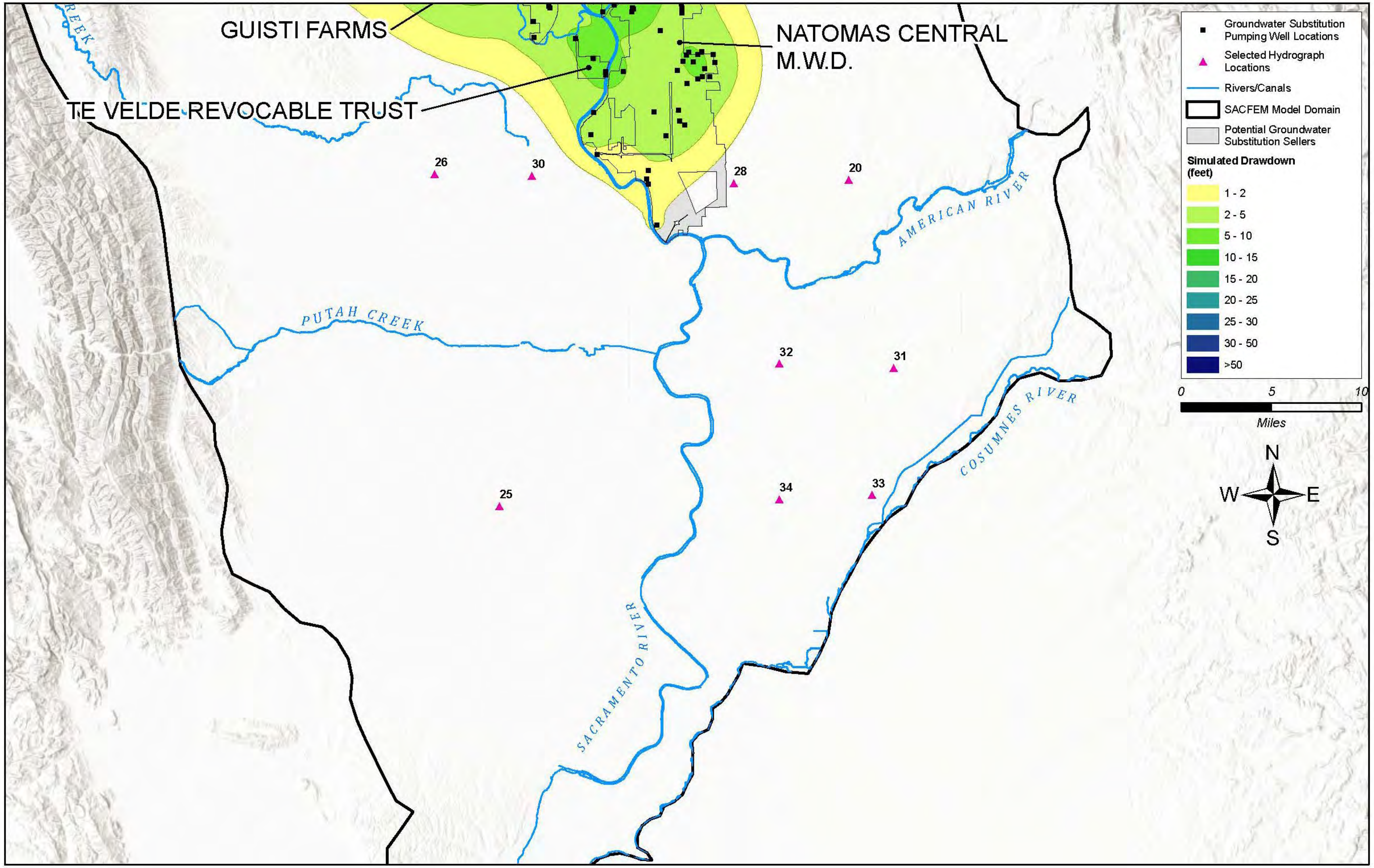


Figure H-6c. Simulated Drawdown in Groundwater Head (approximately 300 to 400 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

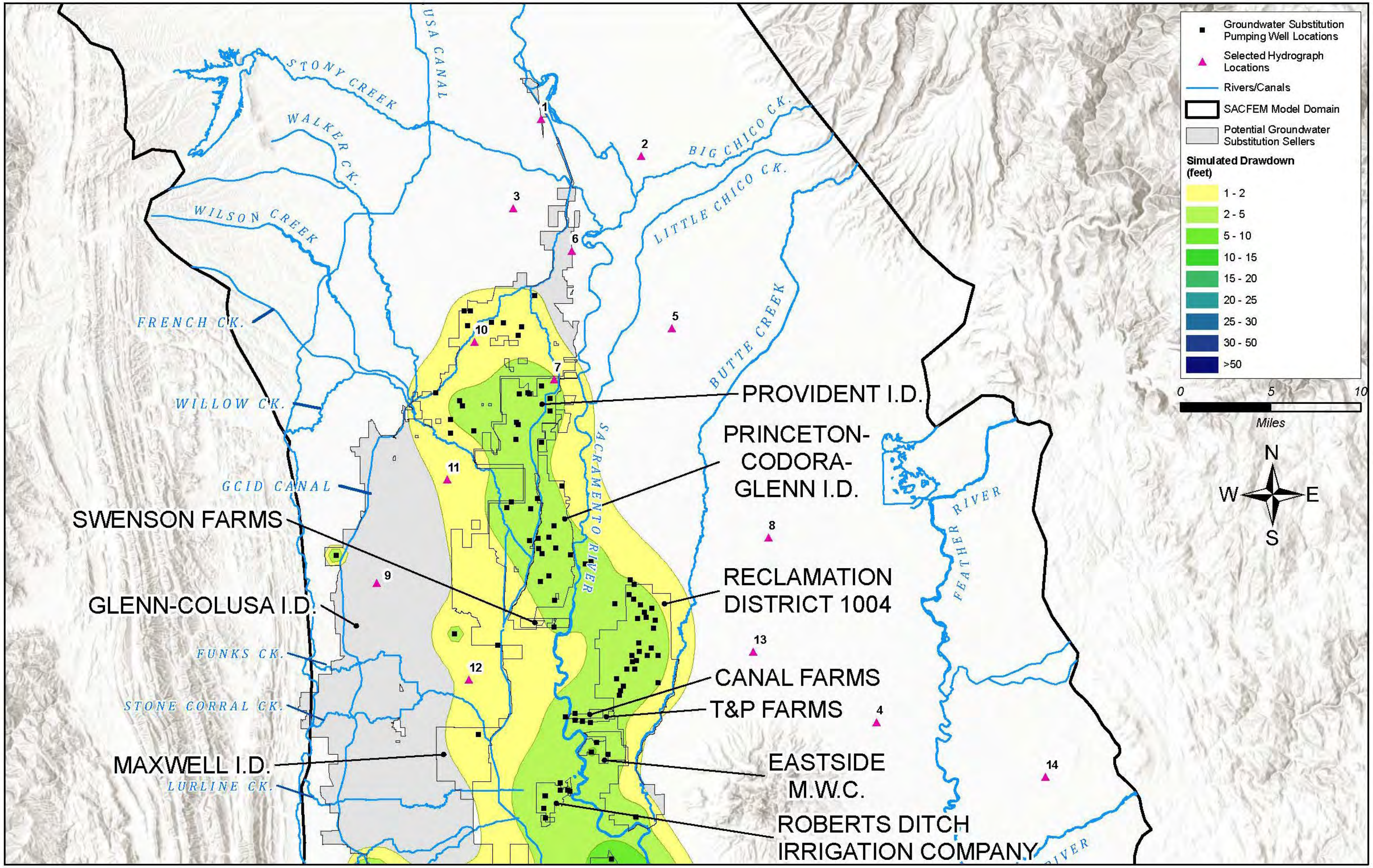


Figure H-7a. Simulated Drawdown in Groundwater Head (approximately 500 to 700 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

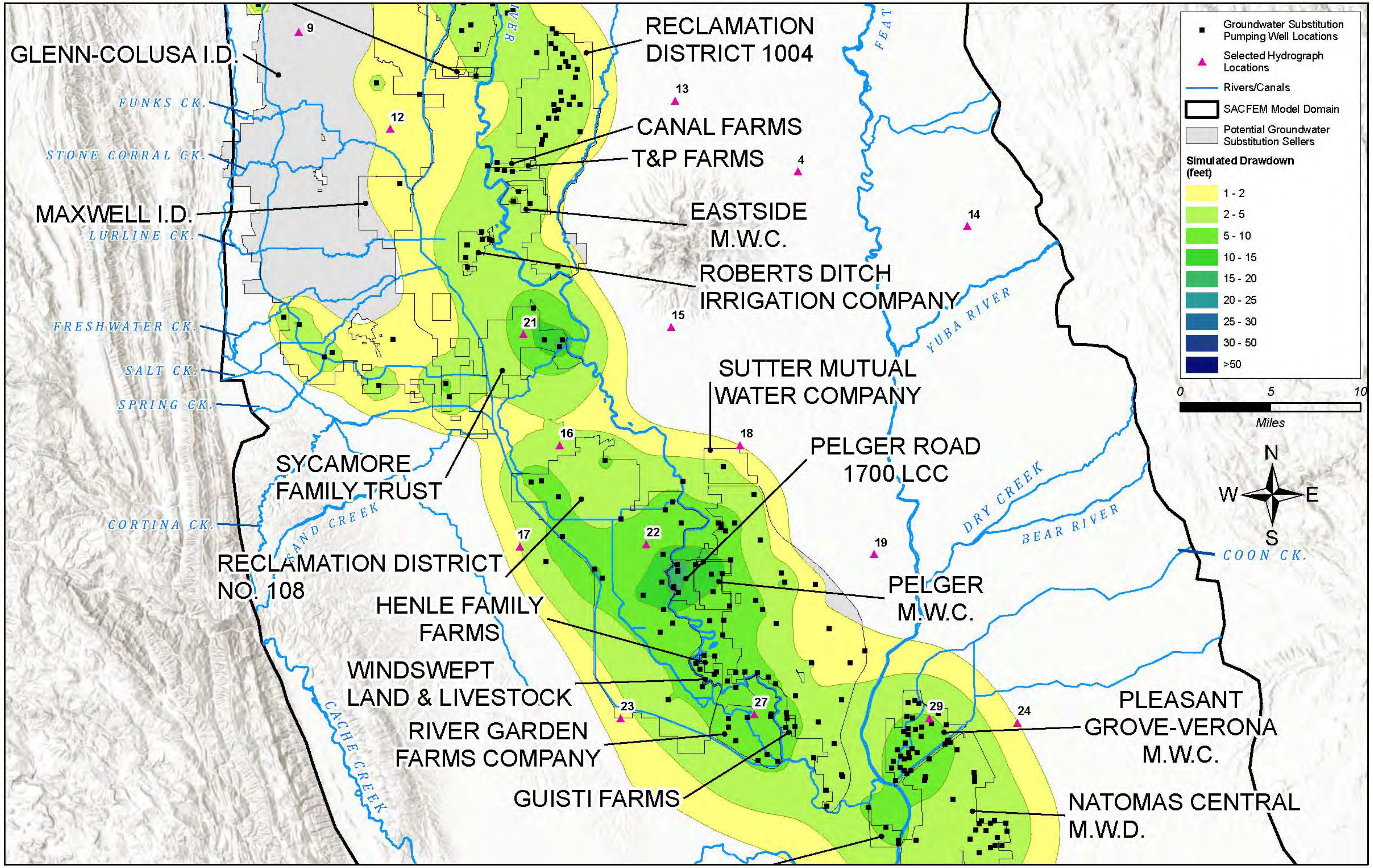


Figure H-7b. Simulated Drawdown in Groundwater Head (approximately 500 to 700 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

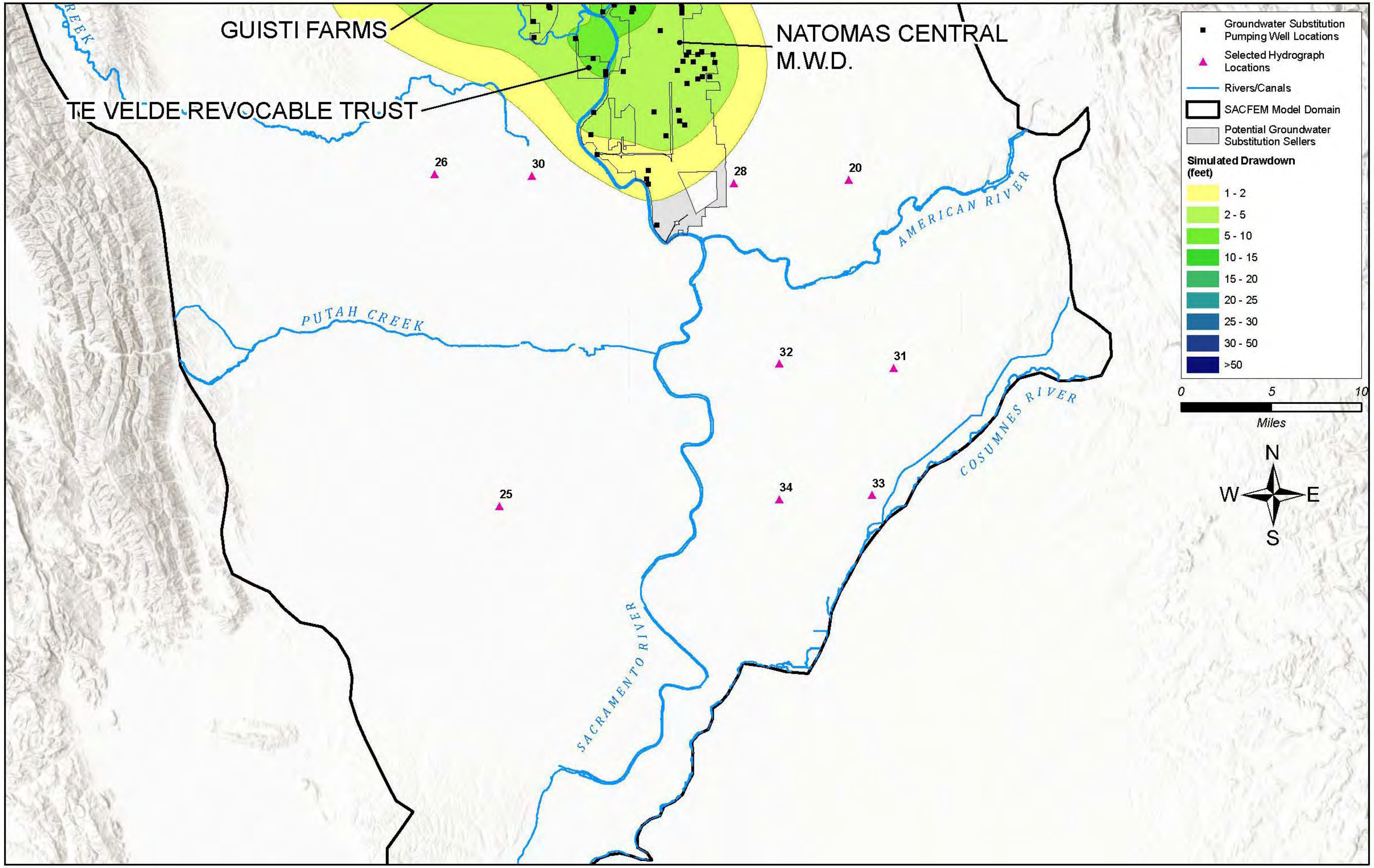


Figure H-7c. Simulated Drawdown in Groundwater Head (approximately 500 to 700 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

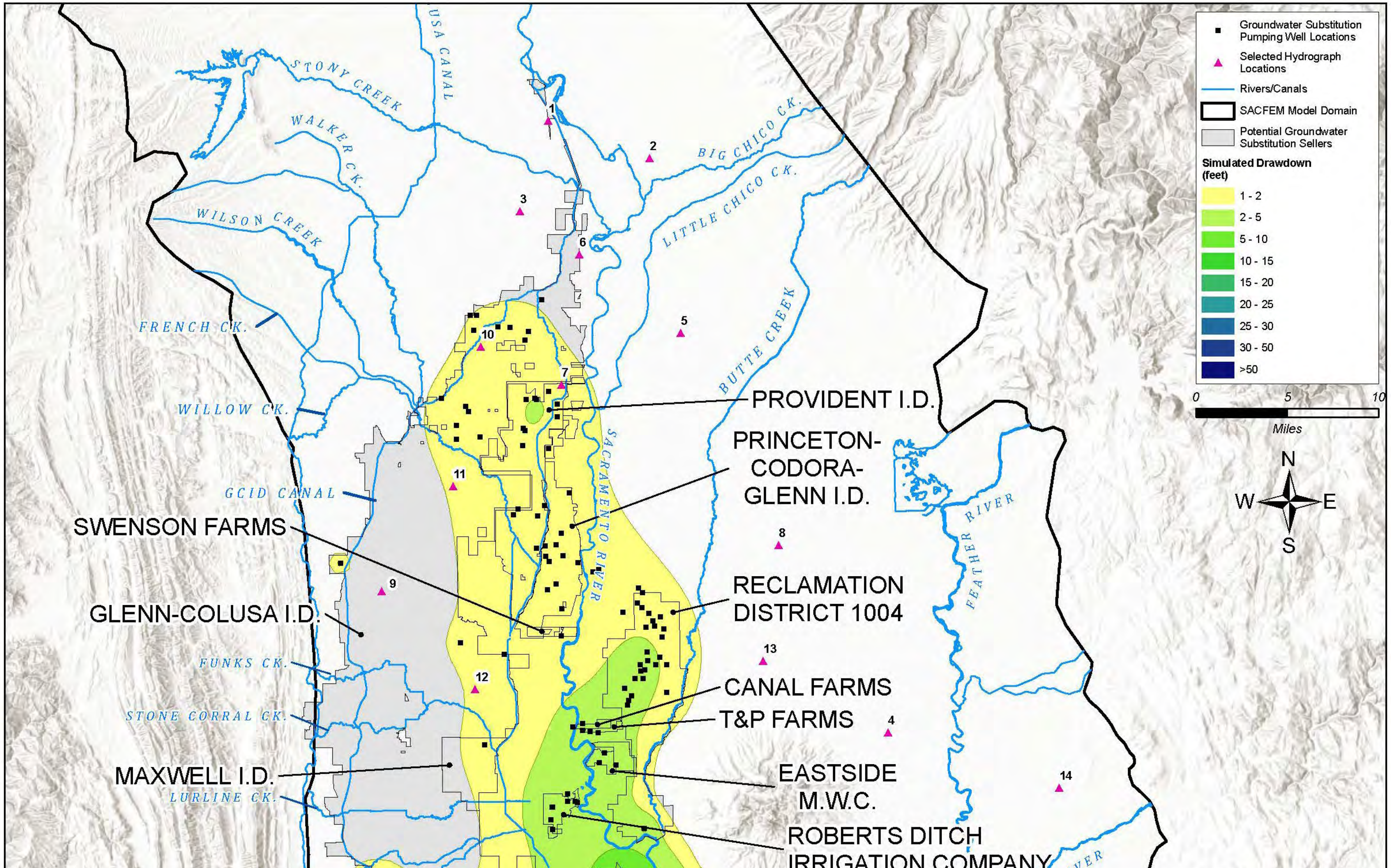


Figure H-8a. Simulated Drawdown in Groundwater Head (approximately 700 to 900 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

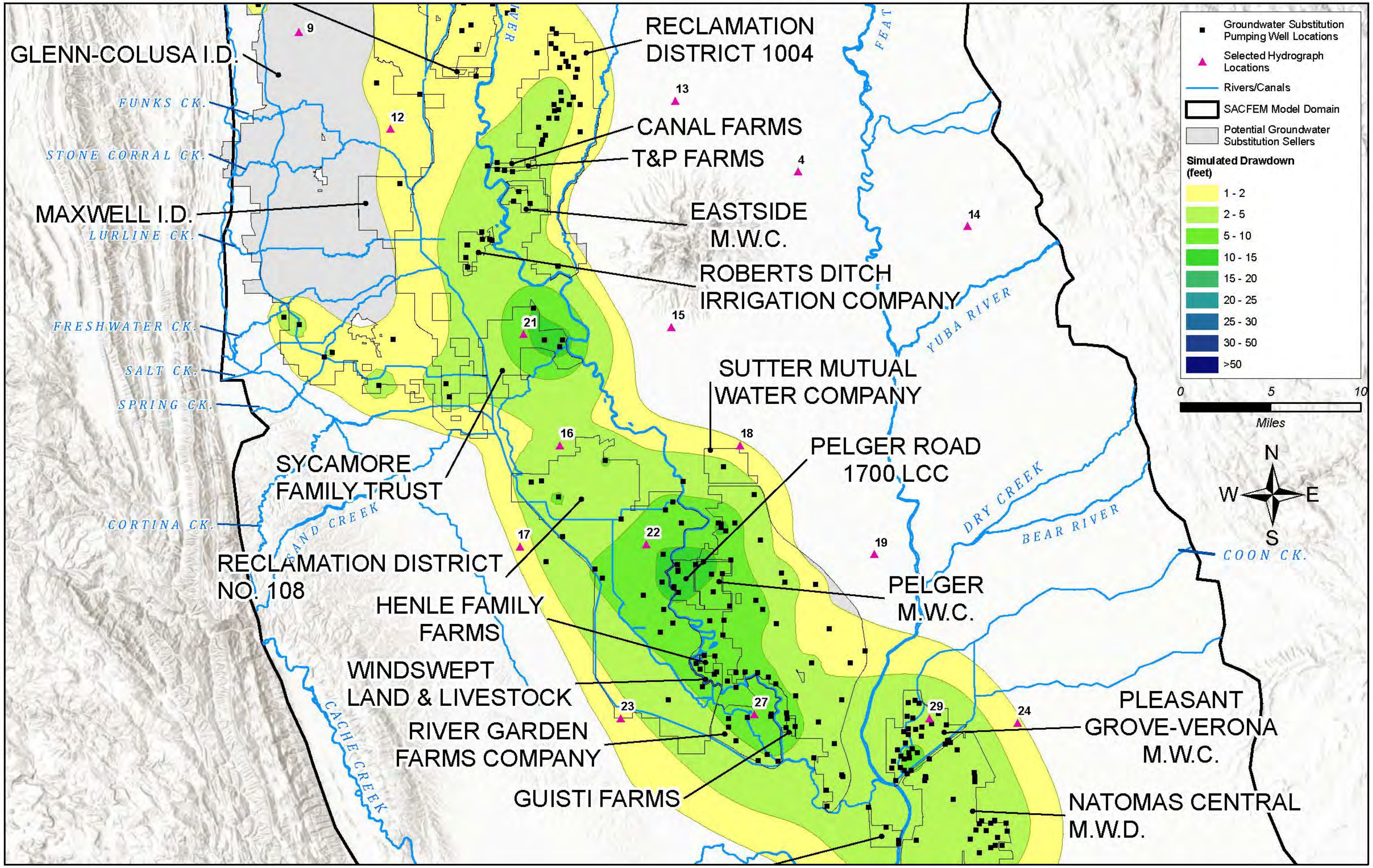


Figure H-8b. Simulated Drawdown in Groundwater Head (approximately 700 to 900 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

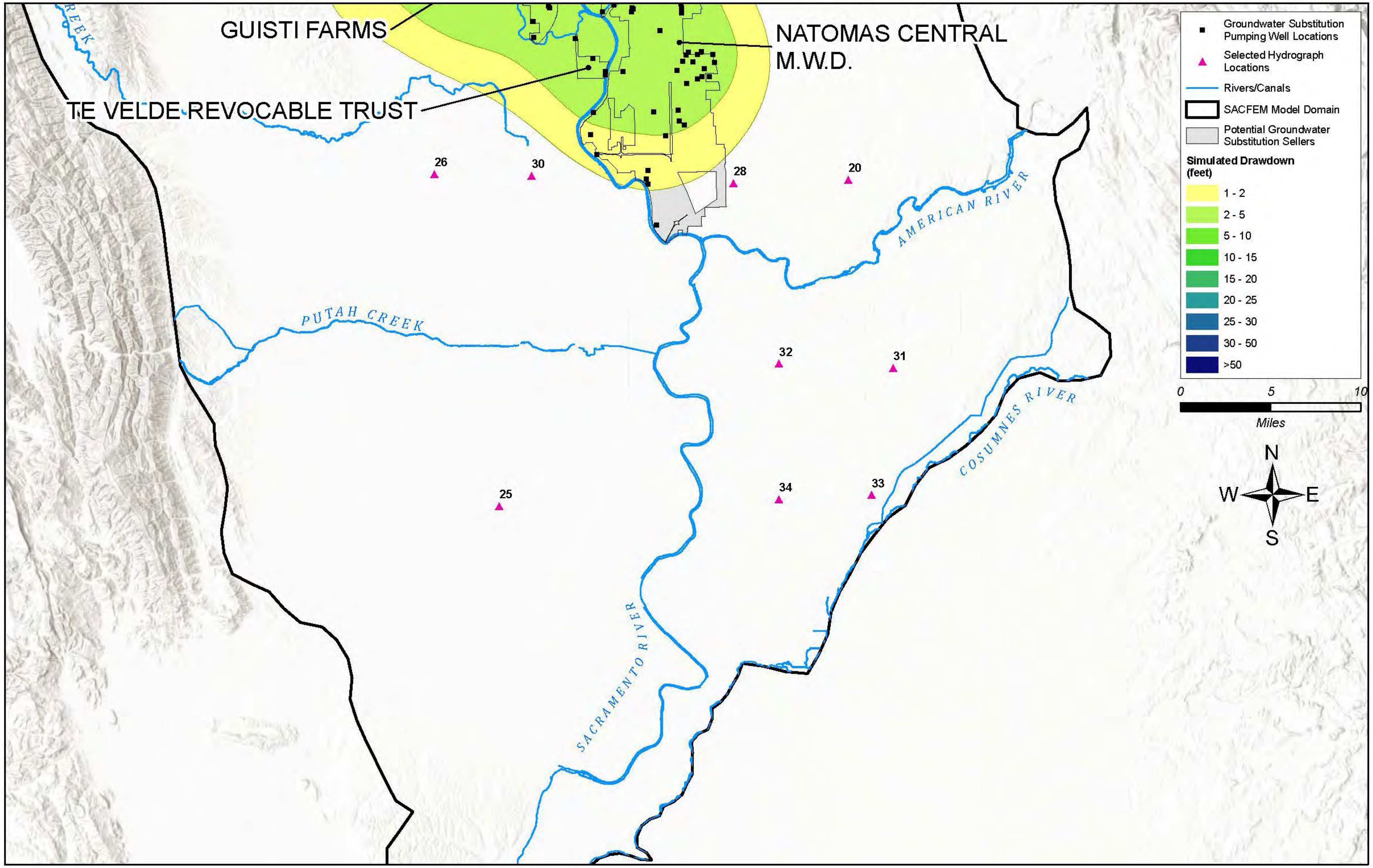


Figure H-8c. Simulated Drawdown in Groundwater Head (approximately 700 to 900 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

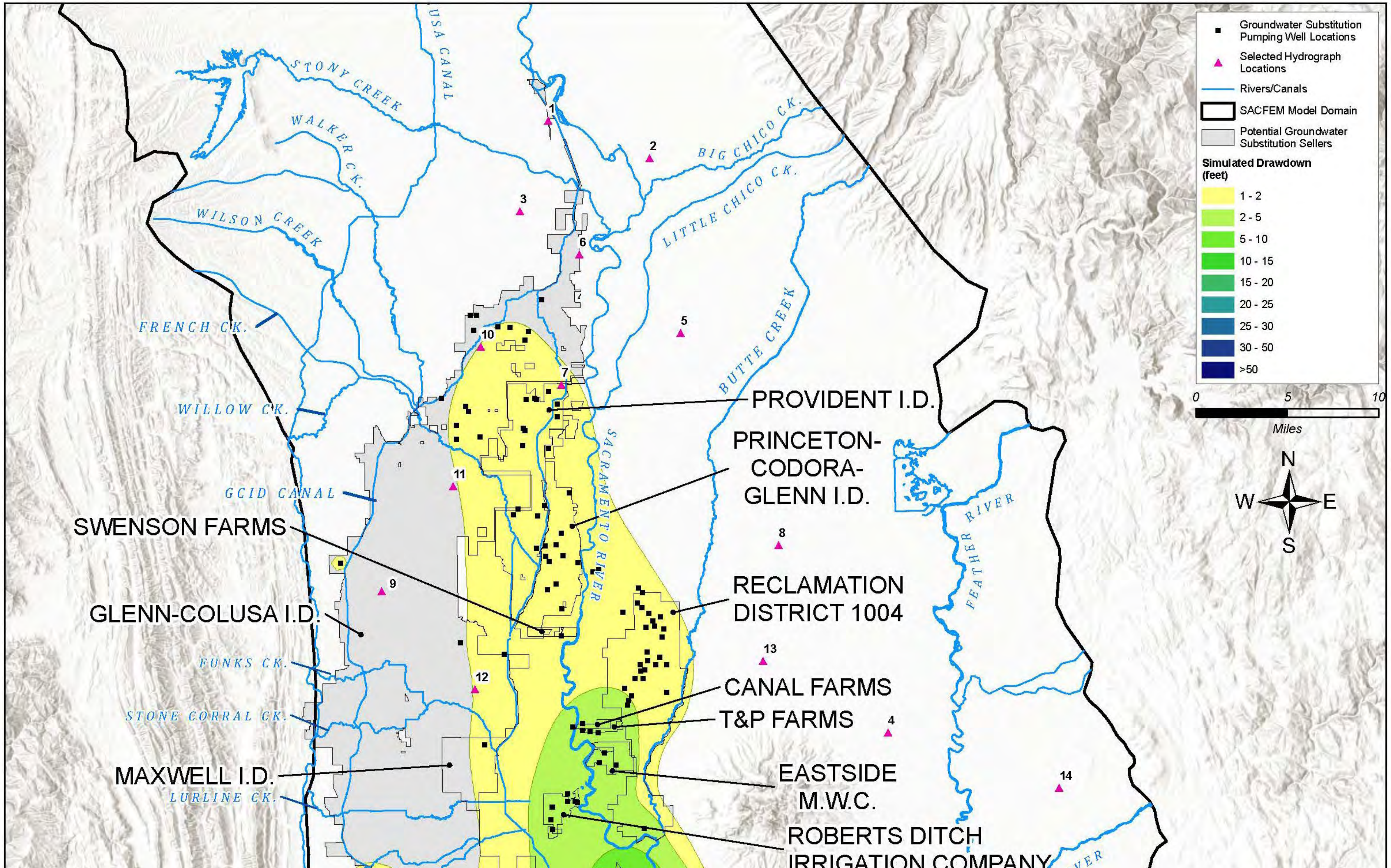


Figure H-9a. Simulated Drawdown in Groundwater Head (approximately 900 to 1,300 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

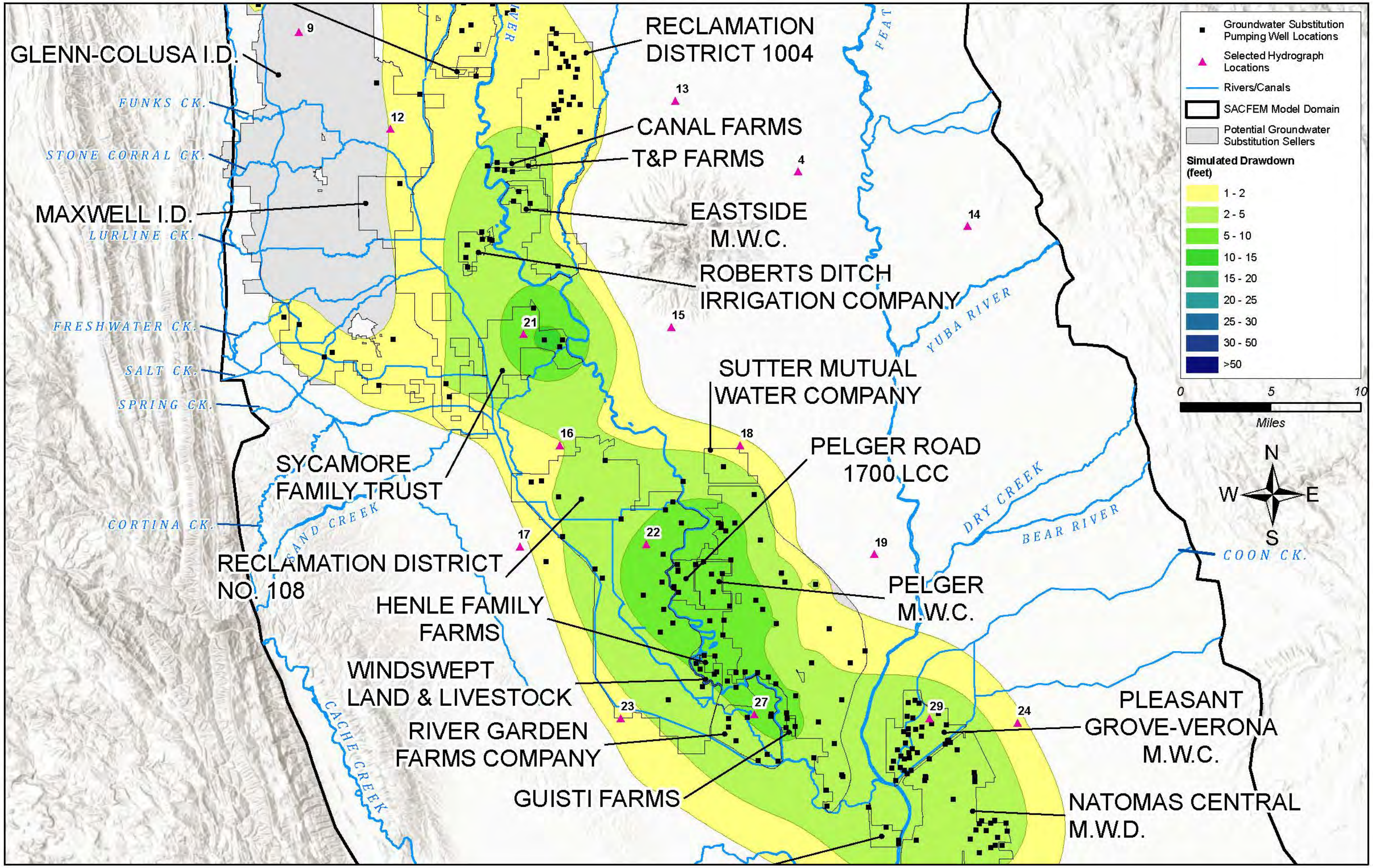


Figure H-9b. Simulated Drawdown in Groundwater Head (approximately 900 to 1,300 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

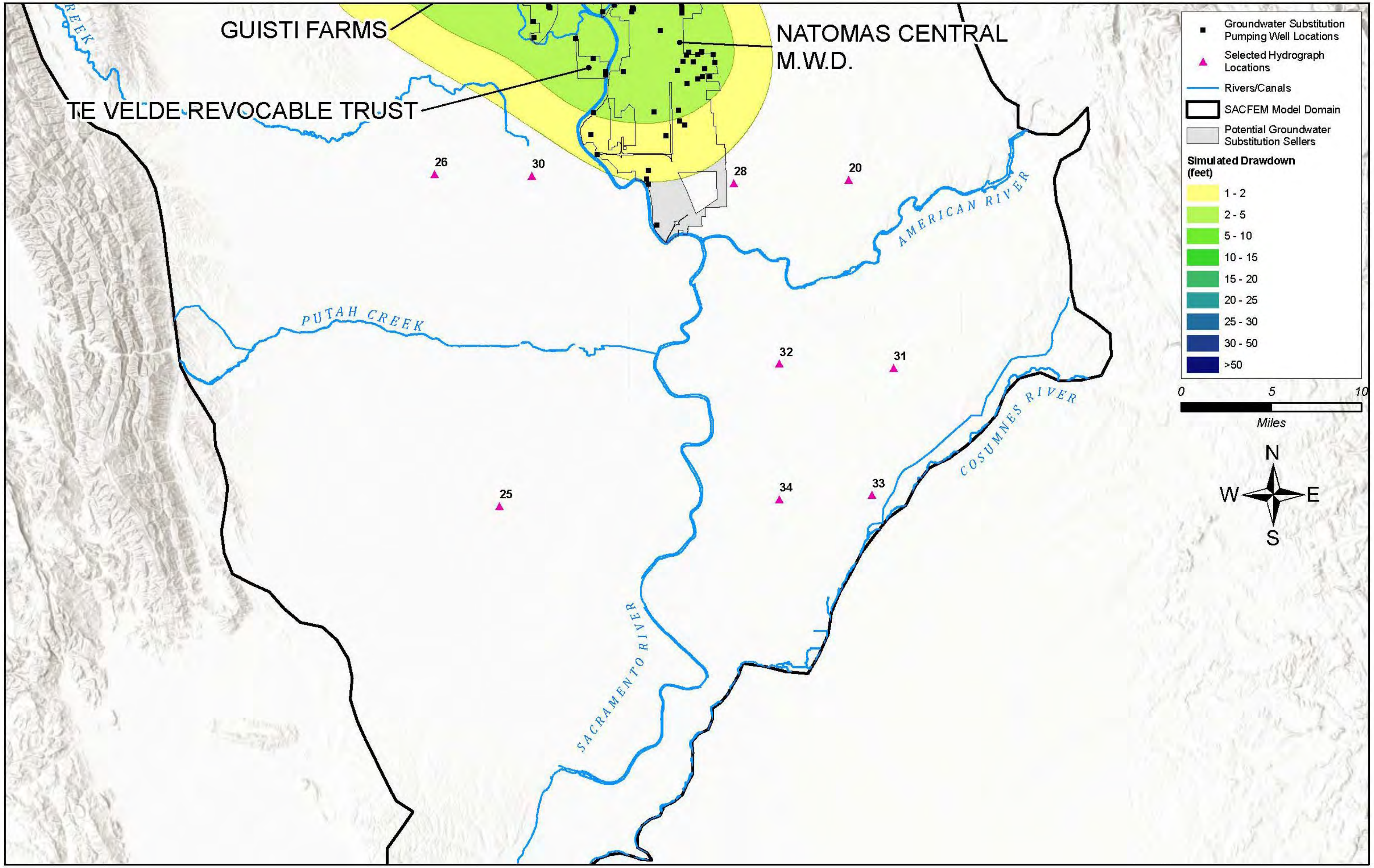


Figure H-9c. Simulated Drawdown in Groundwater Head (approximately 900 to 1,300 feet bgs) Due to the Contemplated 2022 Groundwater Substitution Transfers, Based on September 1977 Hydrologic Conditions

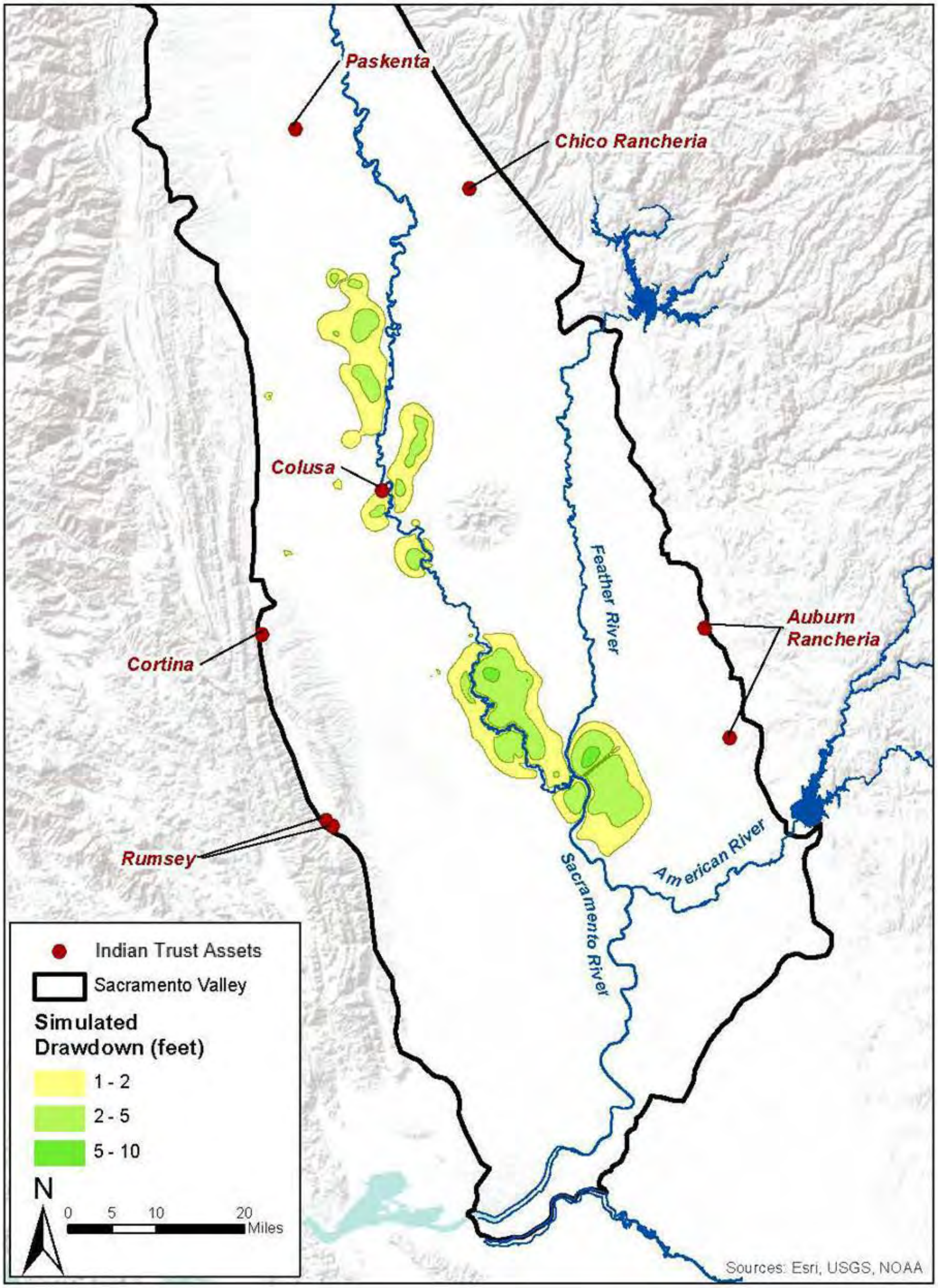


Figure H-10. Groundwater Effects to ITAs in the Sacramento Valley Groundwater Basin (simulated drawdown at the water table)

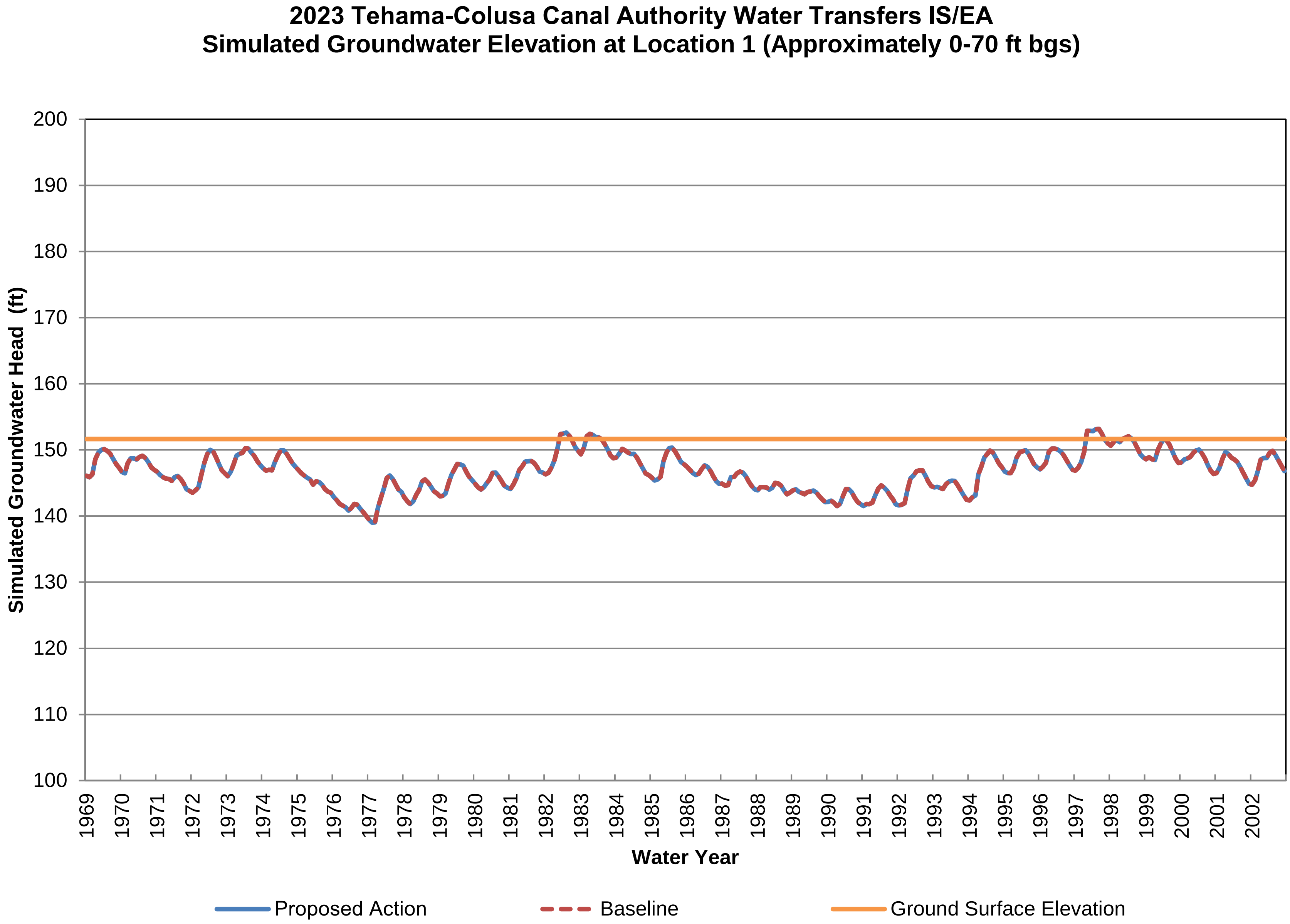
H.2 References

WRIME. 2011. AQUA Exhibit 65: Technical Memorandum. *Peer Review of Sacramento Valley Finite Element Groundwater Model (SACFEM).* Available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/CSPA%20et%20al/aqua_65.pdf. [Accessed on December 29, 2022].

Appendix H2

Groundwater Head Hydrographs

Groundwater head hydrographs for Locations 1 to 34



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 1 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1969
1970
1971
1972
1973
1974
1975
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1977
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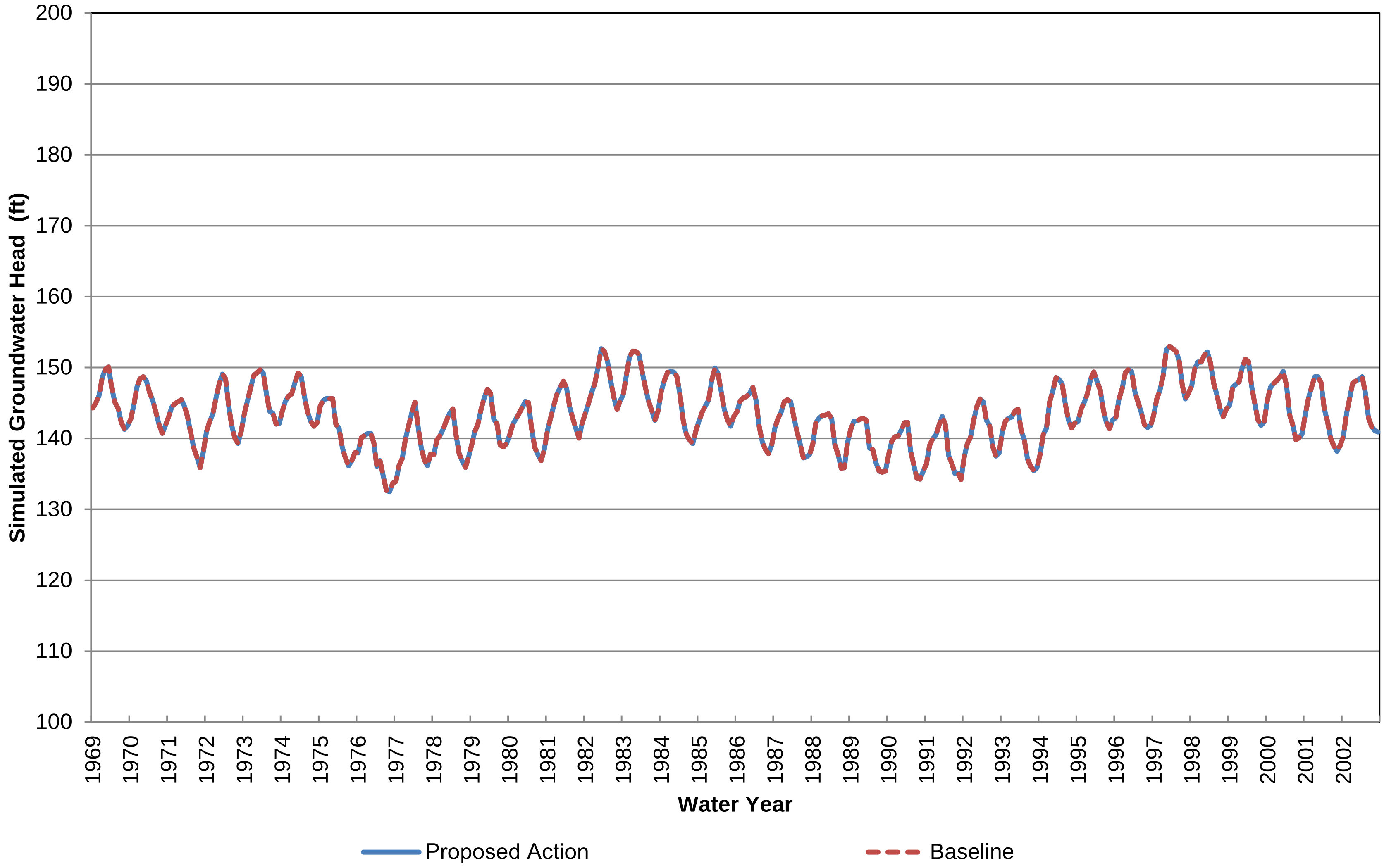
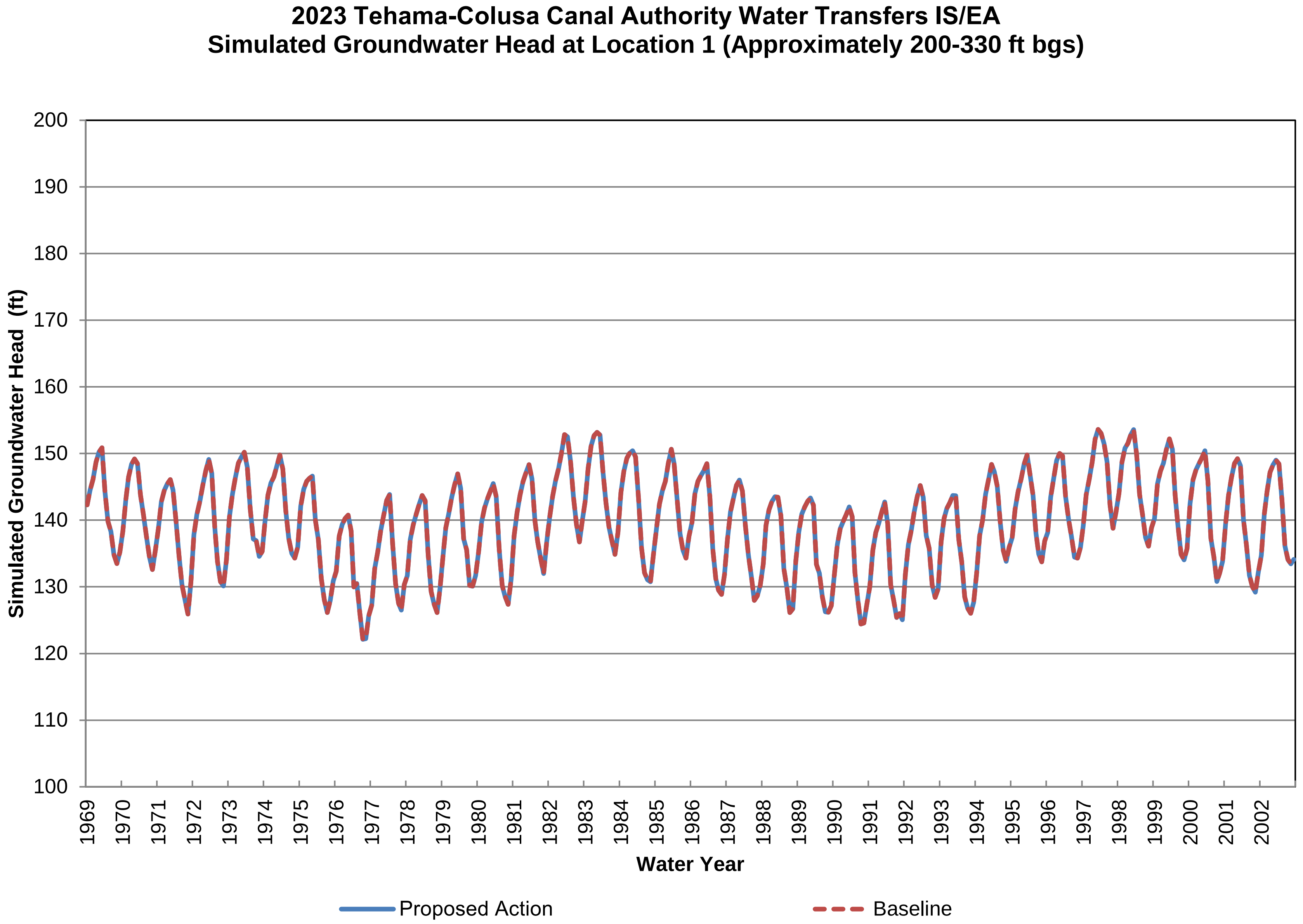
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 1 (Approximately 70-200 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 1 (Approximately 200-330 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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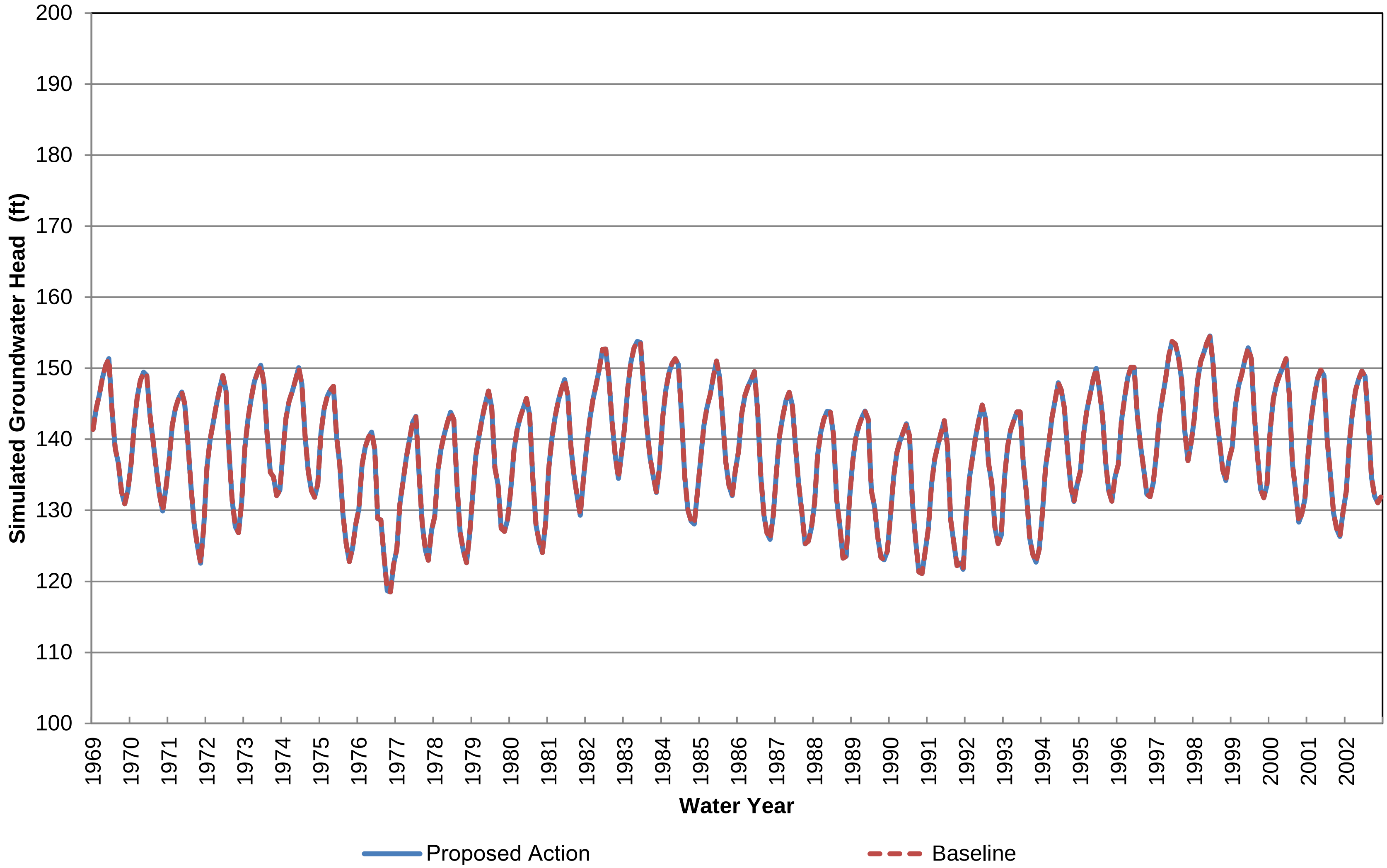
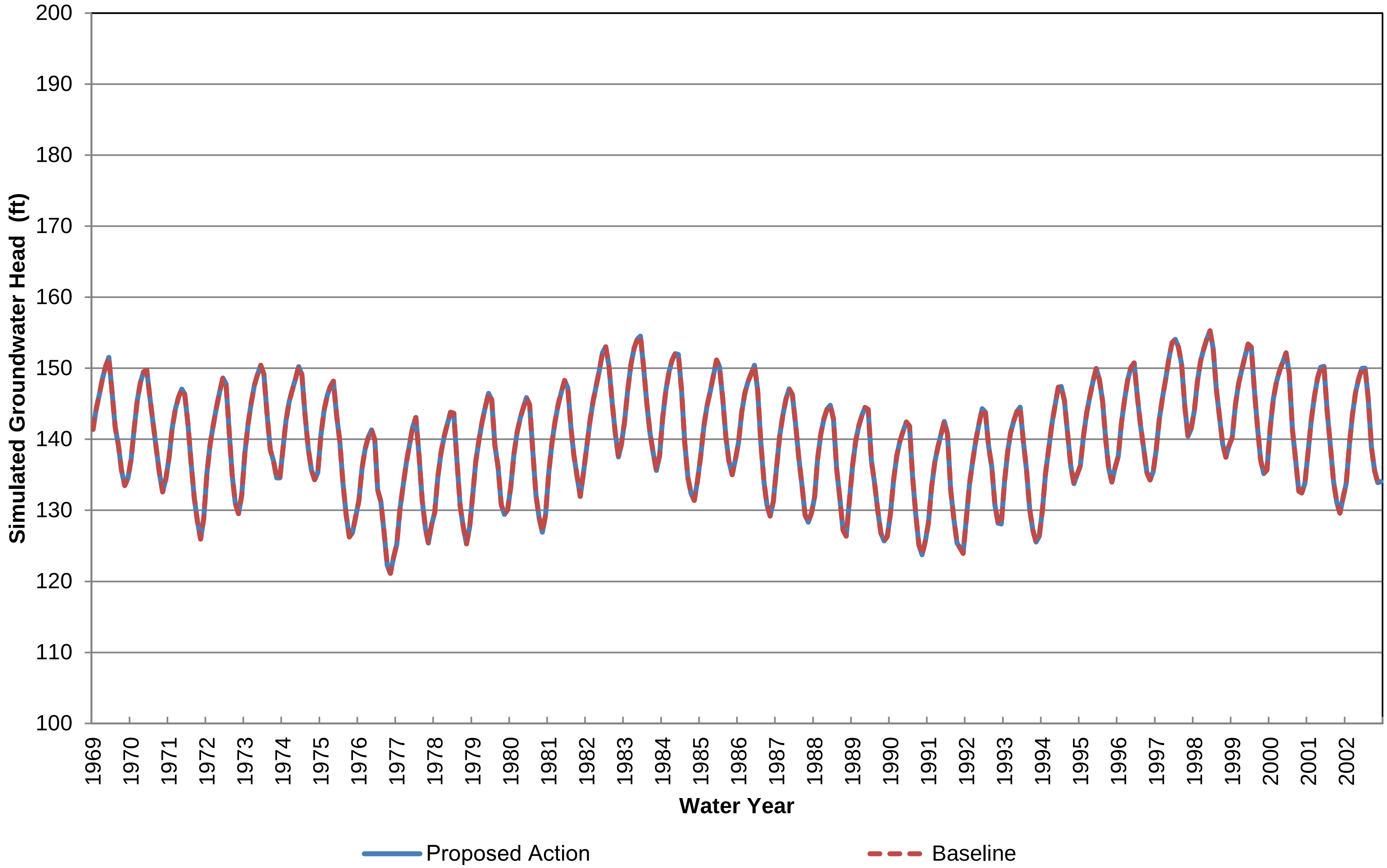
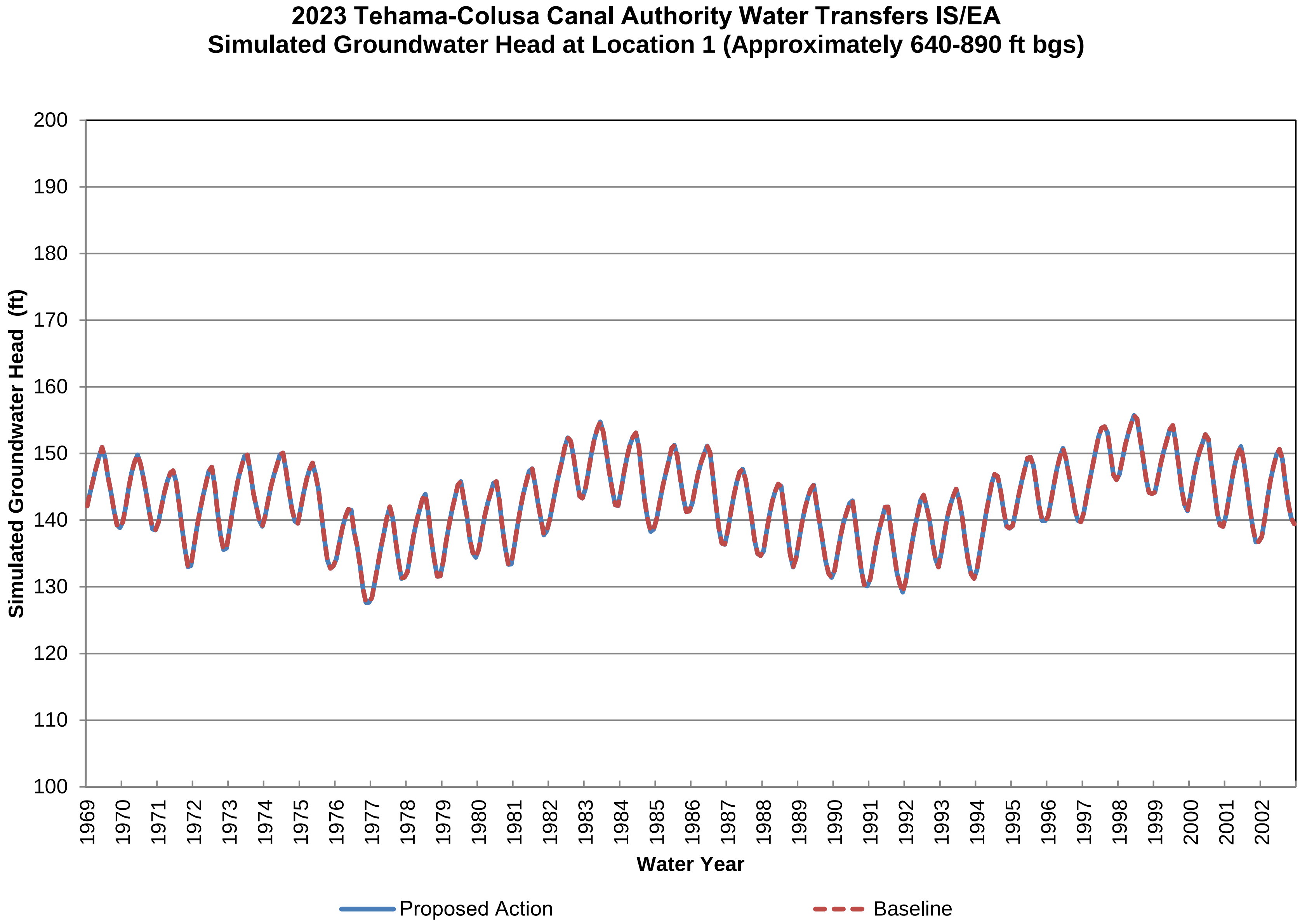
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 1 (Approximately 330-450 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 1 (Approximately 450-640 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 1 (Approximately 640-890 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1969
1970
1971
1972
1973
1974
1975
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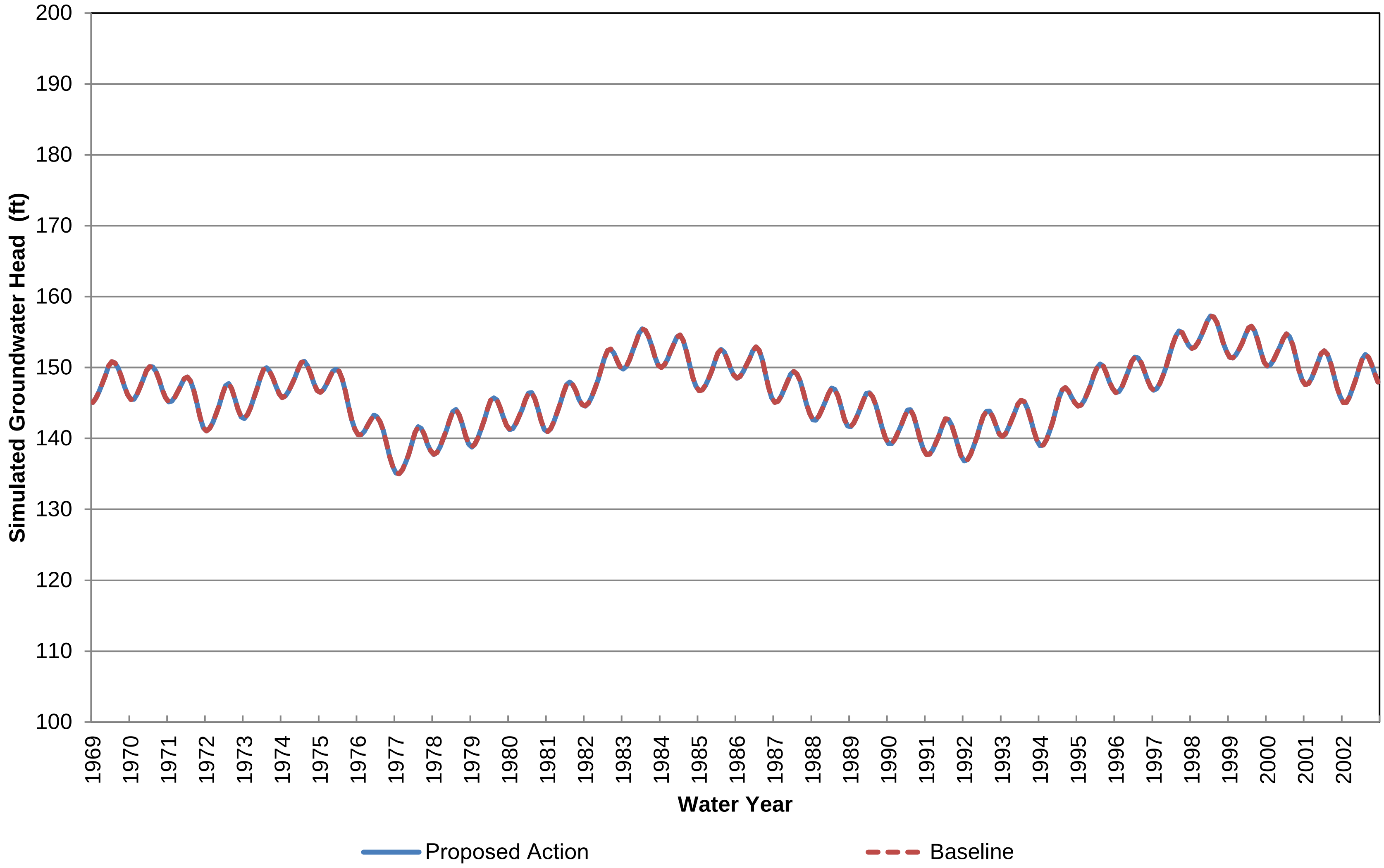
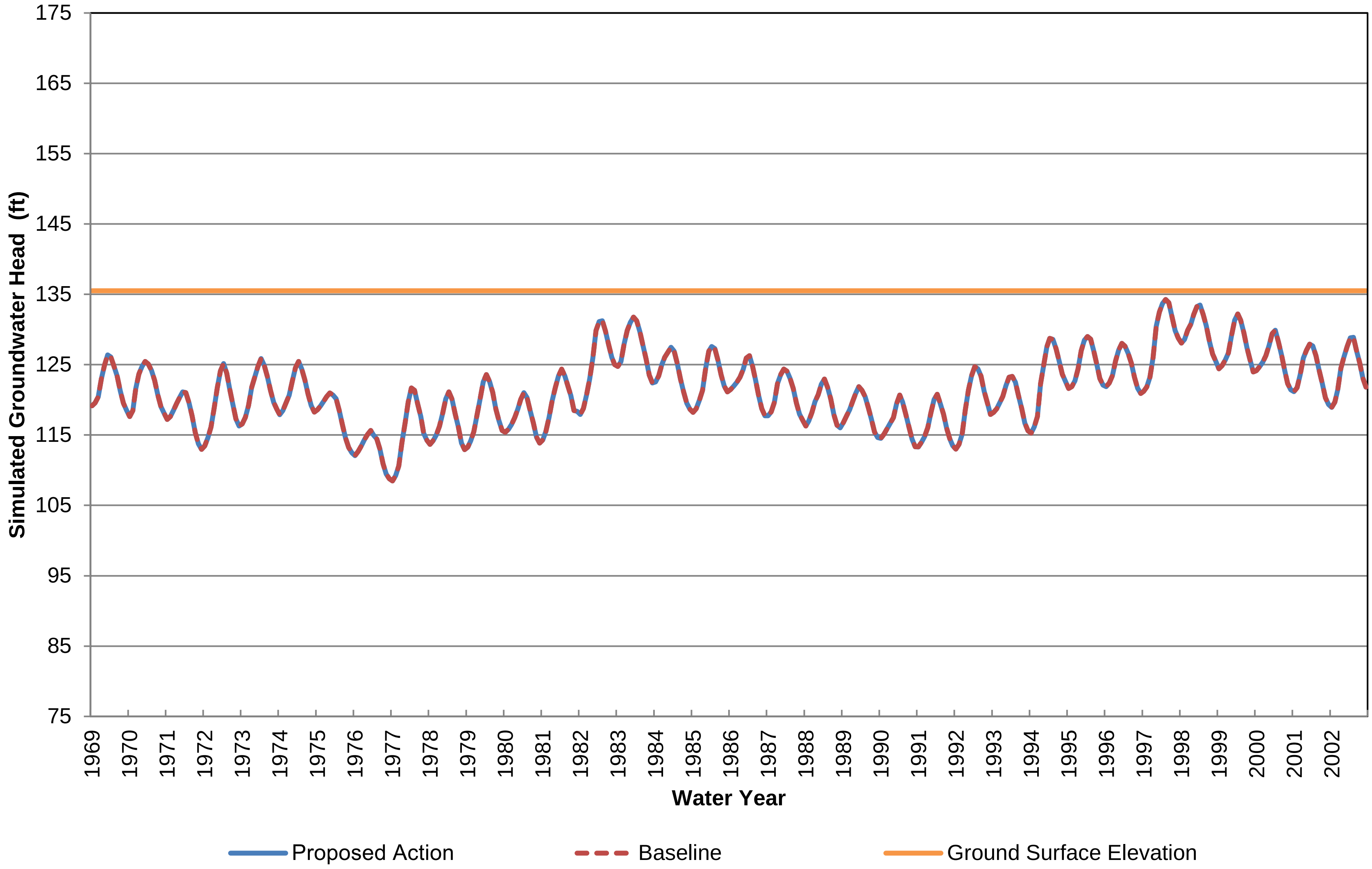
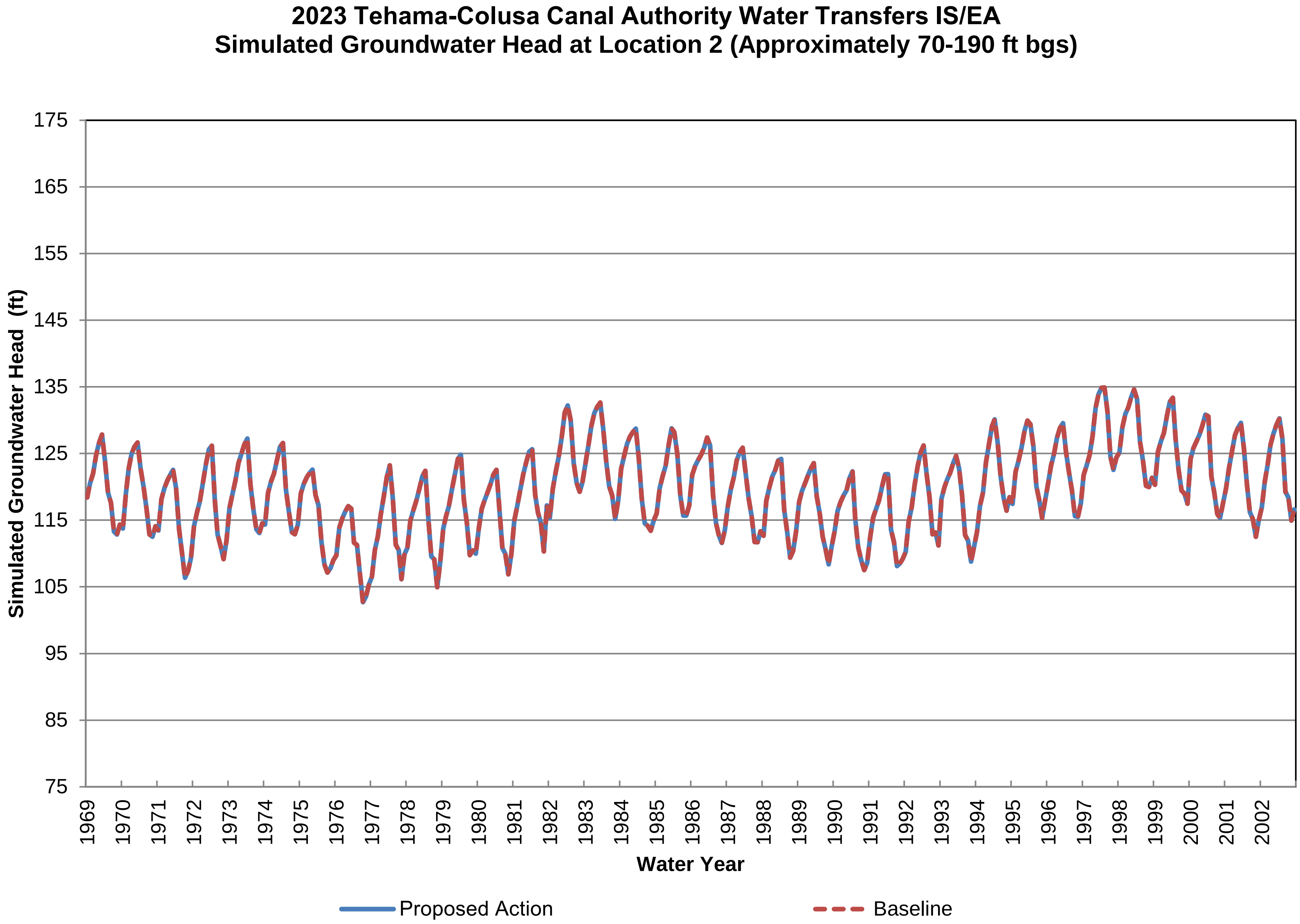
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 1 (Approximately 890-1360 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 2 (Approximately 0-70 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 2 (Approximately 70-190 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
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1970
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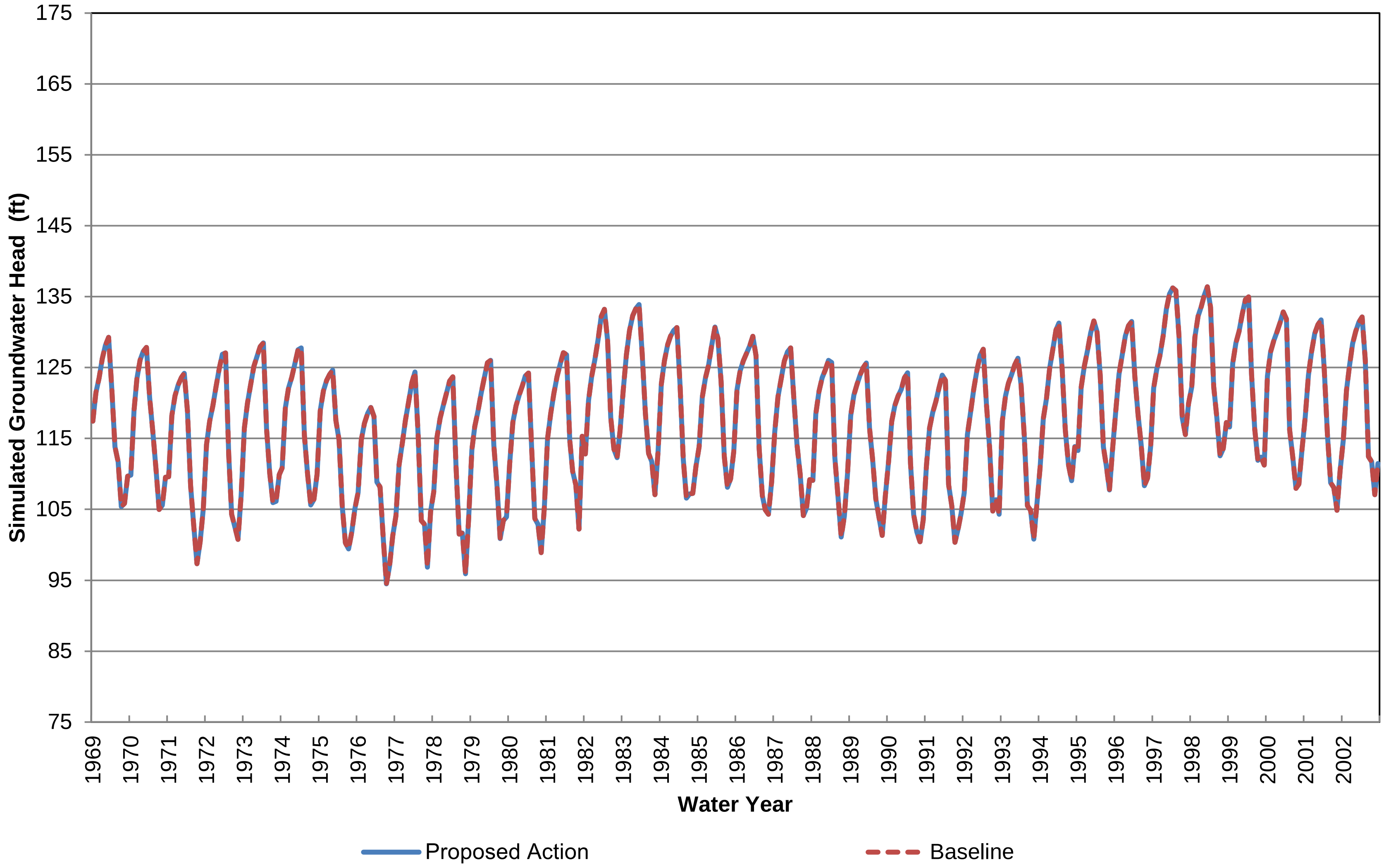
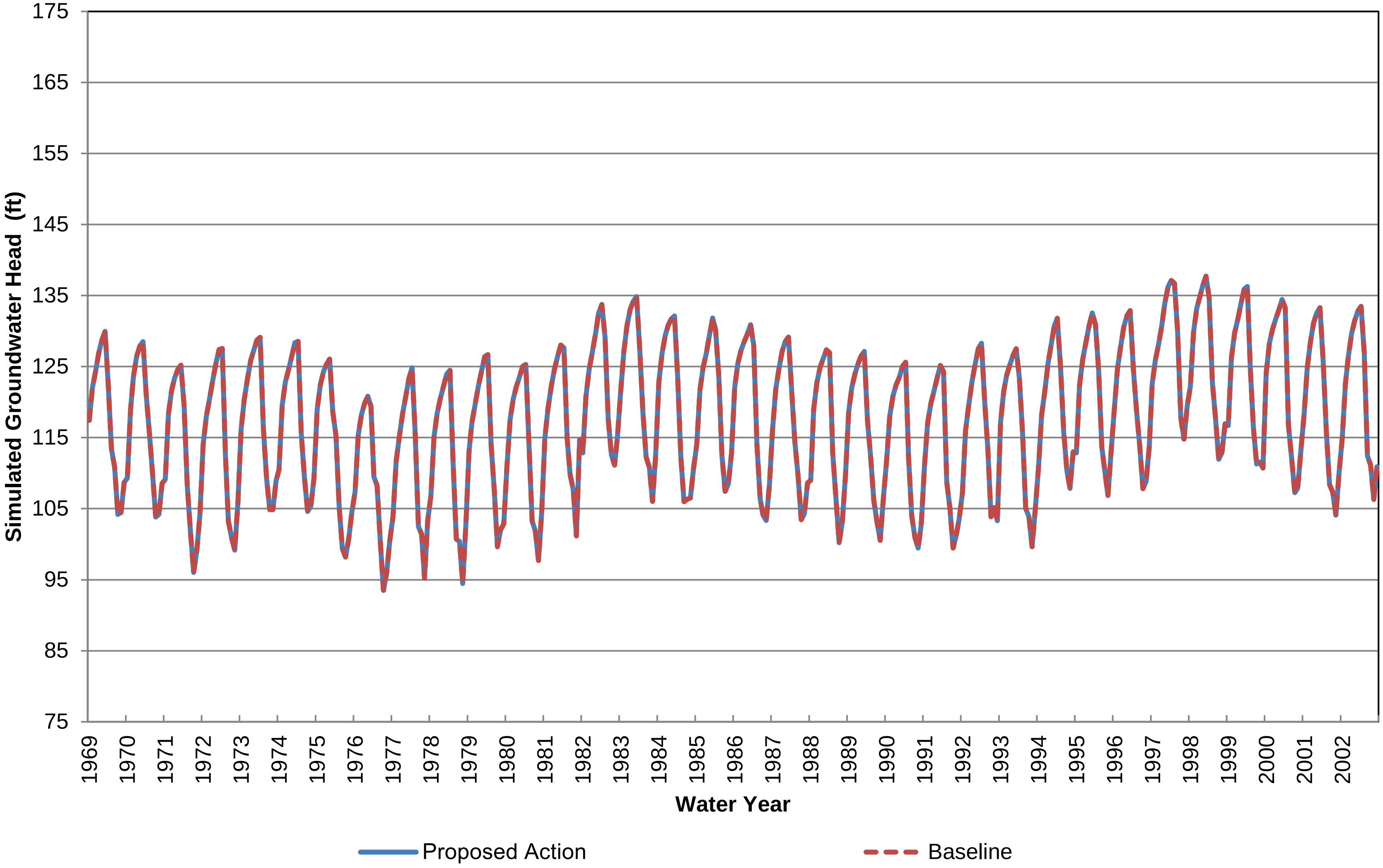
2002
Water Year
Proposed Action
Baseline

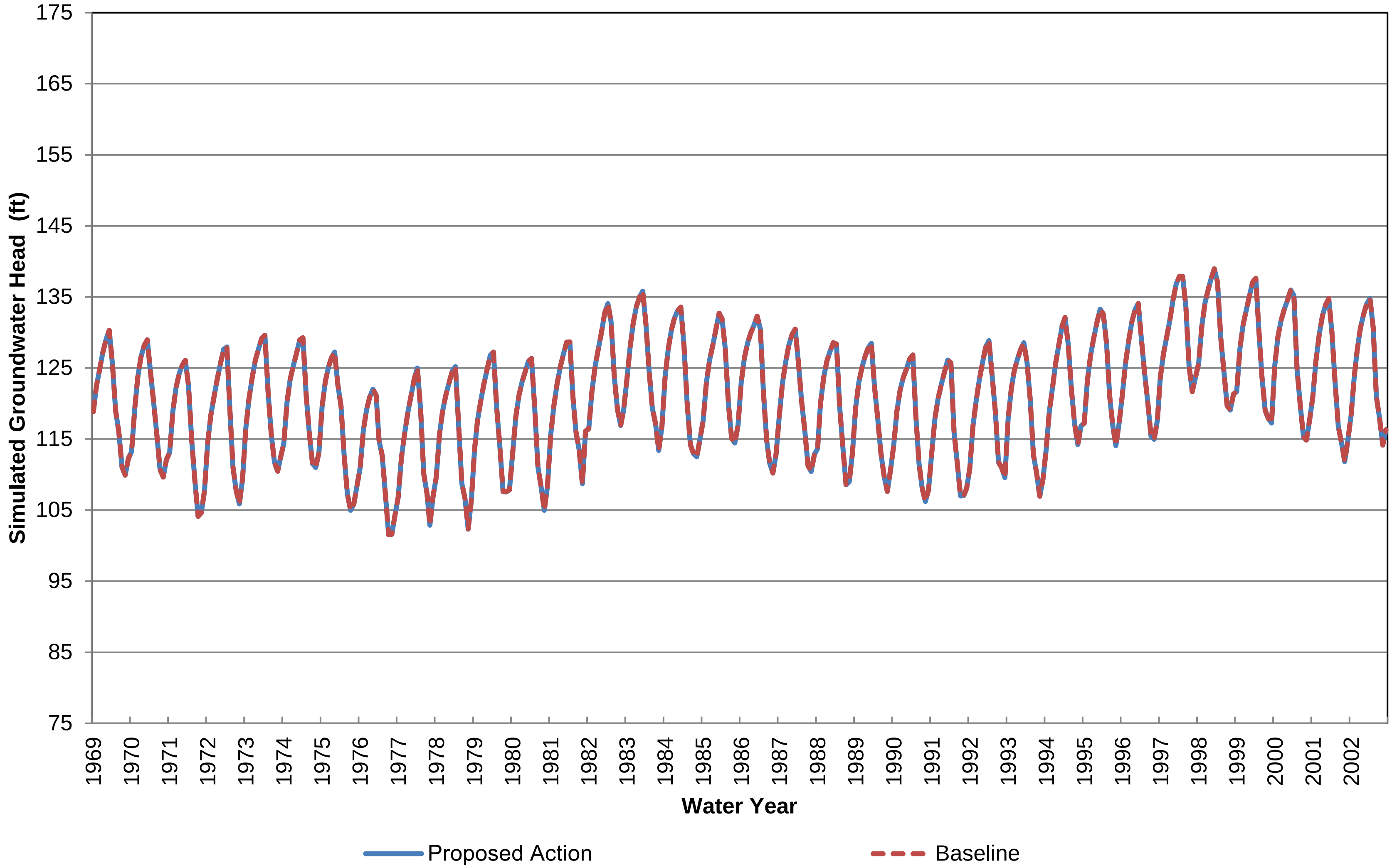
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 2 (Approximately 190-300 ft bgs)



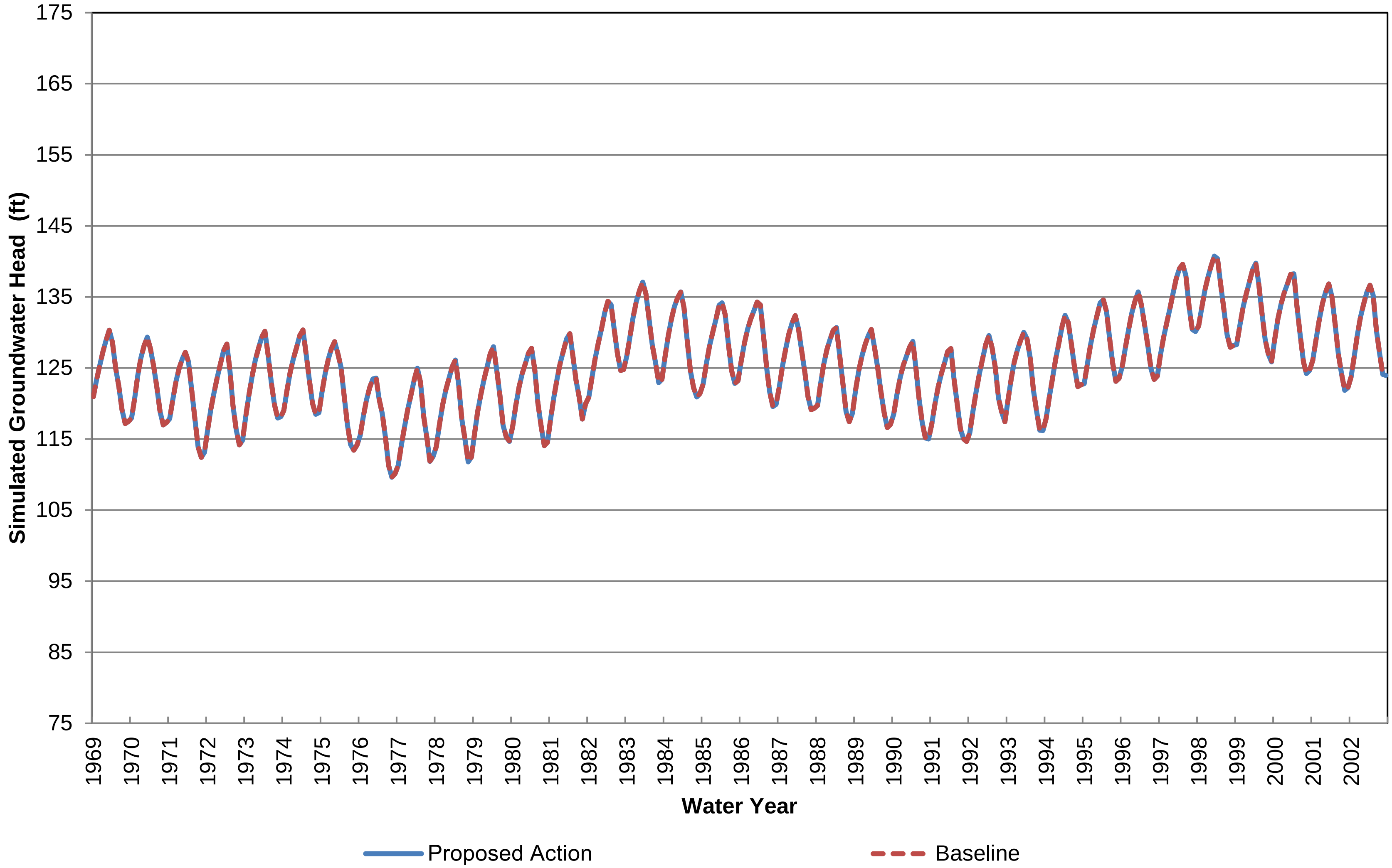
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 2 (Approximately 300-420 ft bgs)

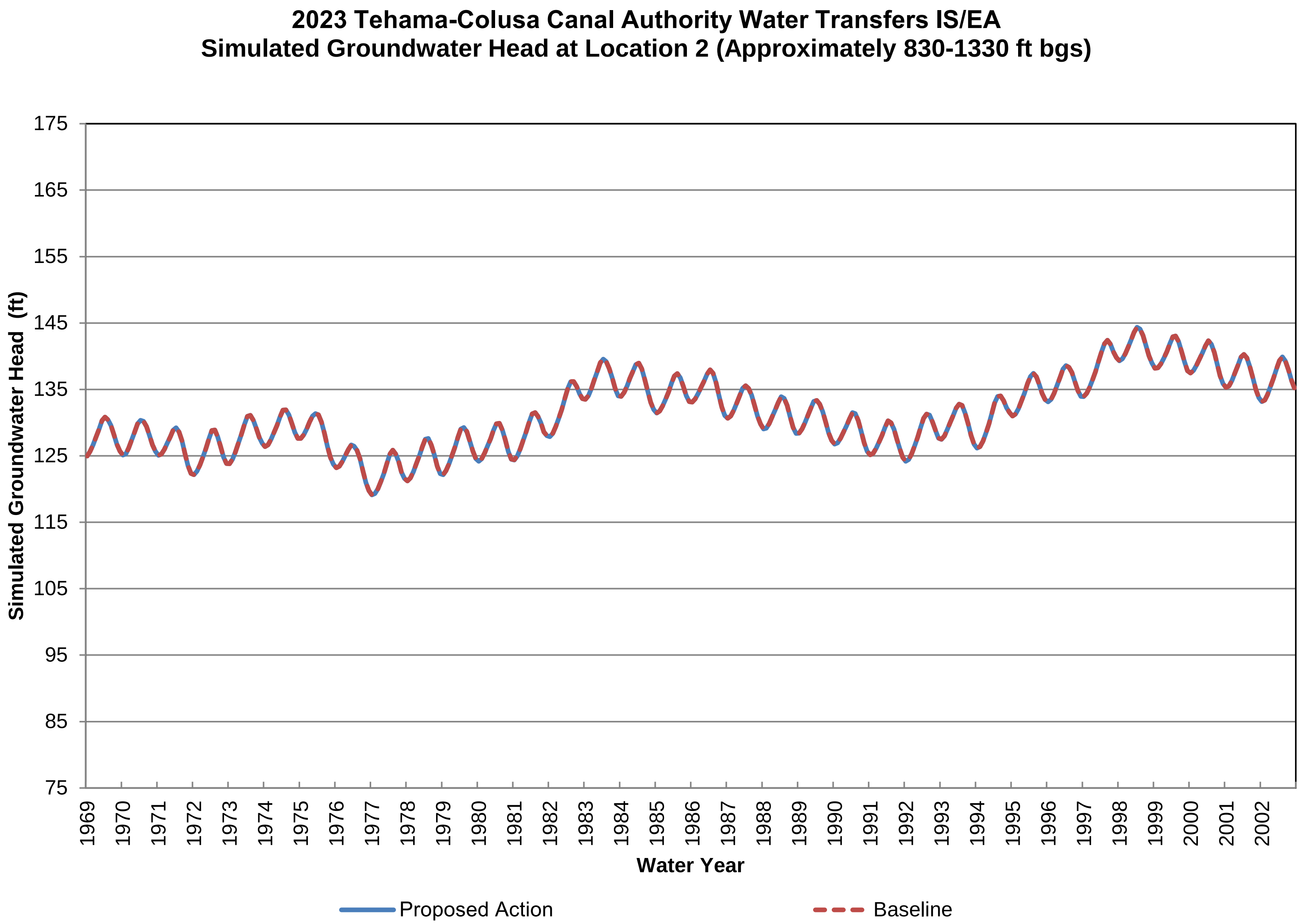


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 2 (Approximately 420-580 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 2 (Approximately 580-830 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 2 (Approximately 830-1330 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1969
1970
1971
1972
1973
1974
1975
1976
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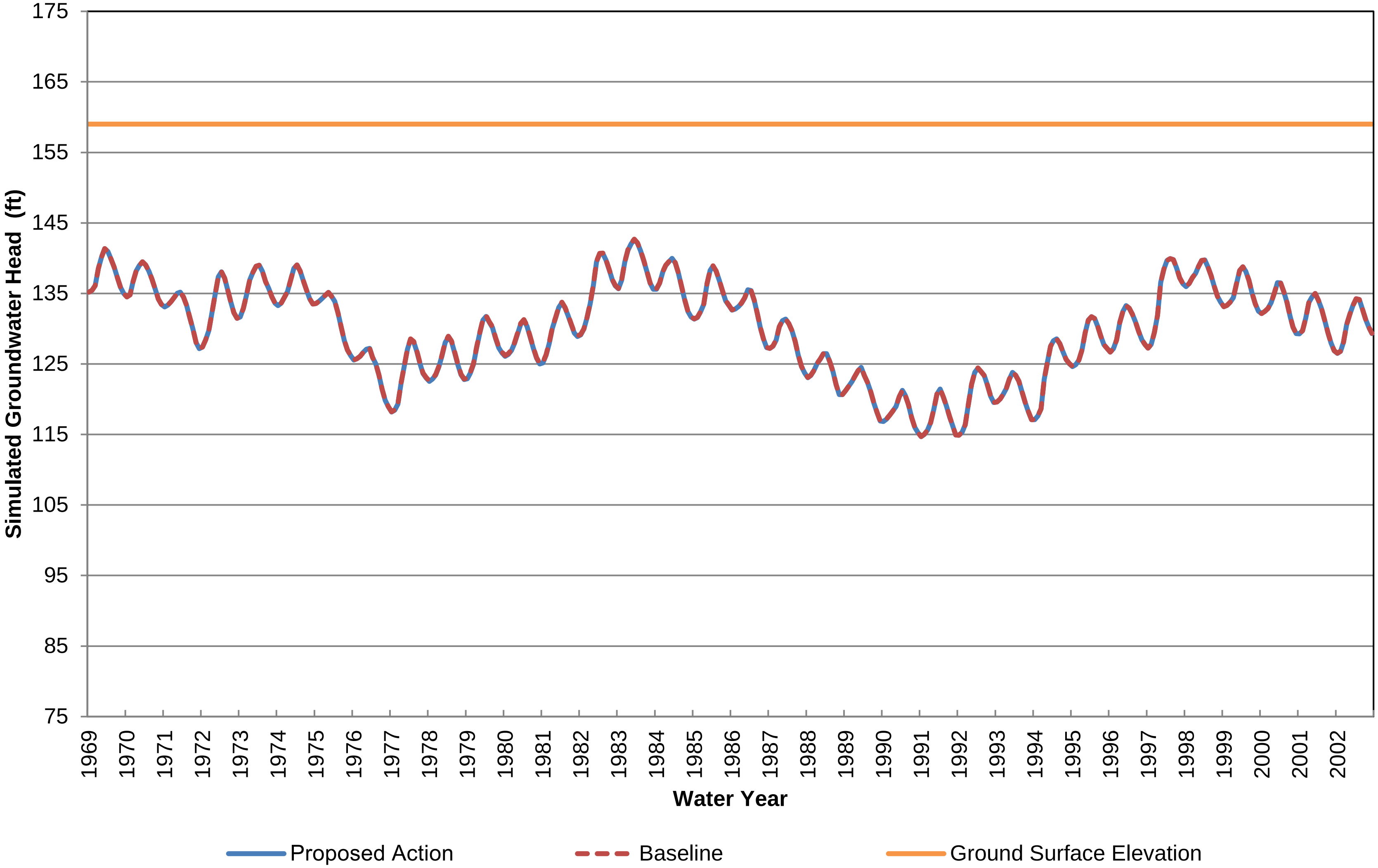
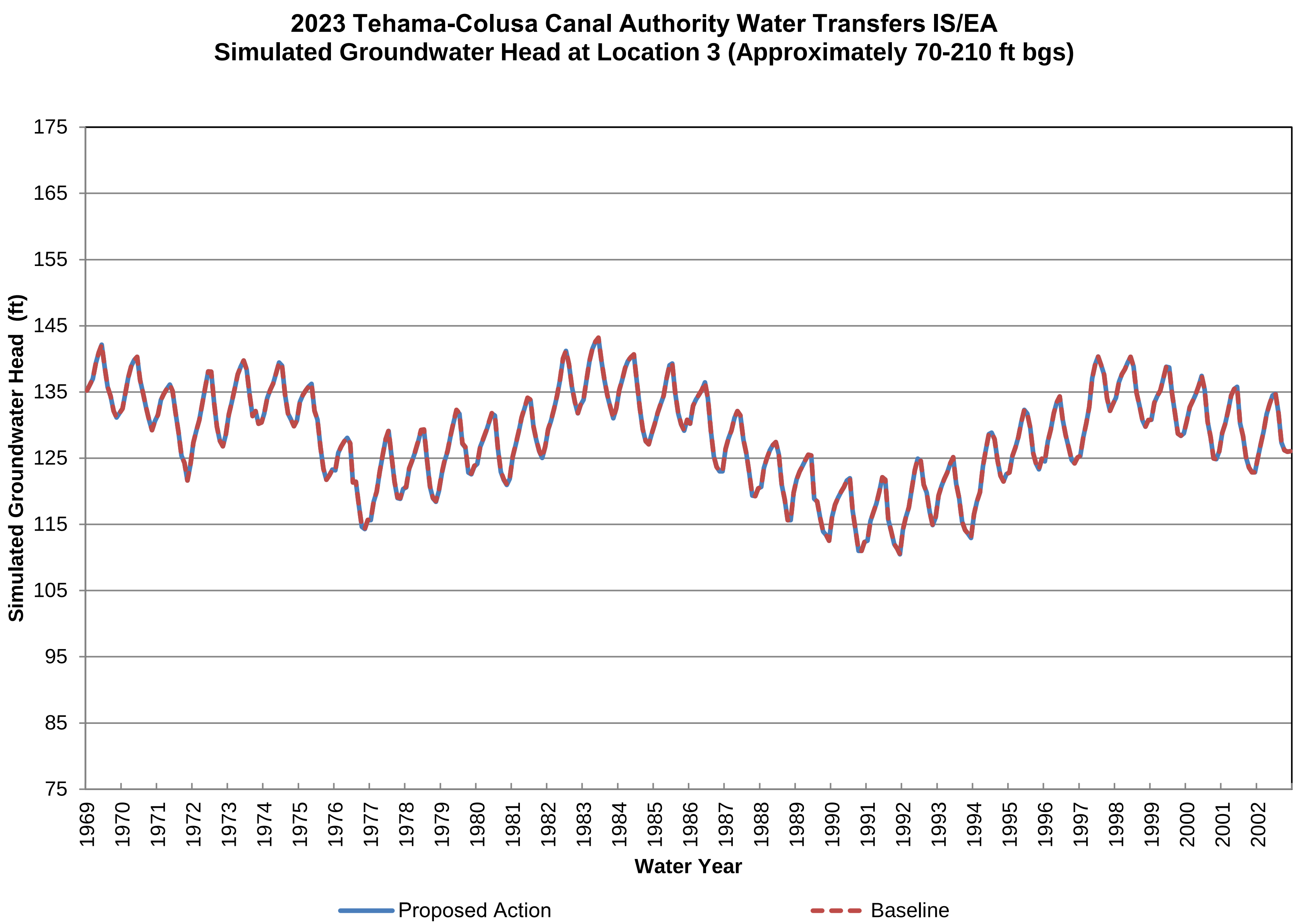
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 3 (Approximately 0-70 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 3 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1969
1970
1971
1972
1973
1974
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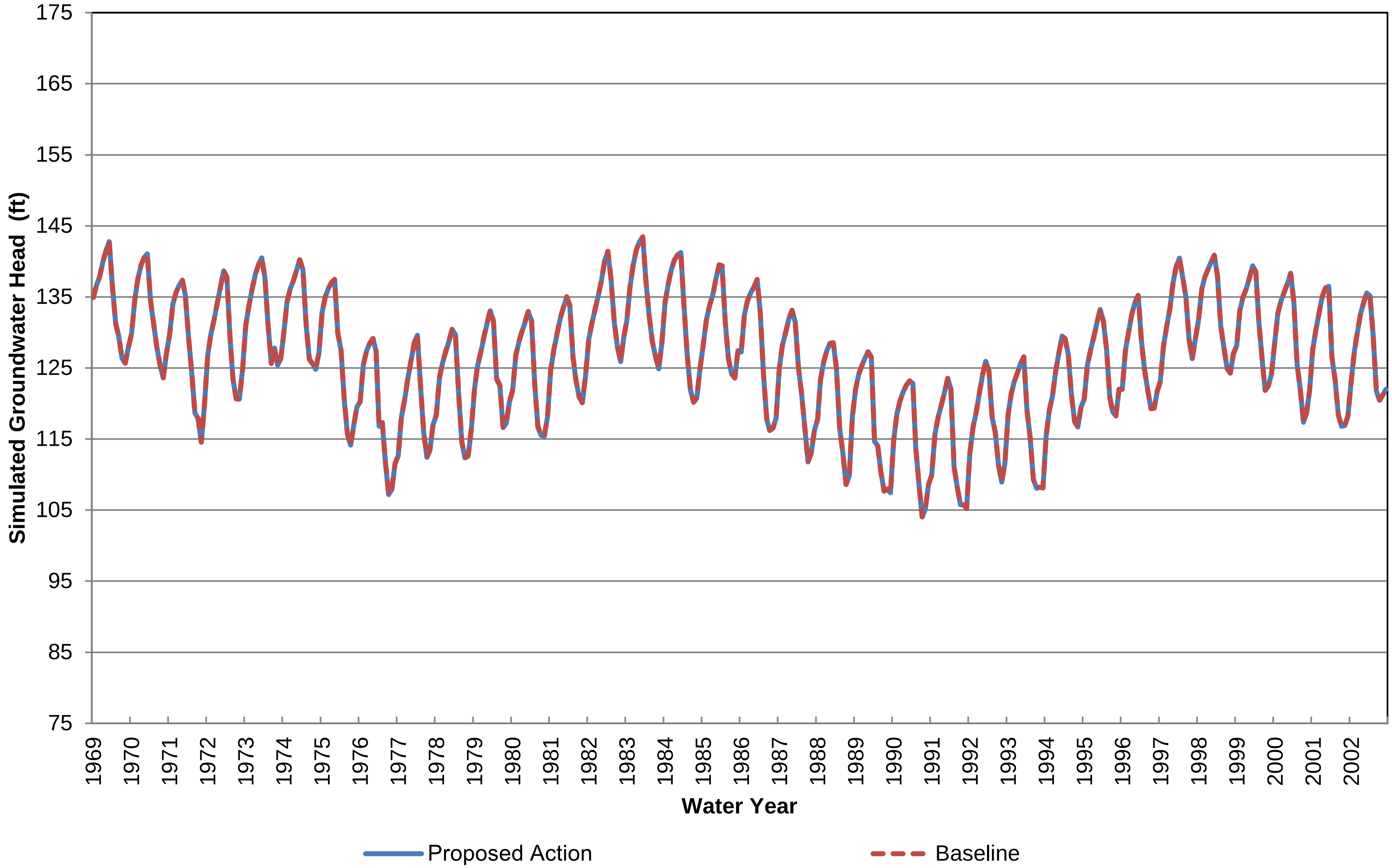
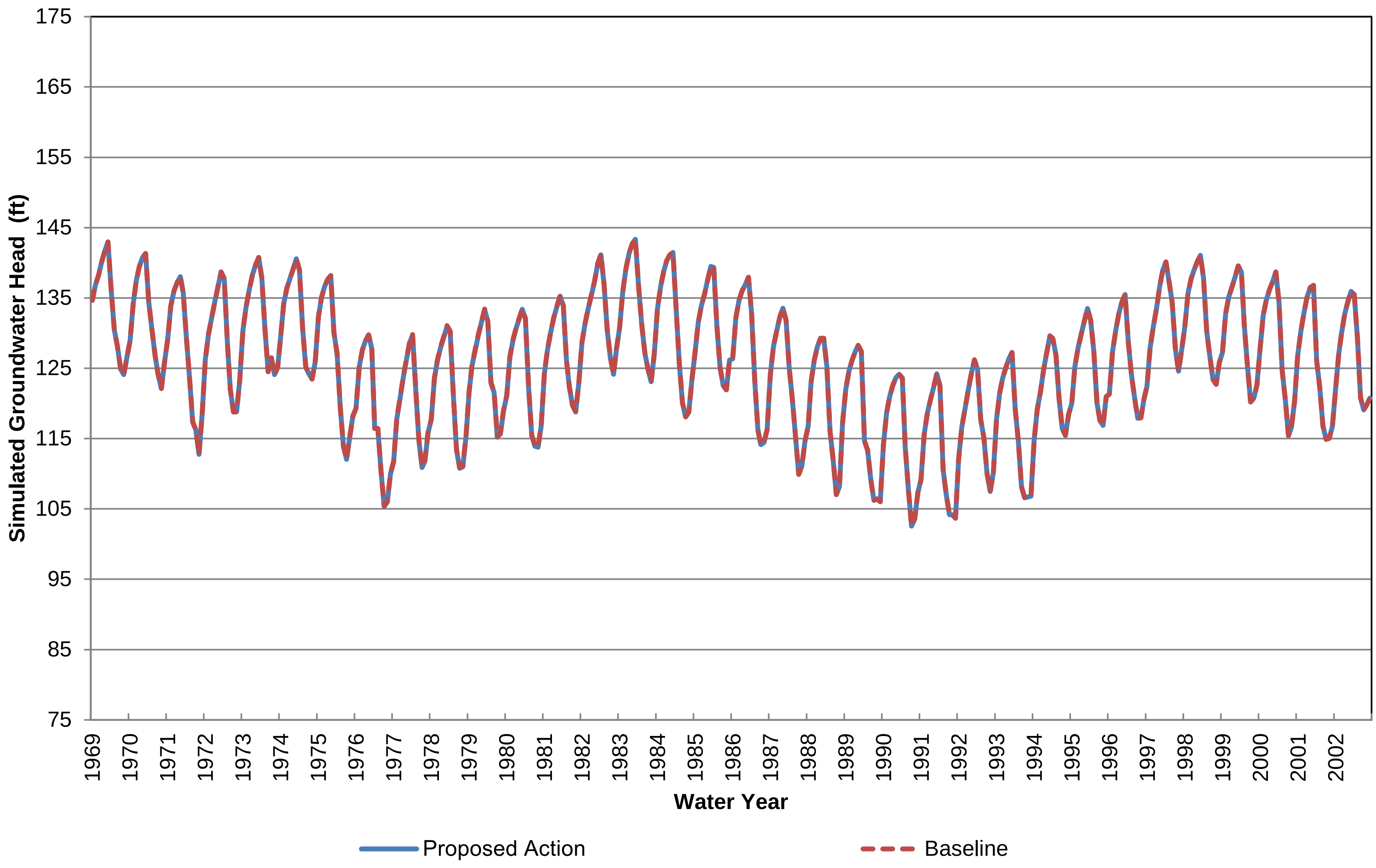
2002
Water Year
Proposed Action
Baseline

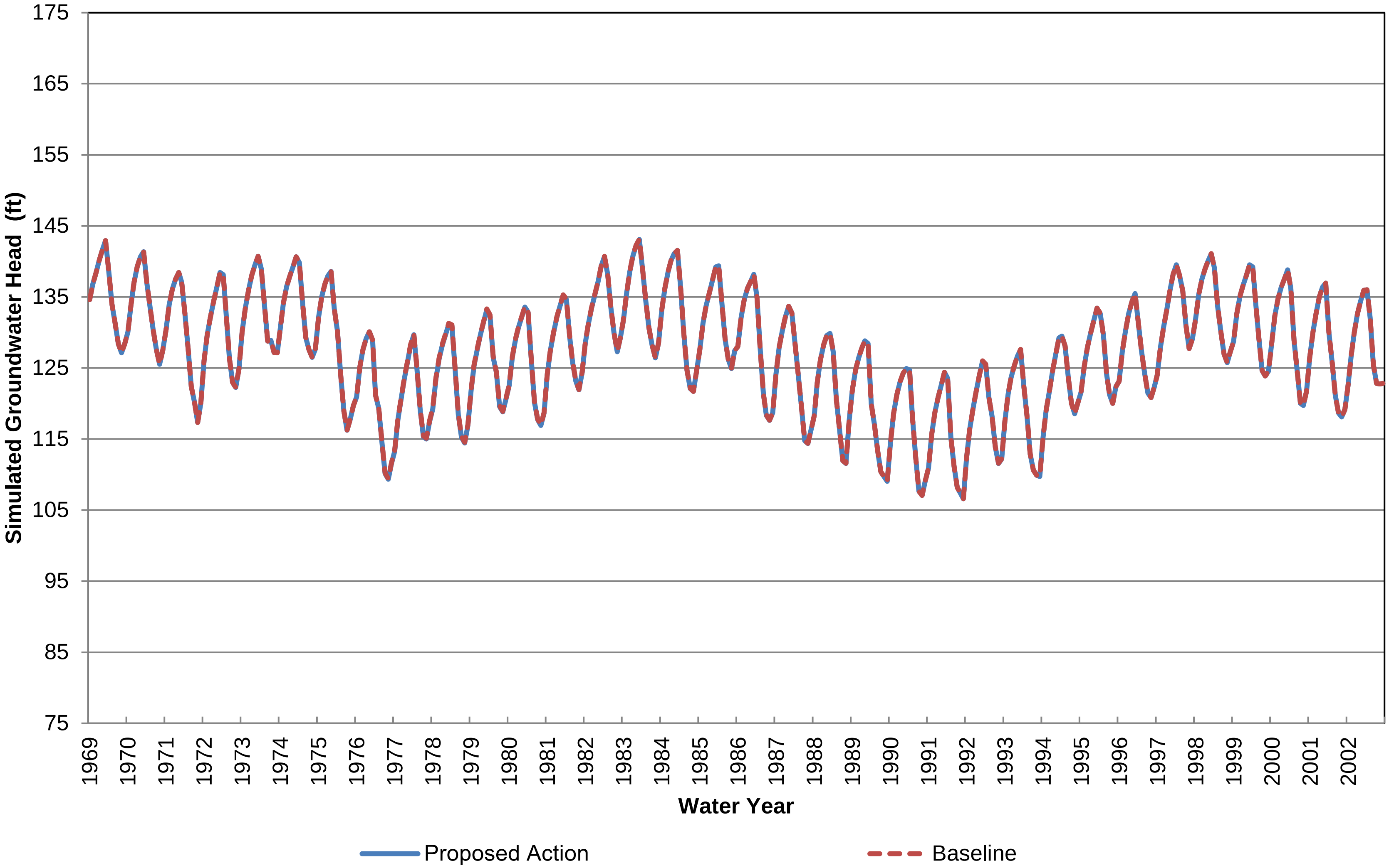
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 3 (Approximately 210-350 ft bgs)

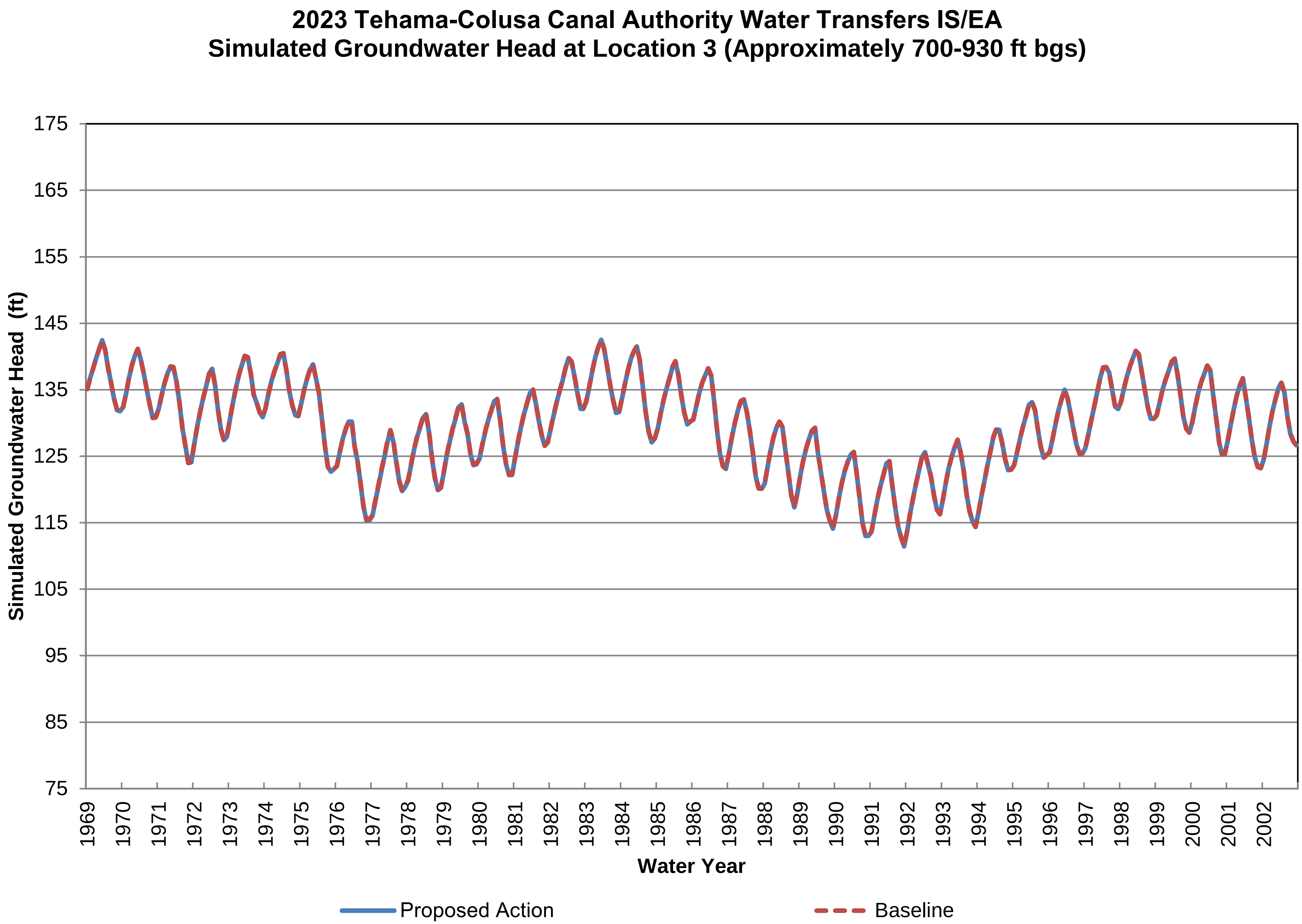


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 3 (Approximately 350-480 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 3 (Approximately 480-700 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 3 (Approximately 700-930 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1969
1970
1971
1972
1973
1974
1975
1976
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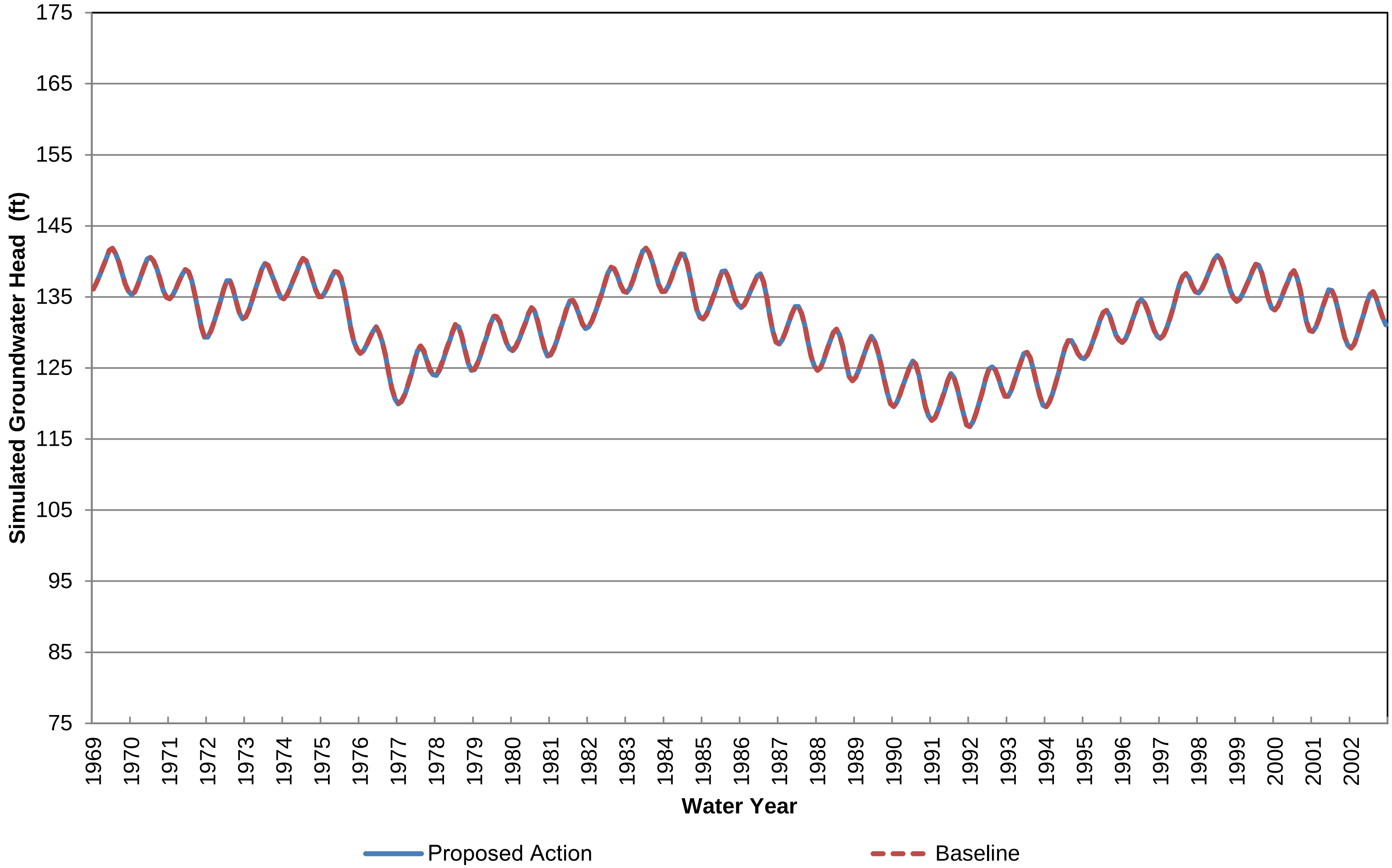
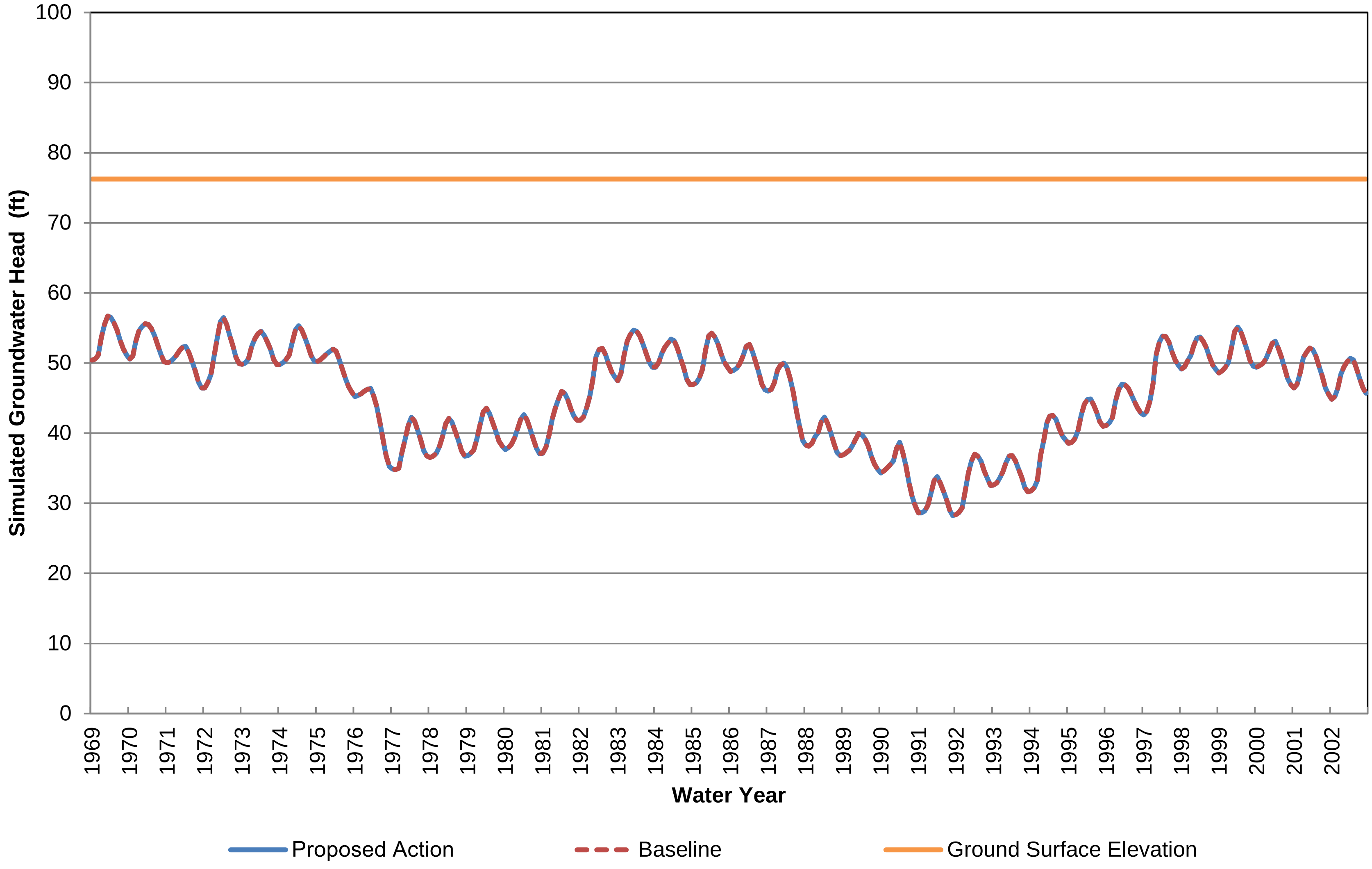
2002
Water Year
Proposed Action
Baseline

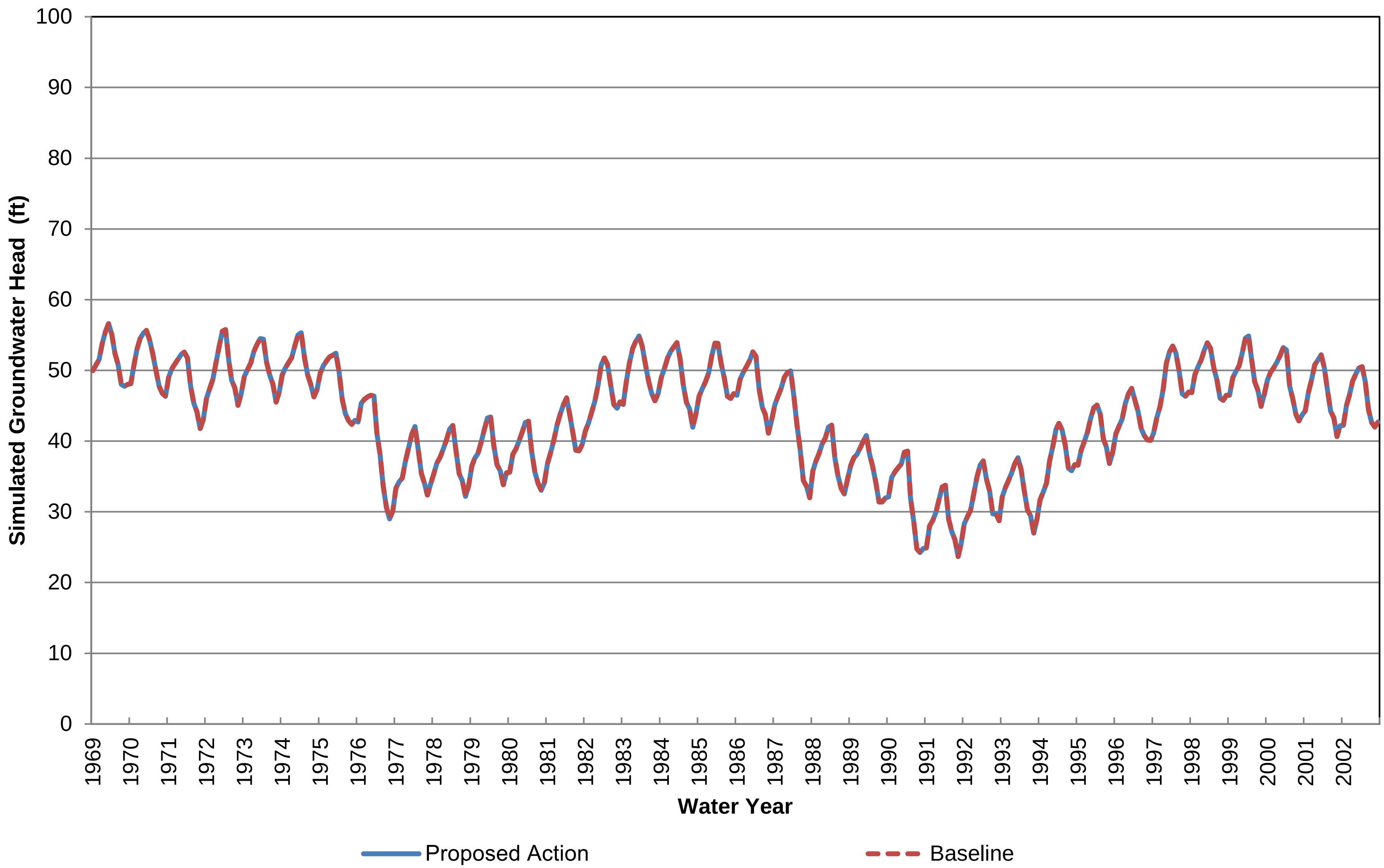
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 3 (Approximately 930-1290 ft bgs)

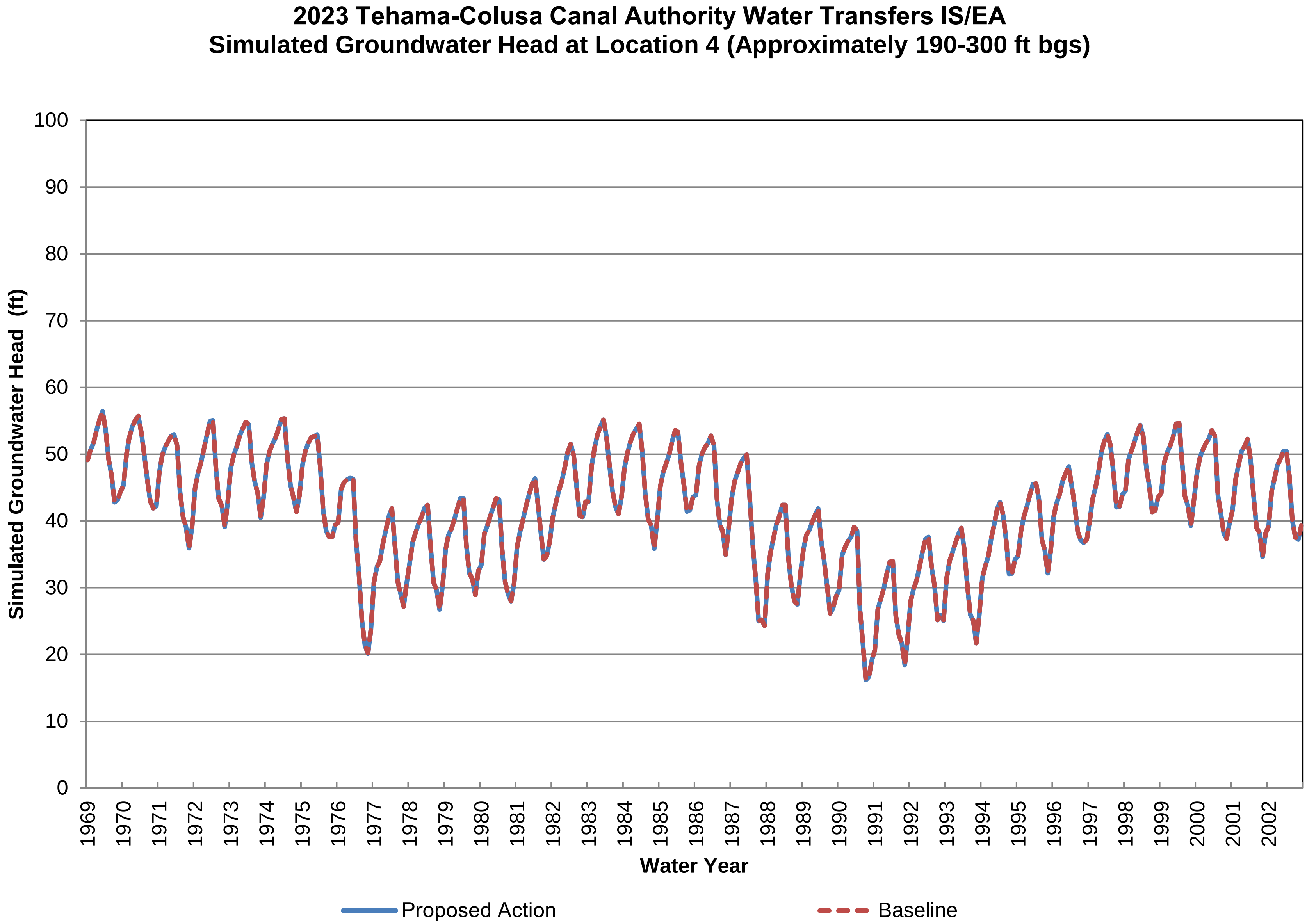


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 4 (Approximately 0-70 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 4 (Approximately 70-190 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 4 (Approximately 190-300 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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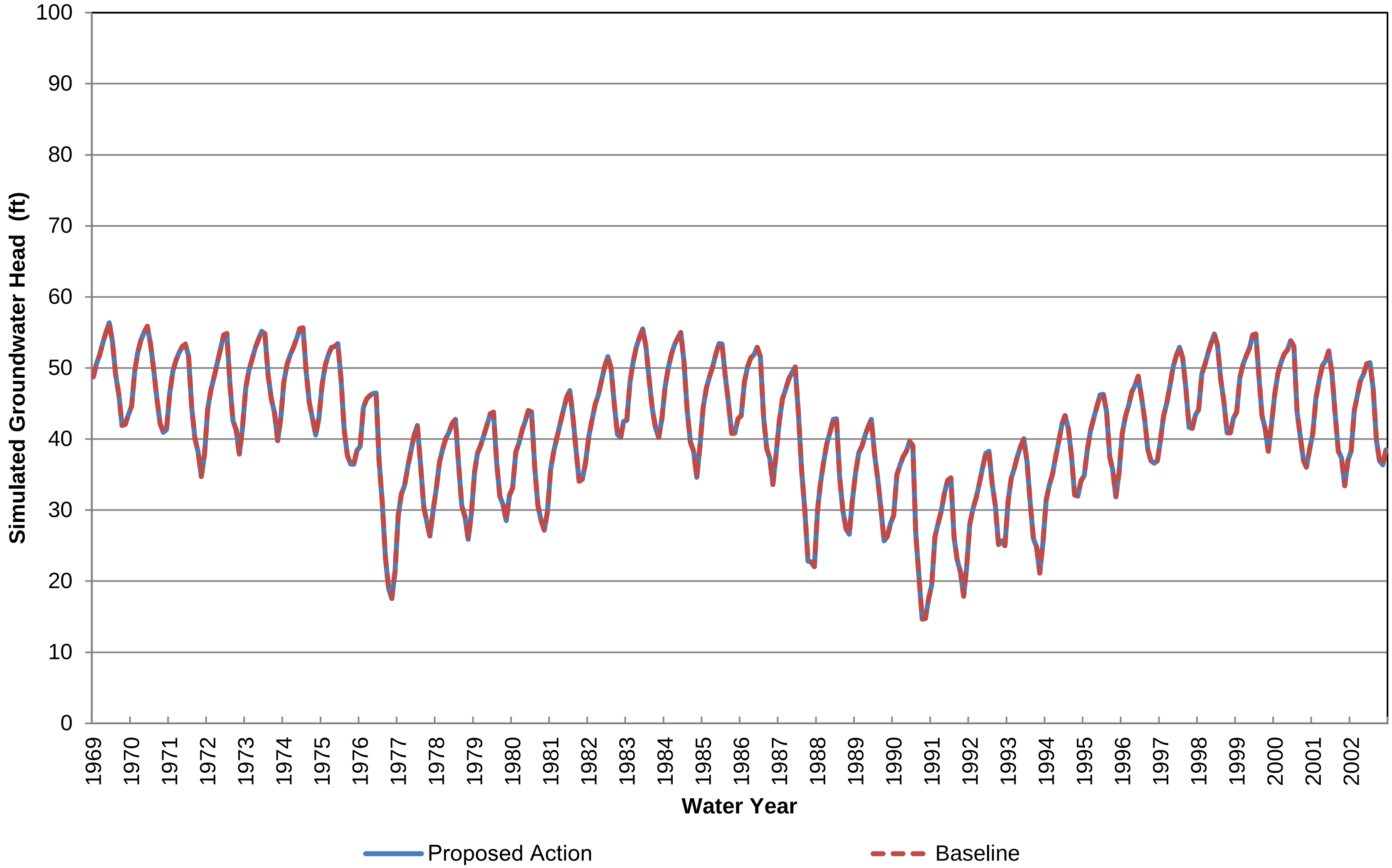
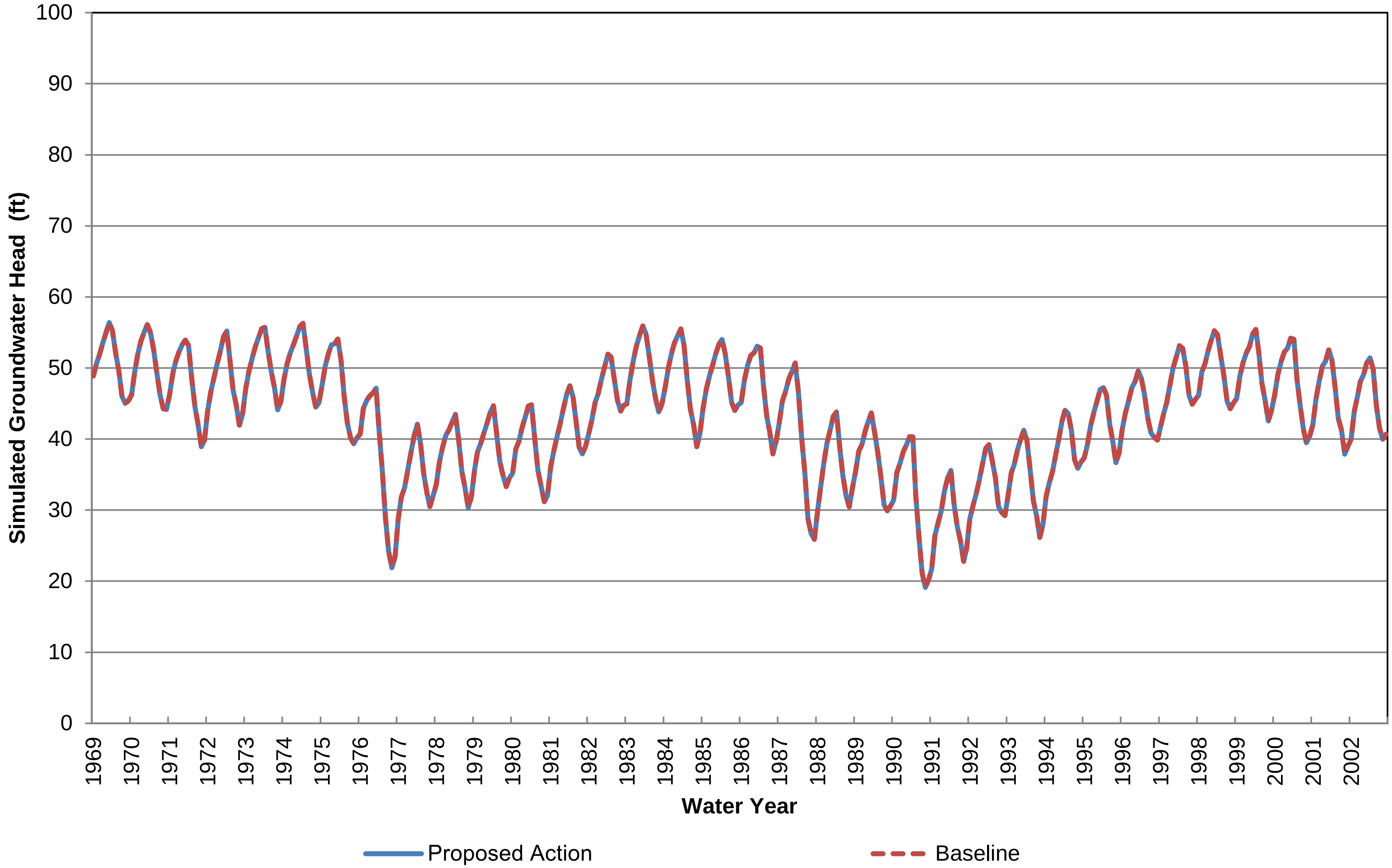
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

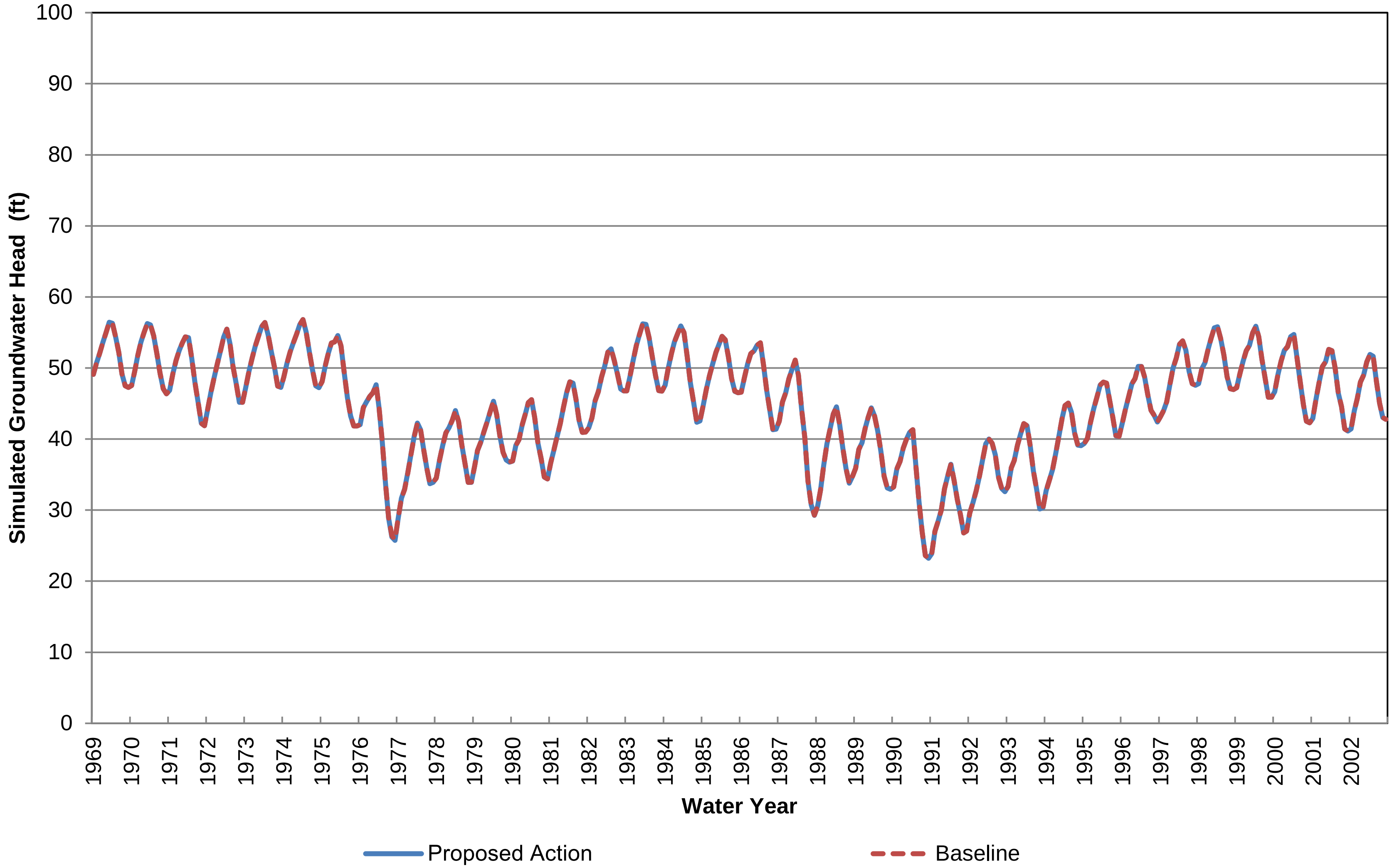
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 4 (Approximately 300-420 ft bgs)



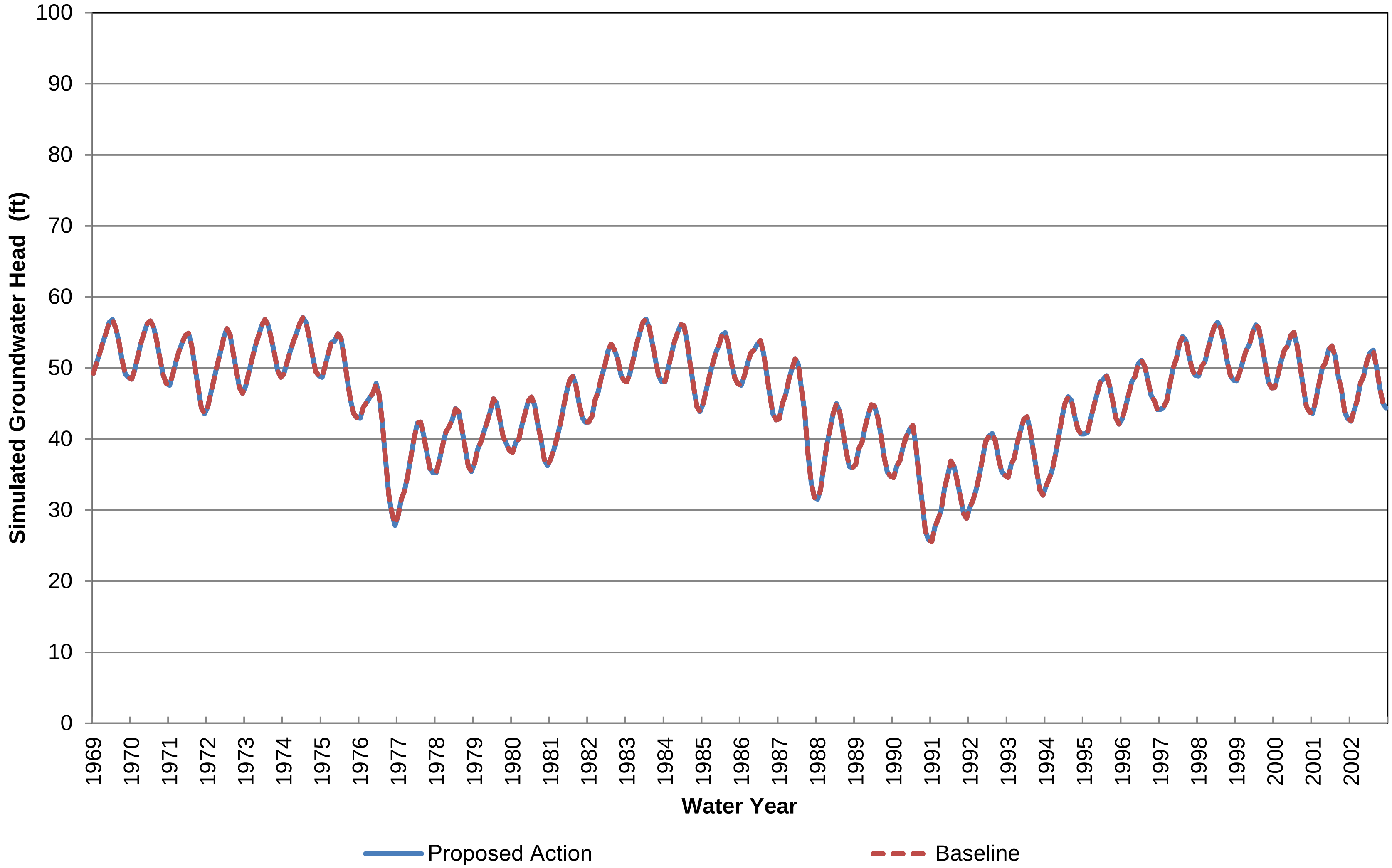
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 4 (Approximately 420-580 ft bgs)



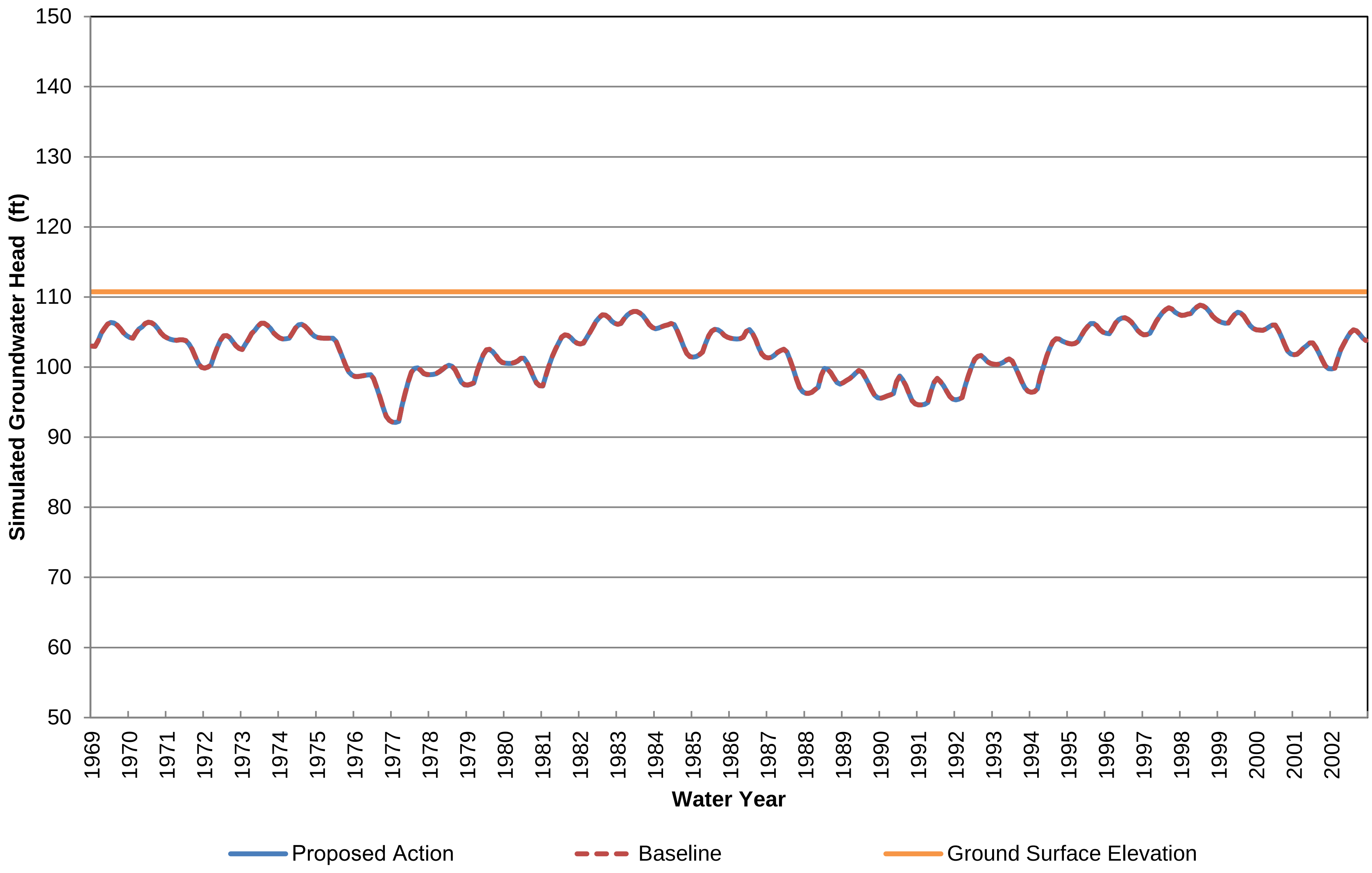
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 4 (Approximately 580-780 ft bgs)



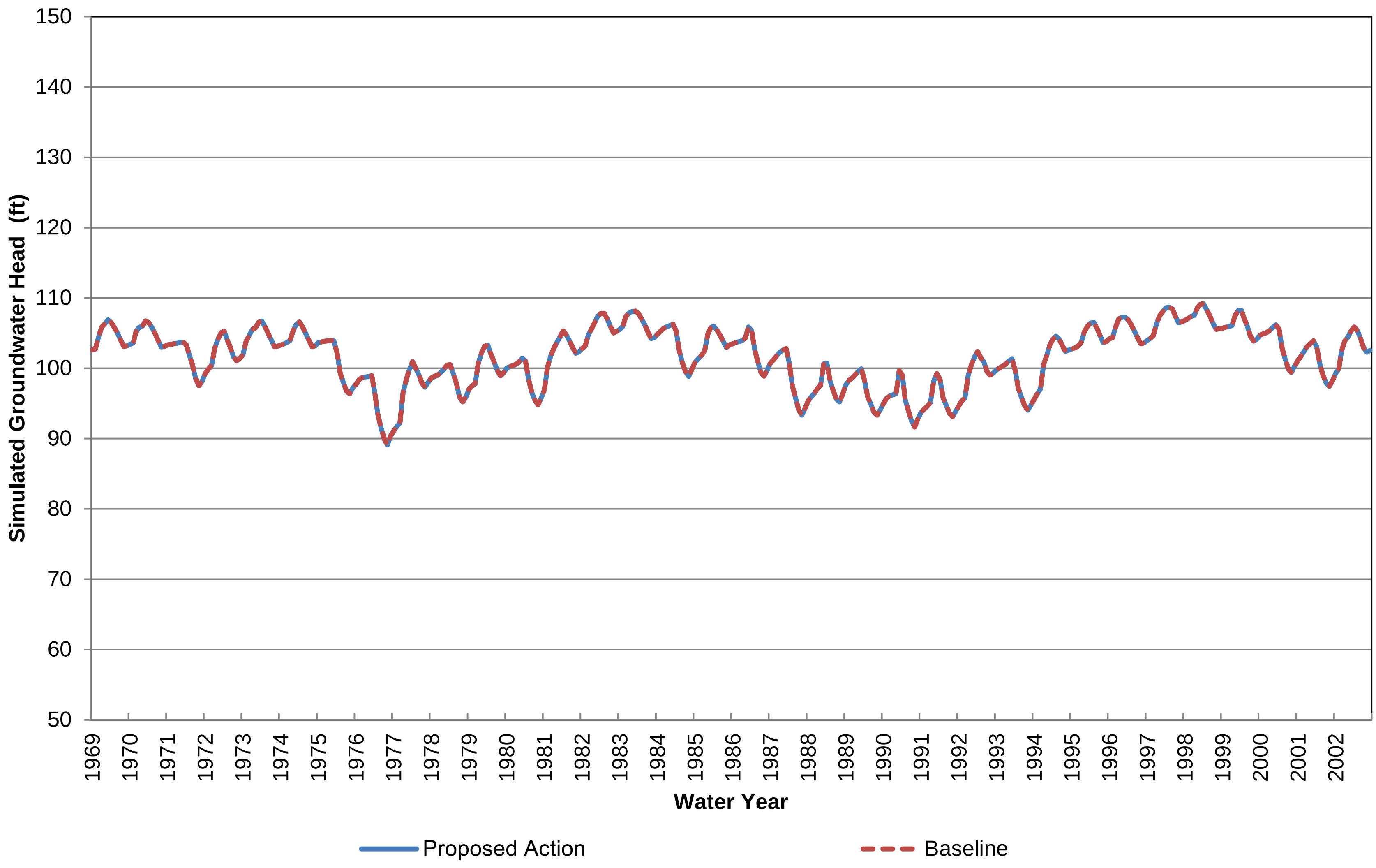
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 4 (Approximately 780-1060 ft bgs)



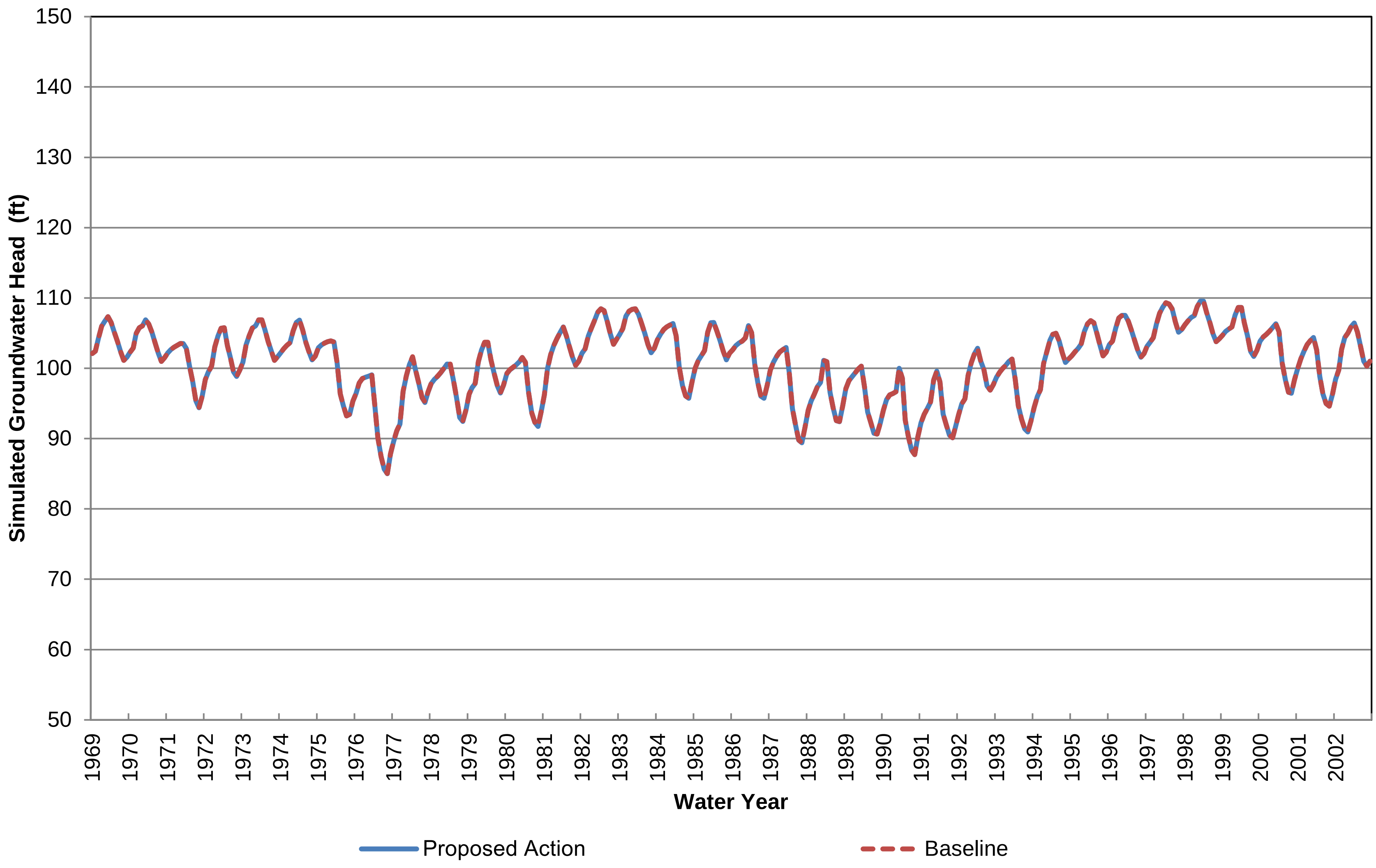
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 5 (Approximately 0-70 ft bgs)



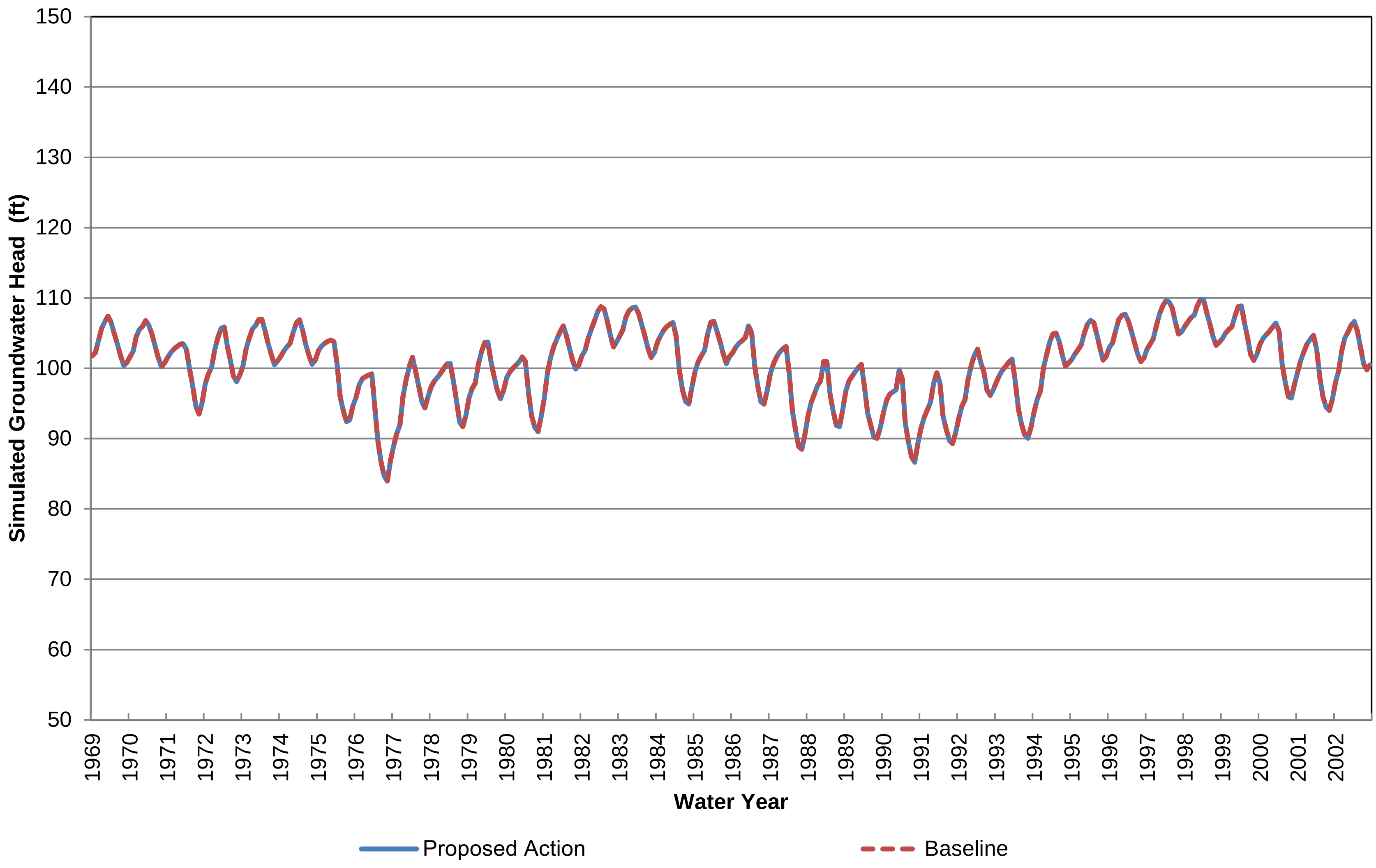
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 5 (Approximately 70-200 ft bgs)



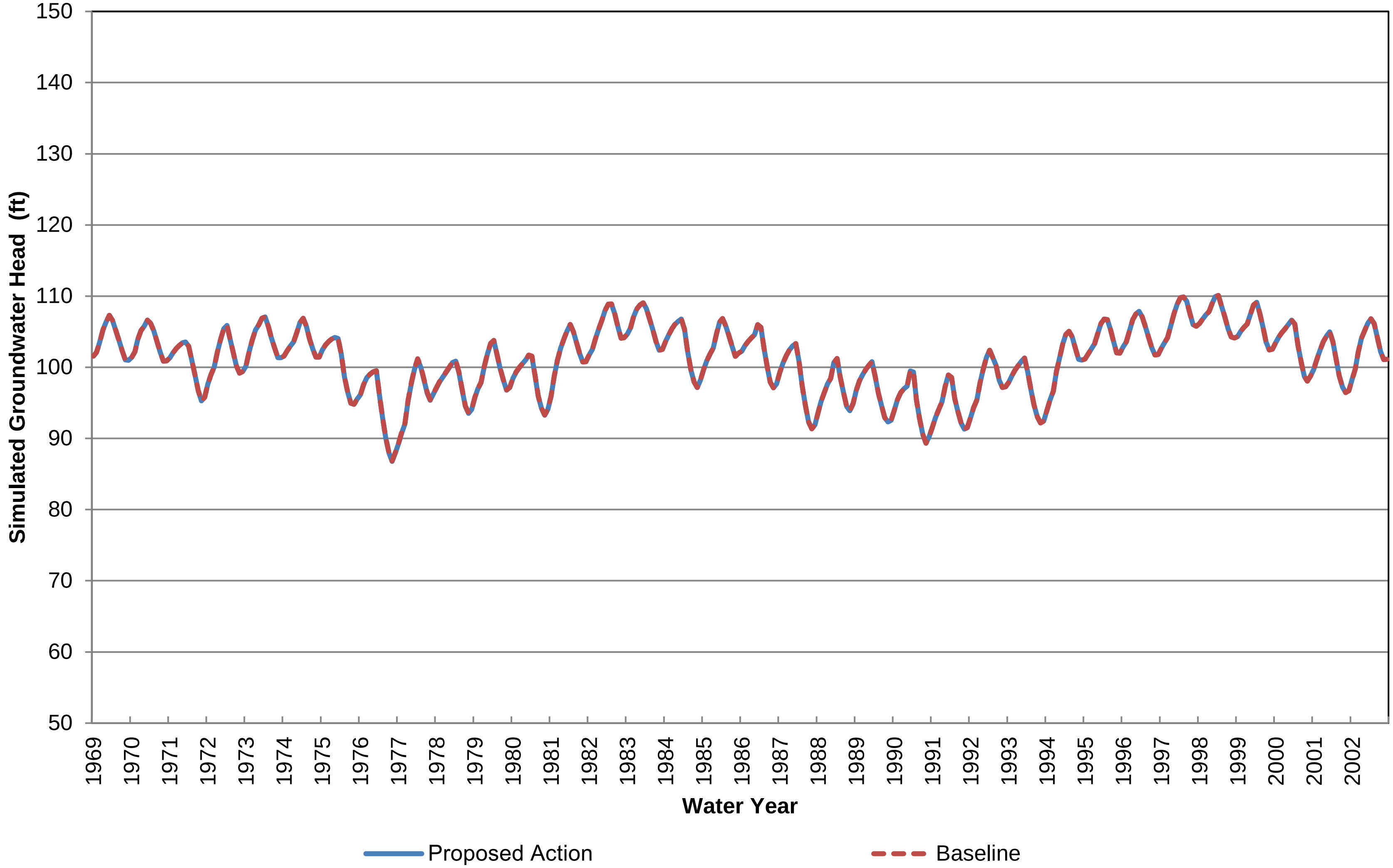
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 5 (Approximately 200-340 ft bgs)

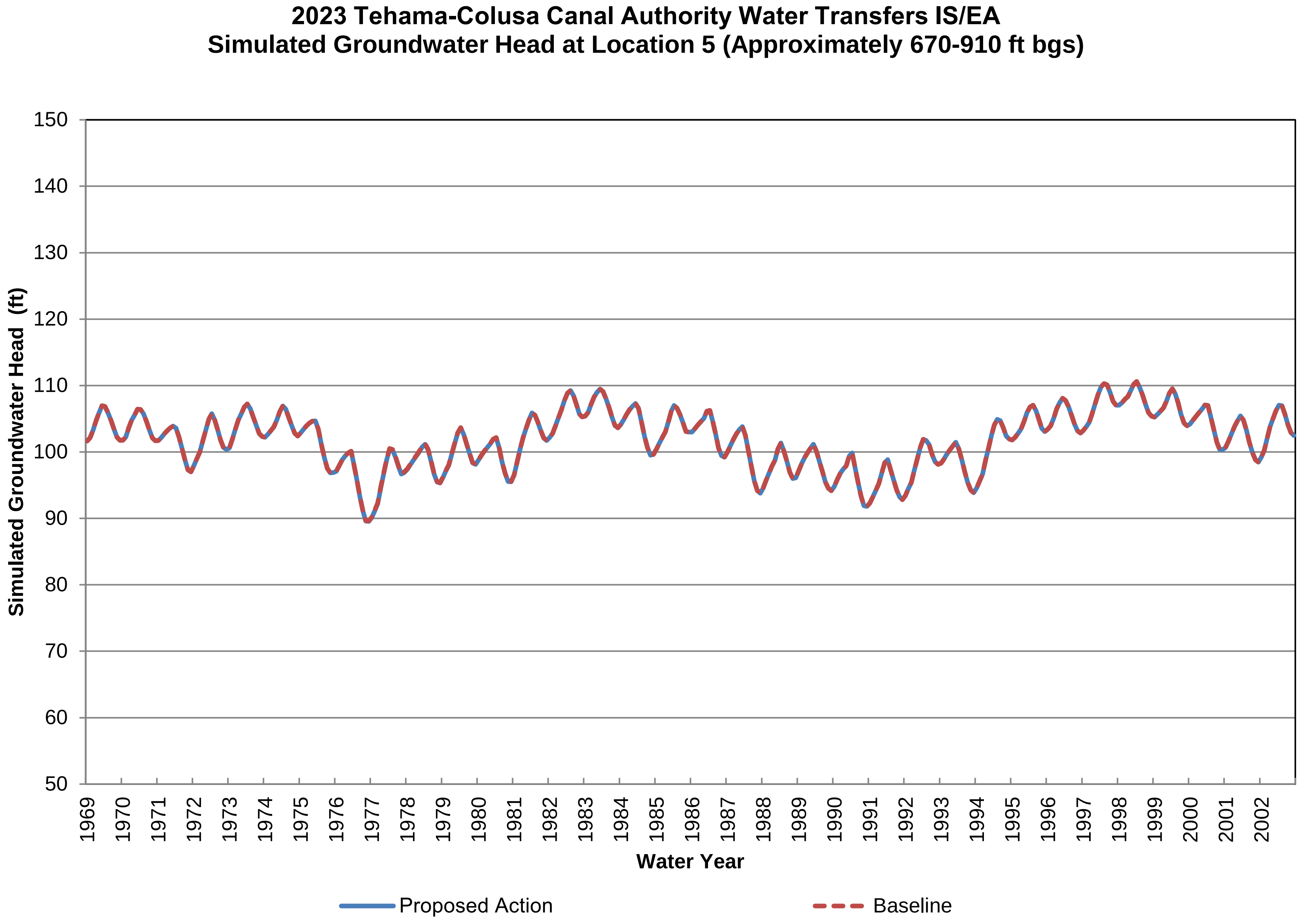


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 5 (Approximately 340-470 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 5 (Approximately 470-670 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 5 (Approximately 670-910 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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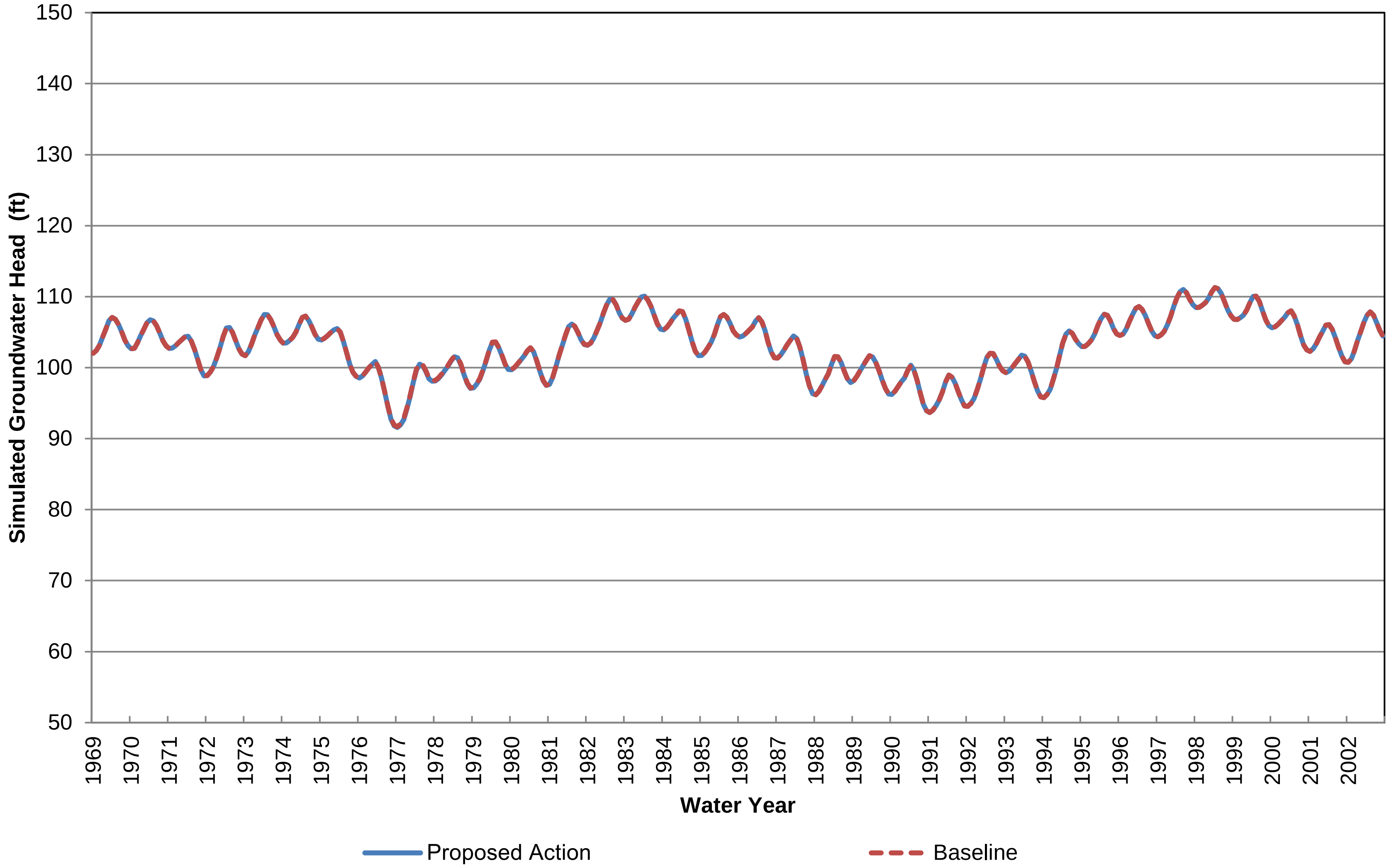
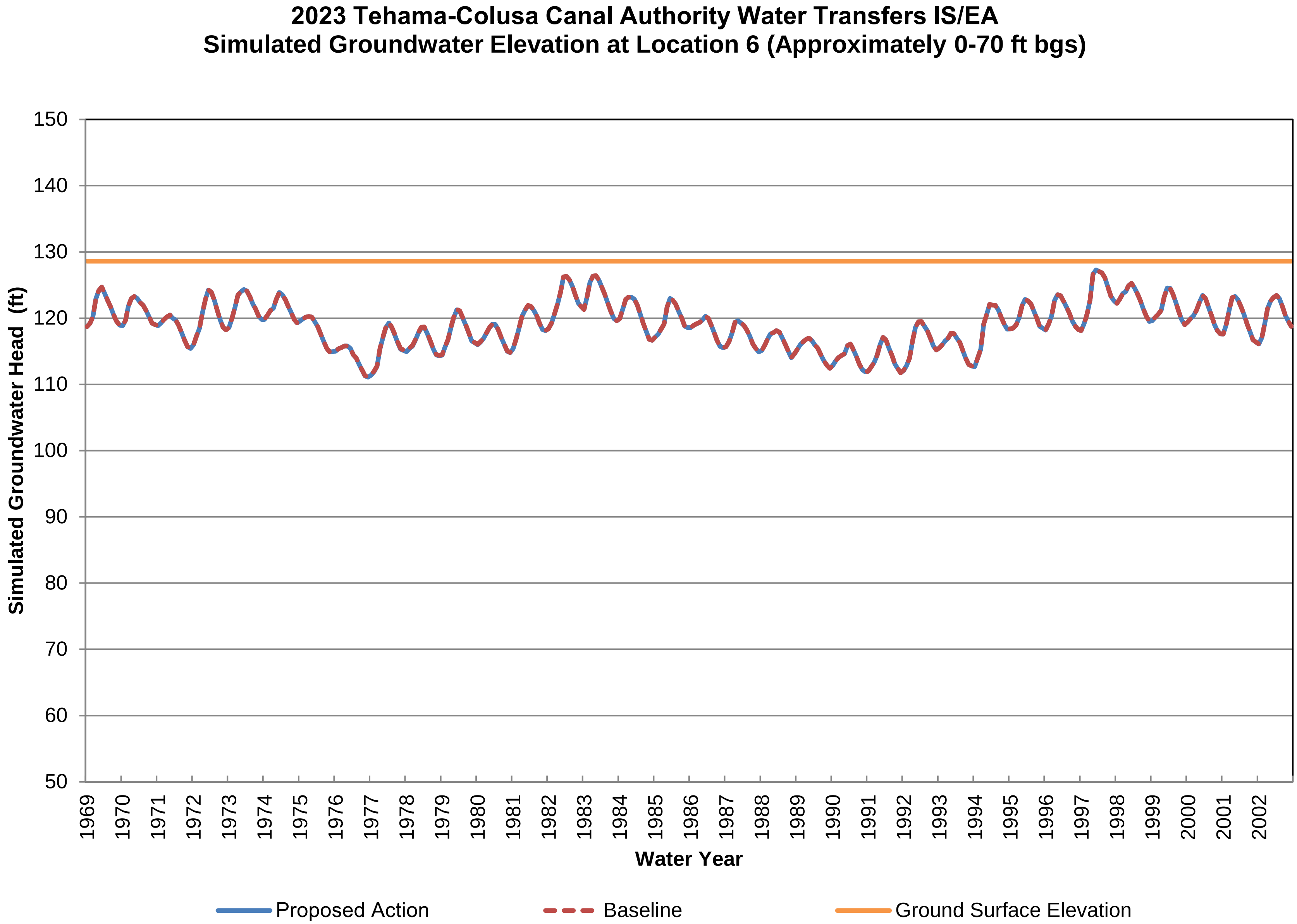
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 5 (Approximately 910-1310 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 6 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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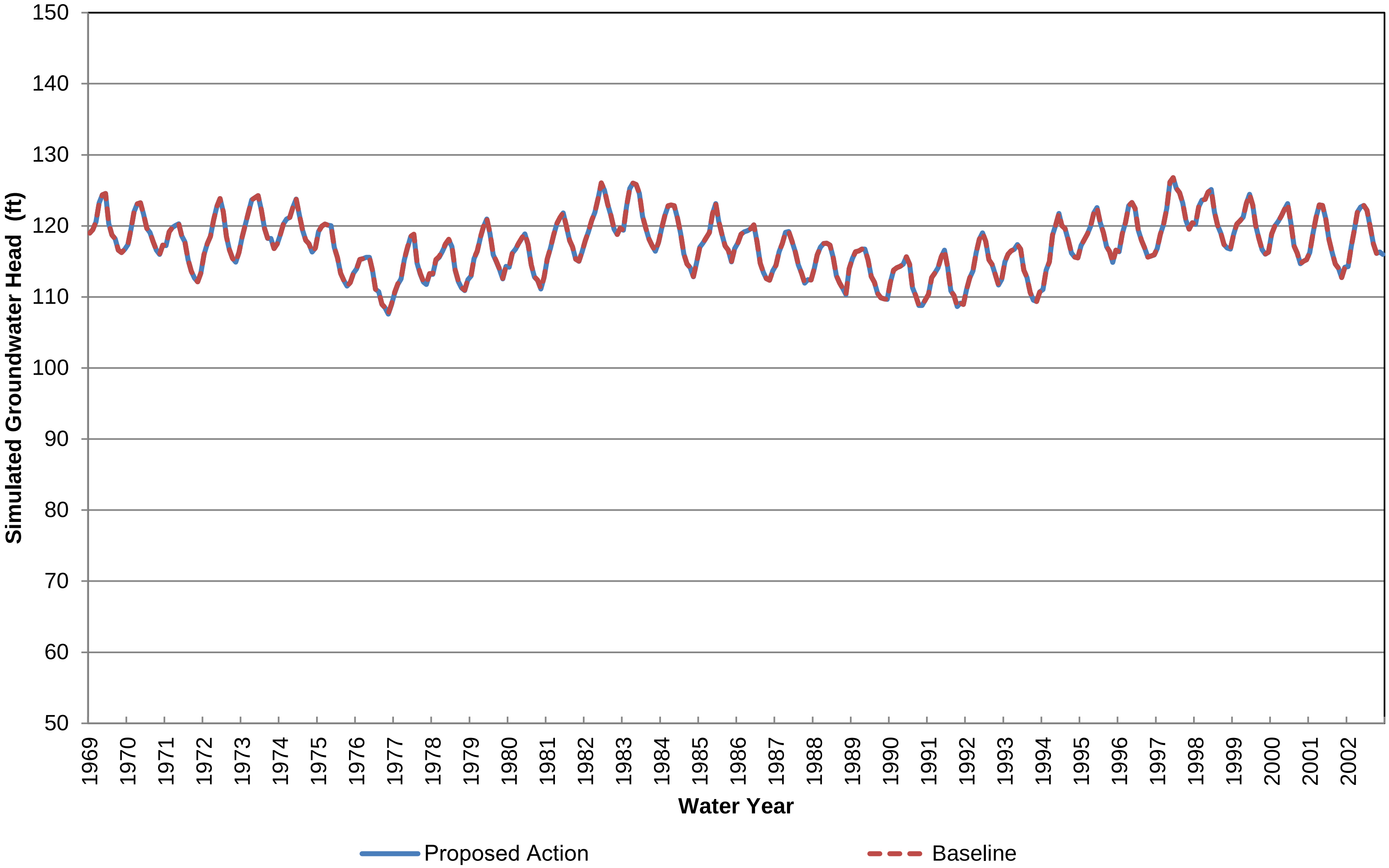
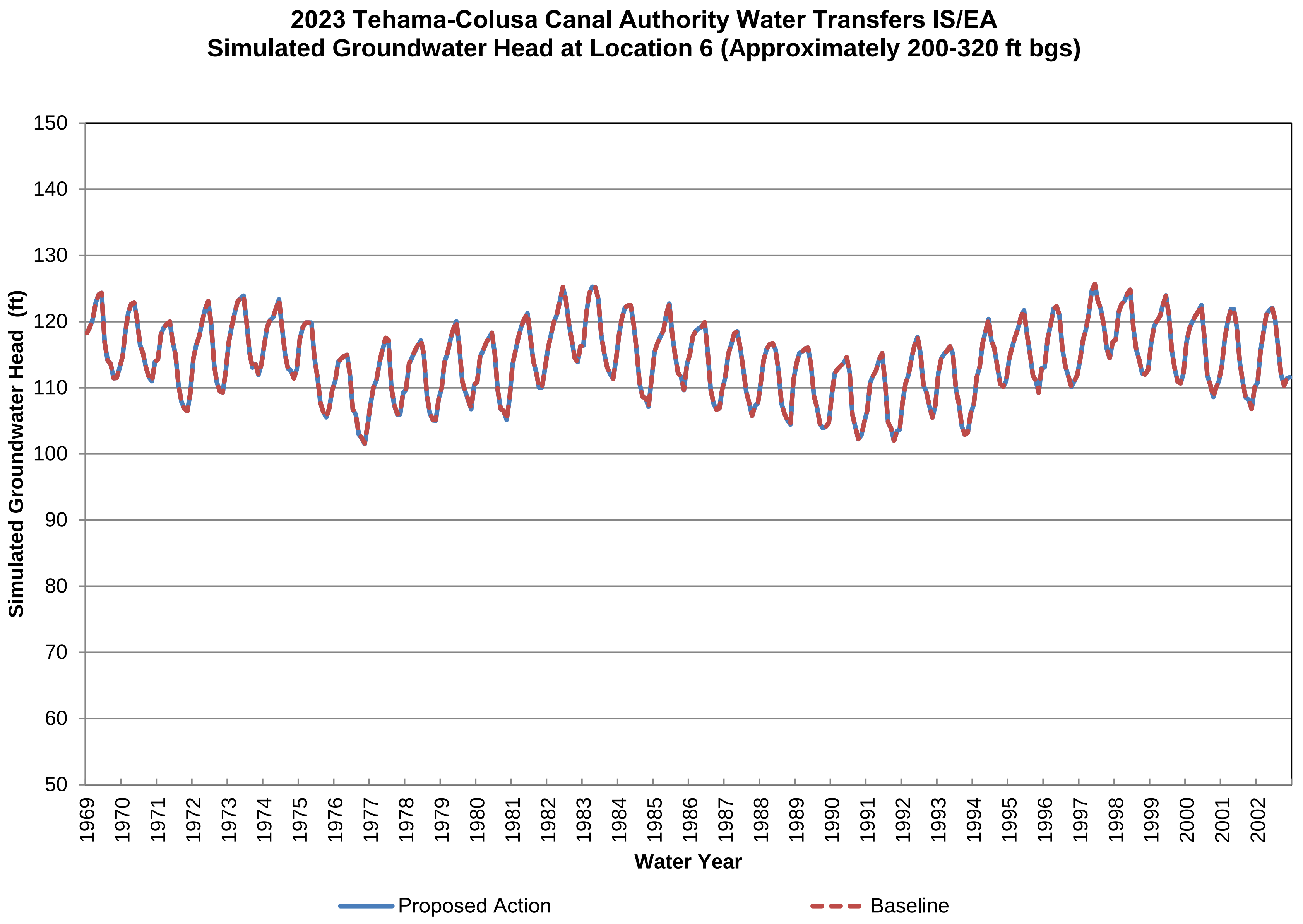
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 6 (Approximately 70-200 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 6 (Approximately 200-320 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
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1969
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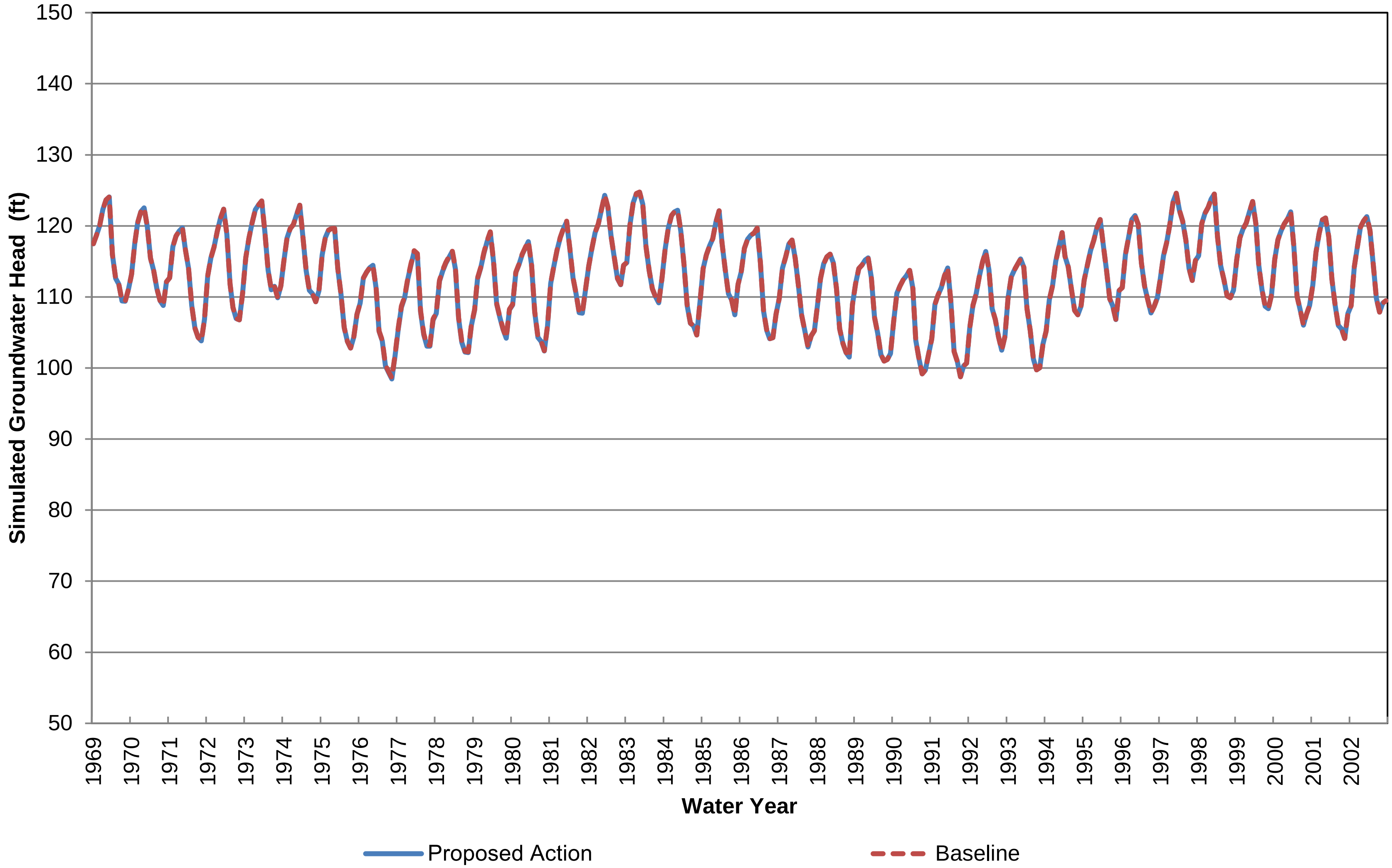
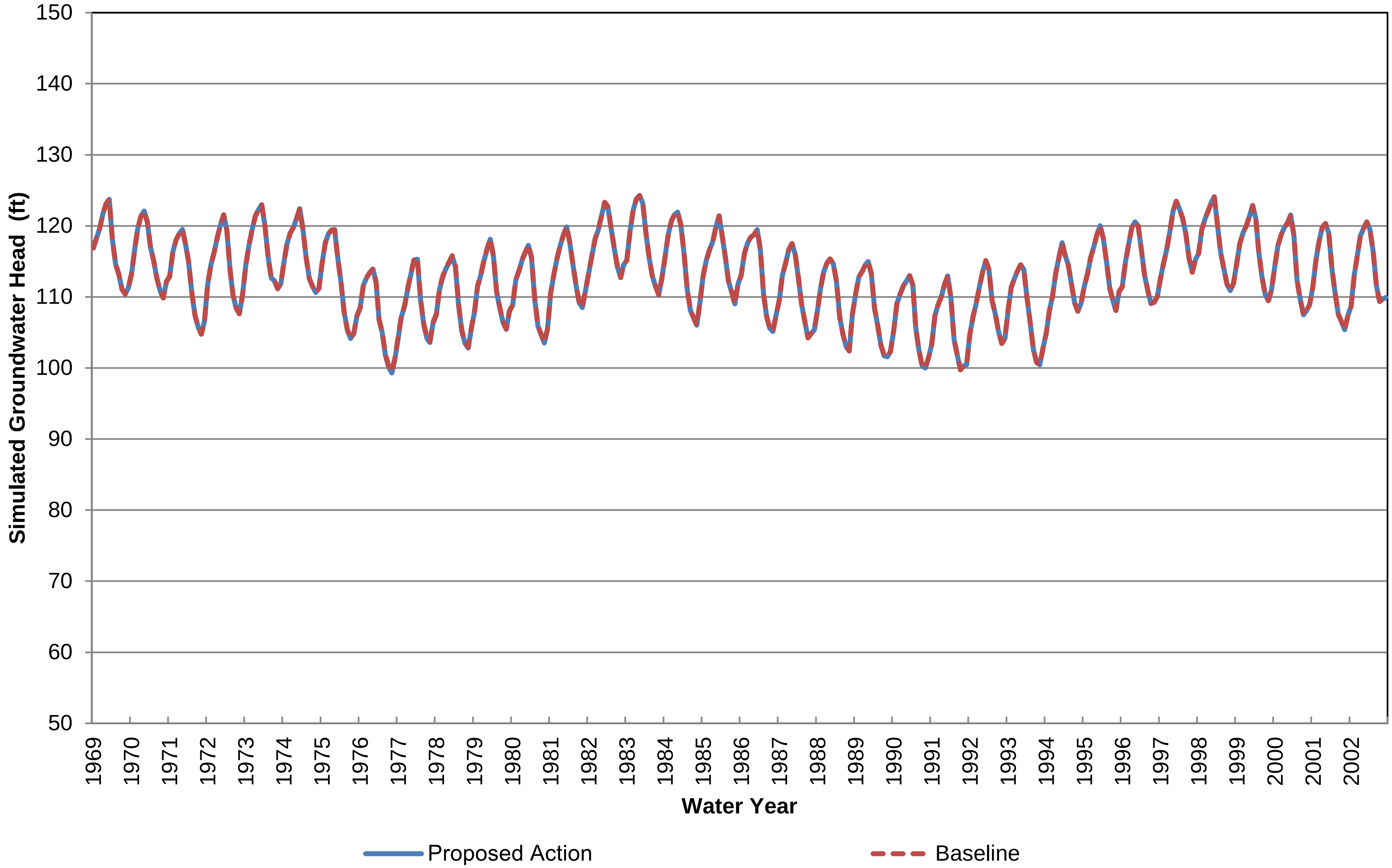
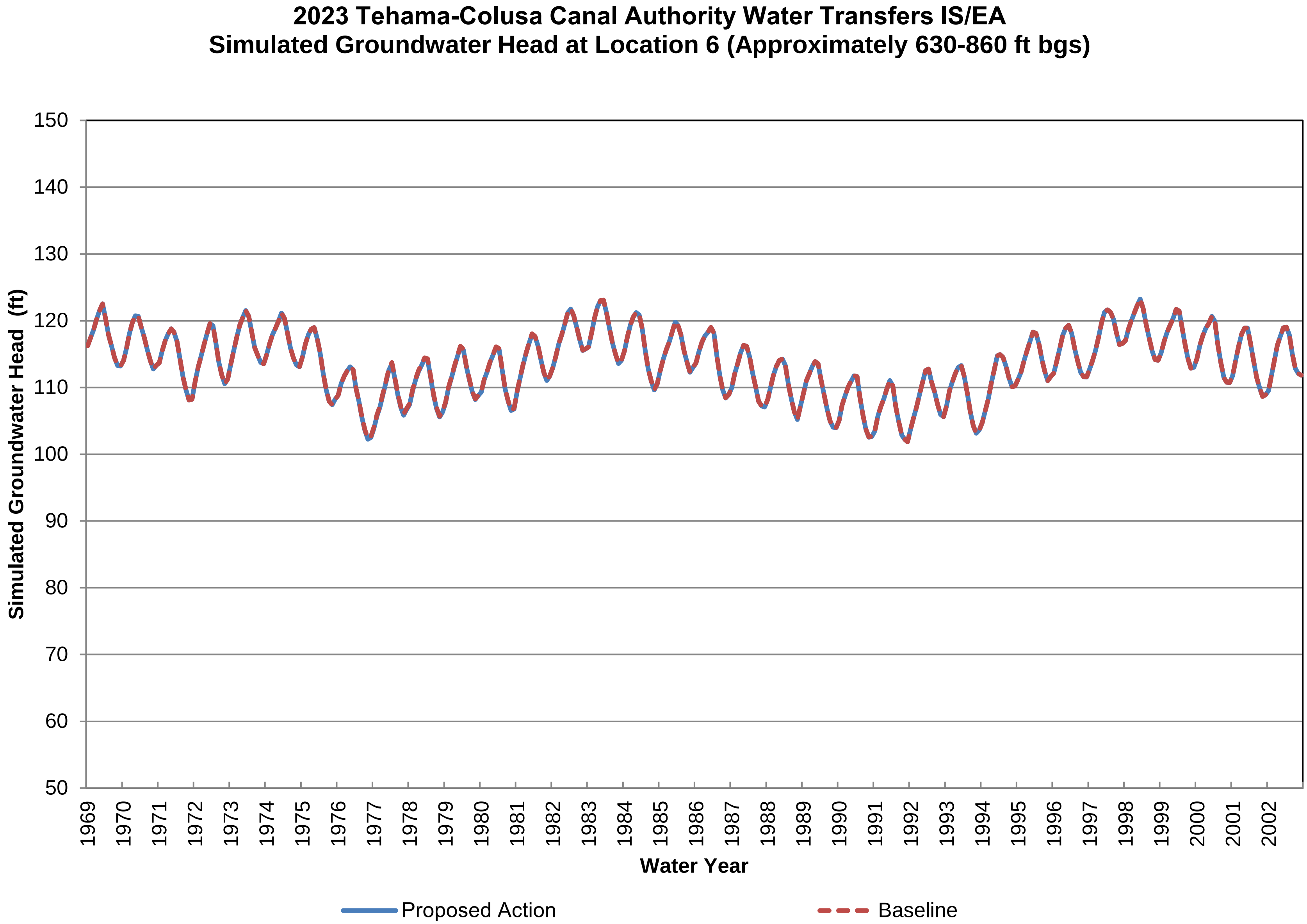
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 6 (Approximately 320-440 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 6 (Approximately 440-630 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 6 (Approximately 630-860 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
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1969
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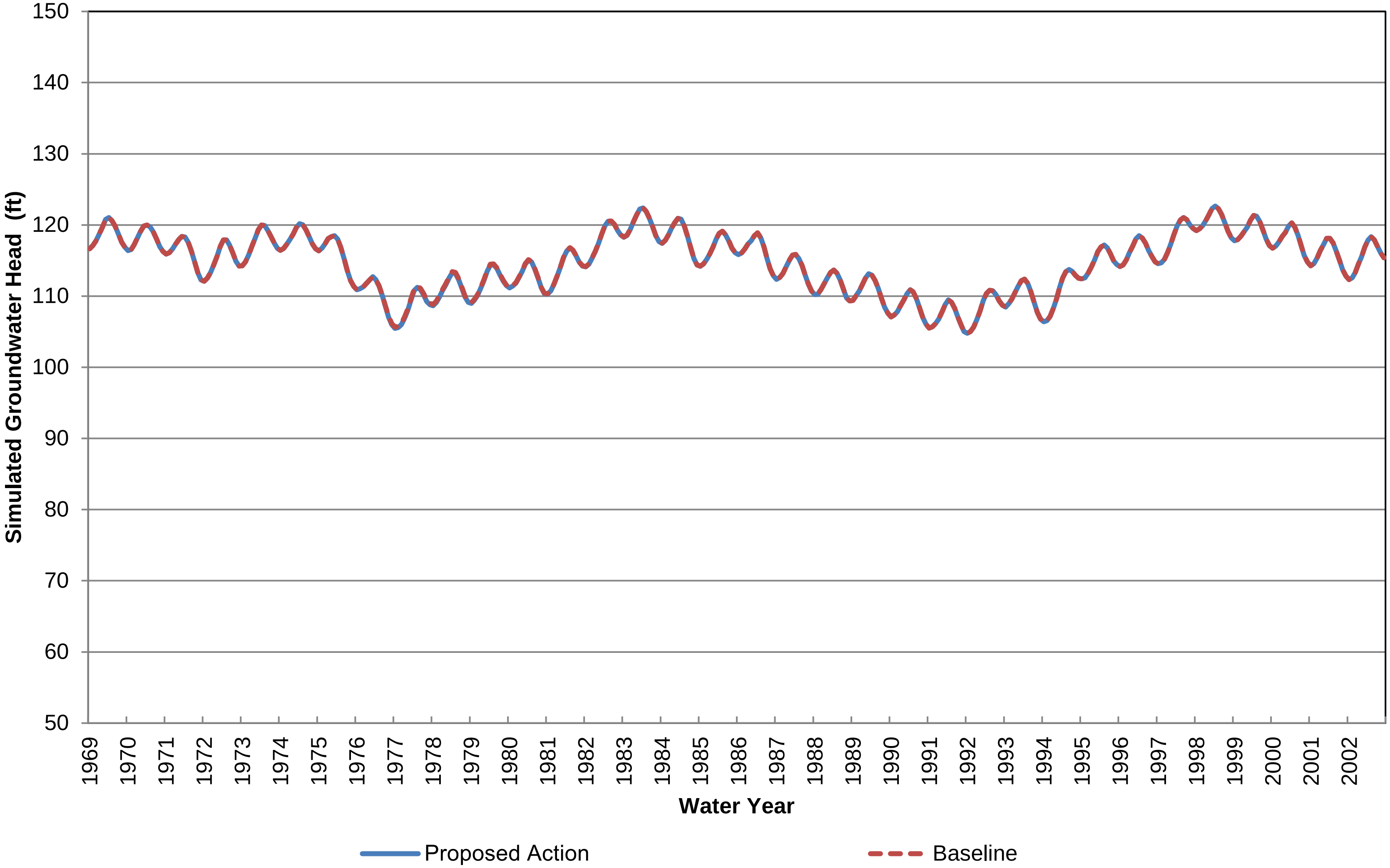
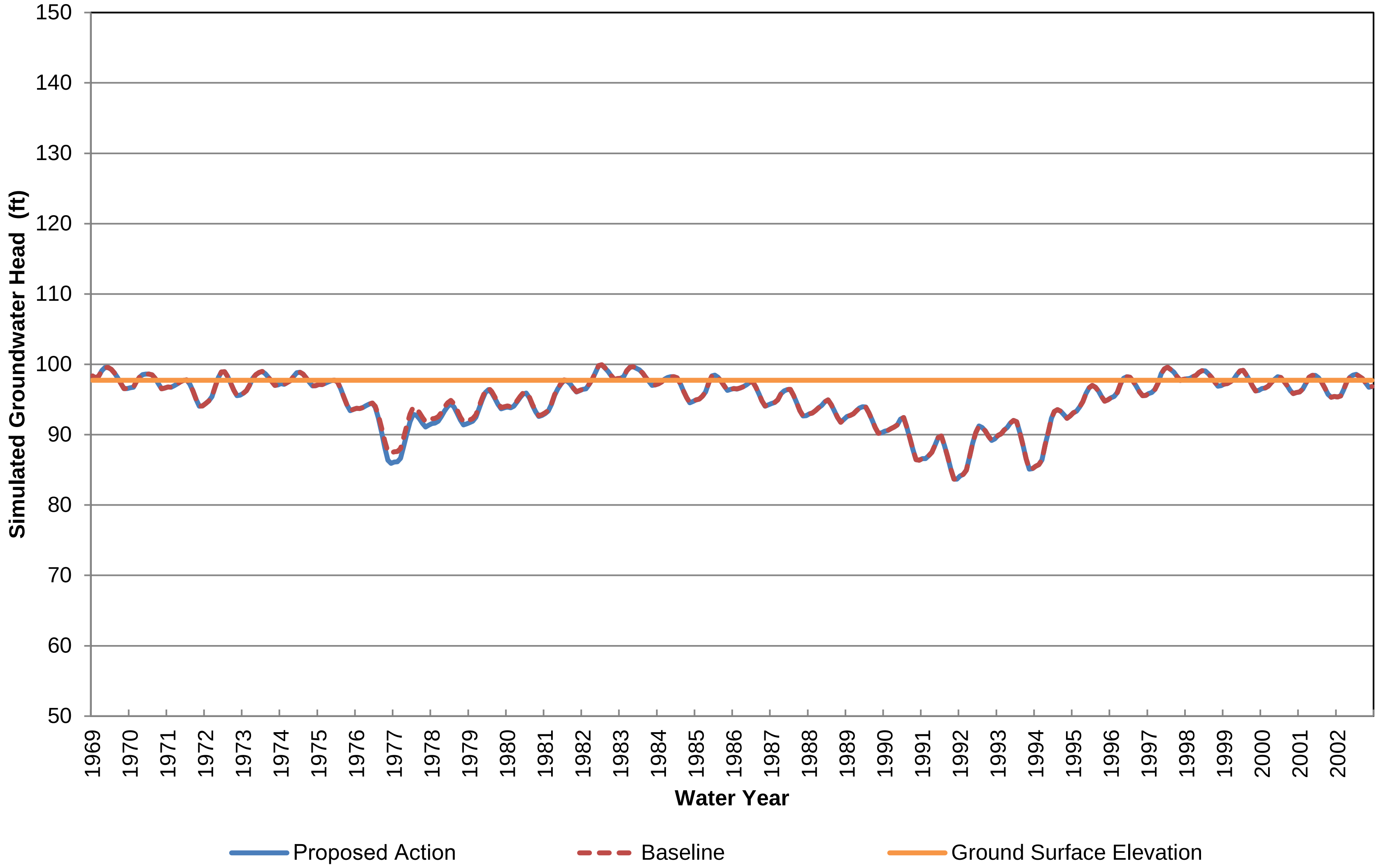
2001
2002
Water Year
Proposed Action
Baseline

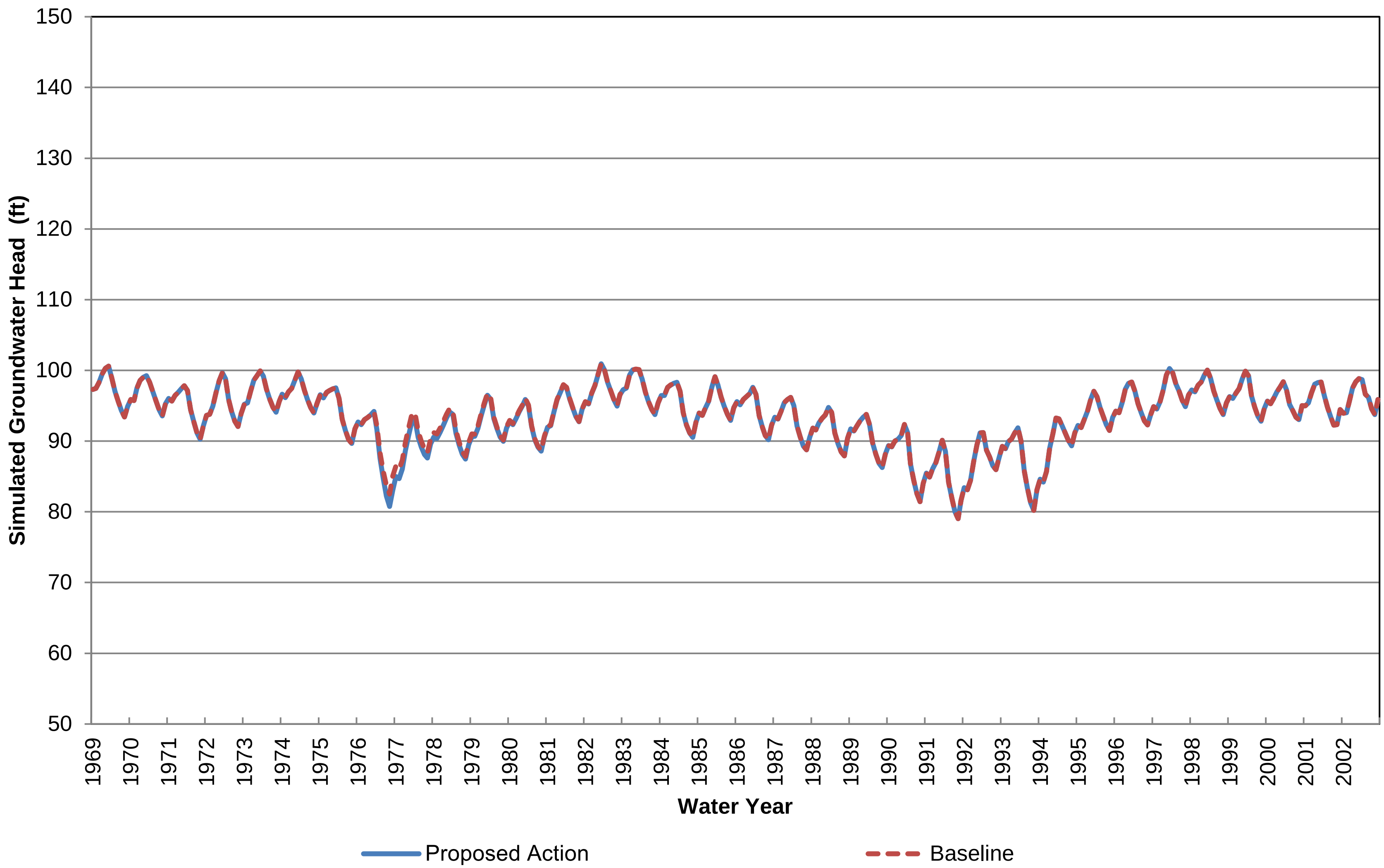
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 6 (Approximately 860-1290 ft bgs)

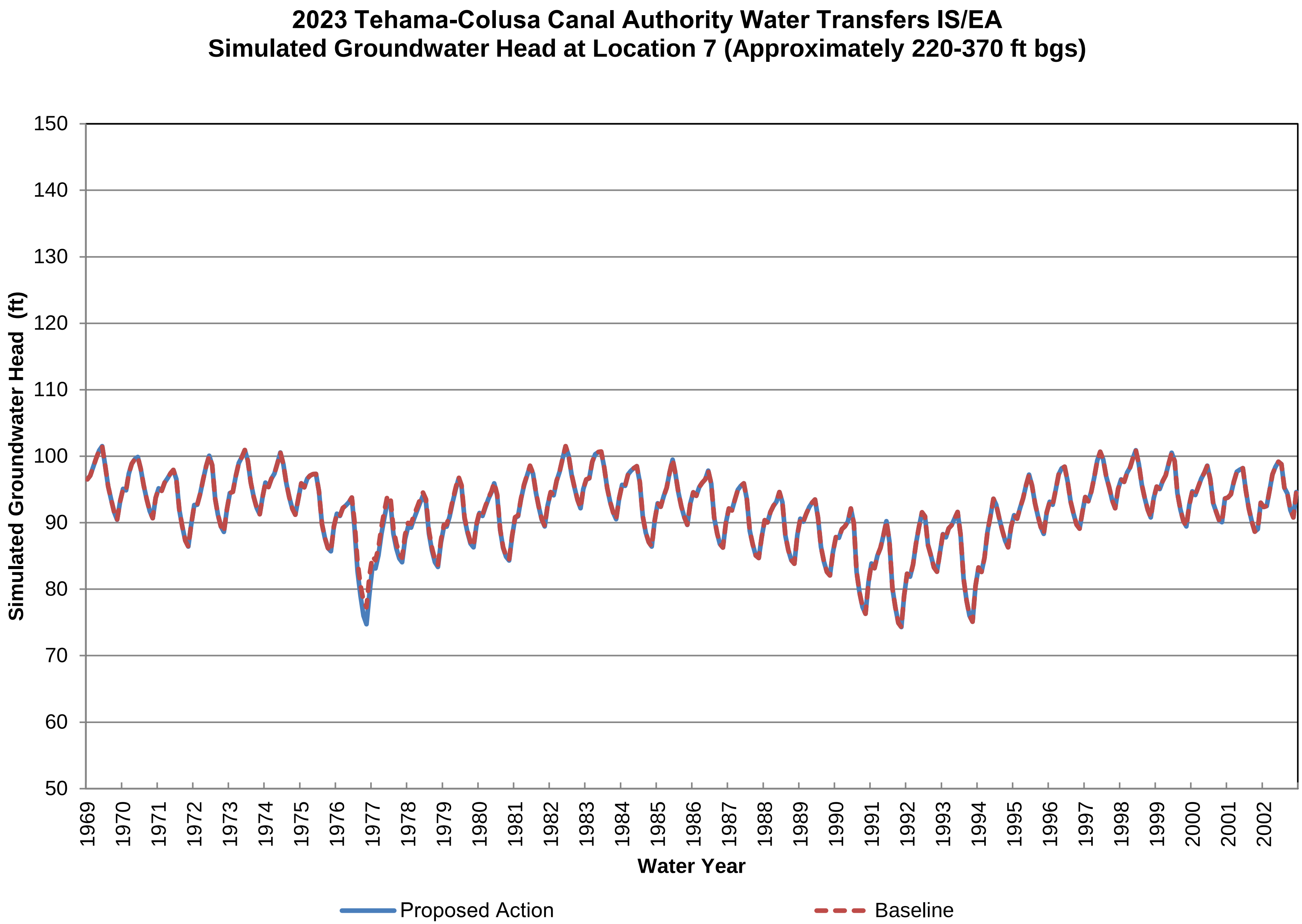


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 7 (Approximately 0-70 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 7 (Approximately 70-220 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 7 (Approximately 220-370 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
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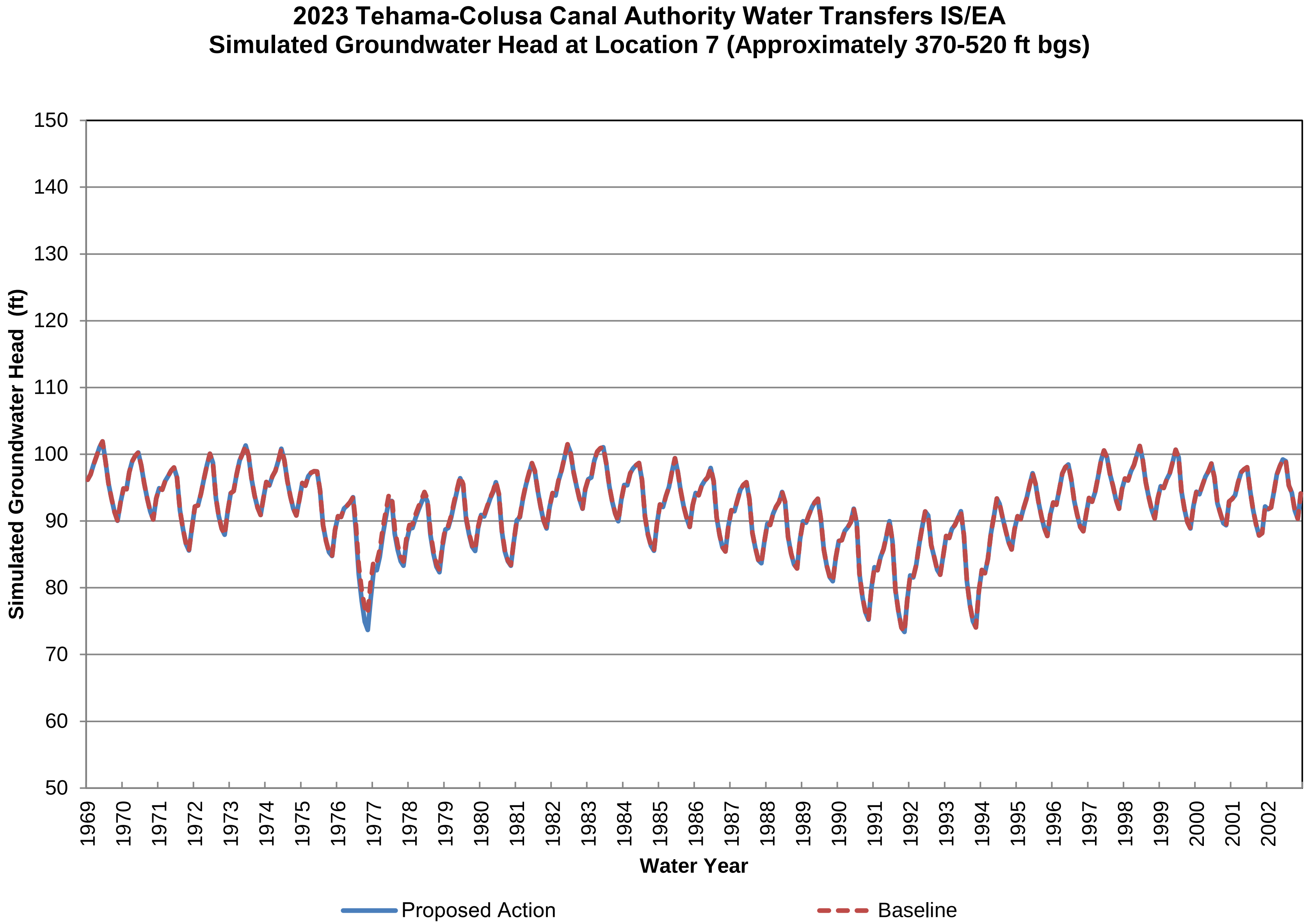
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 7 (Approximately 370-520 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
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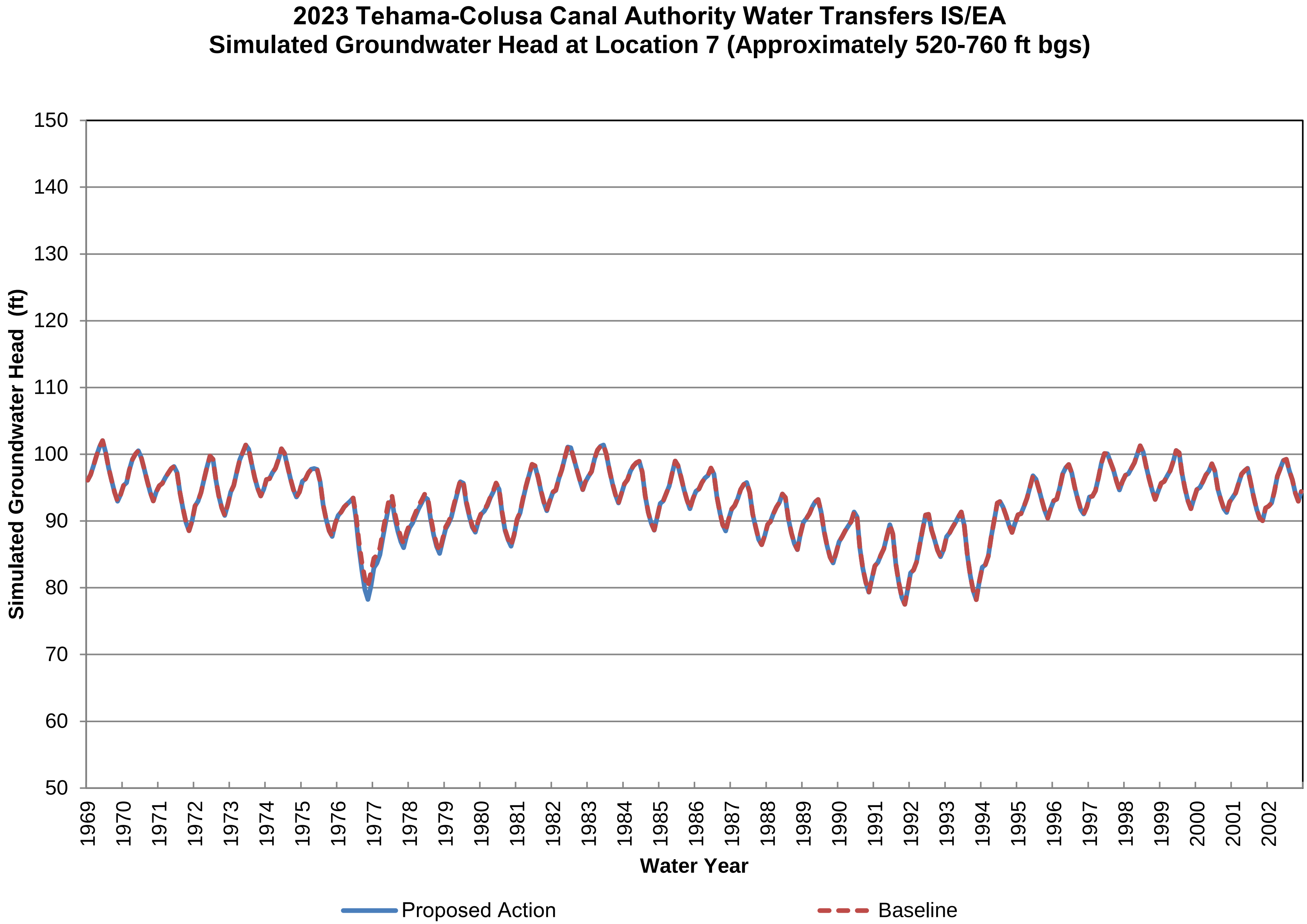
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 7 (Approximately 520-760 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
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1969
1970
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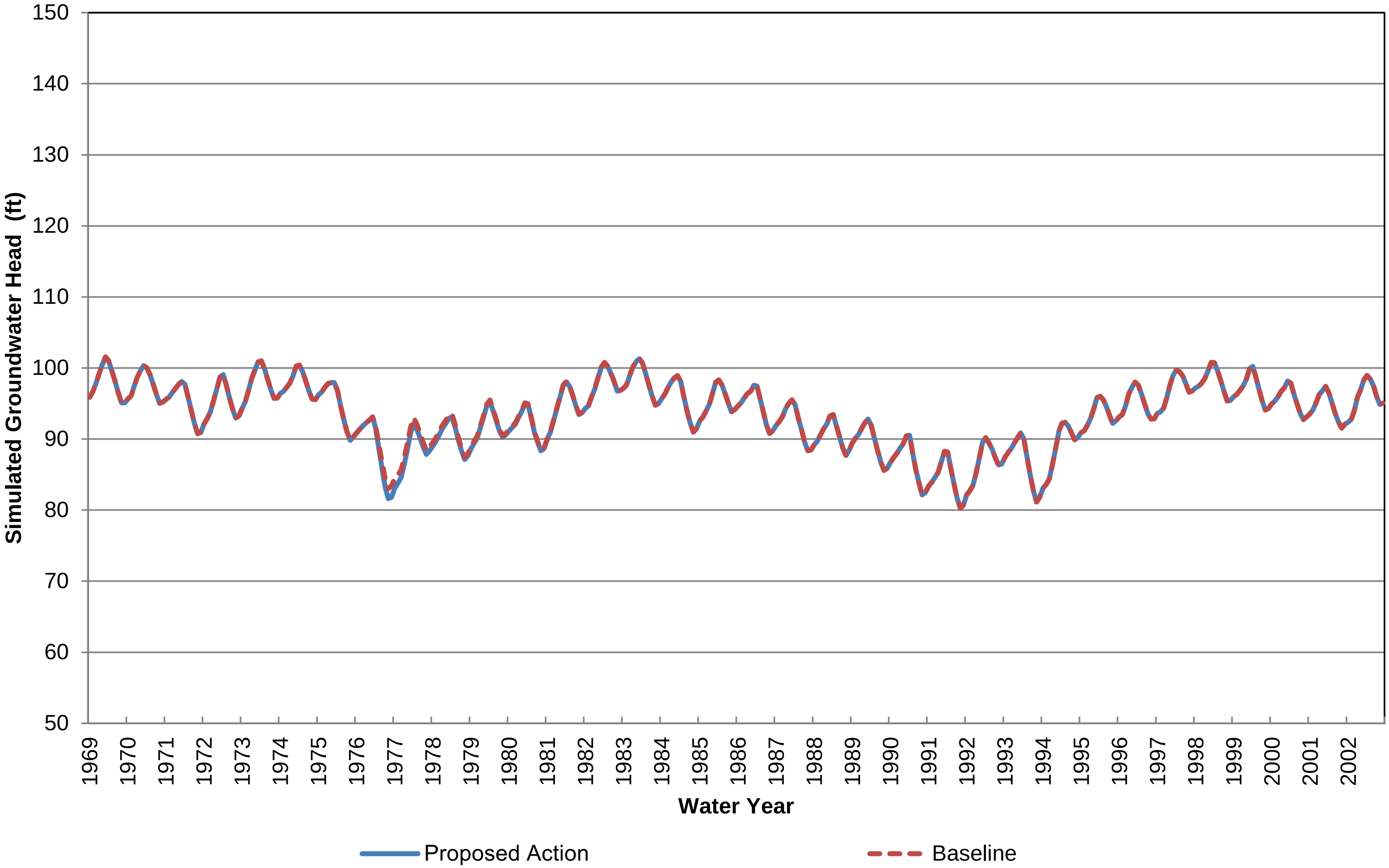
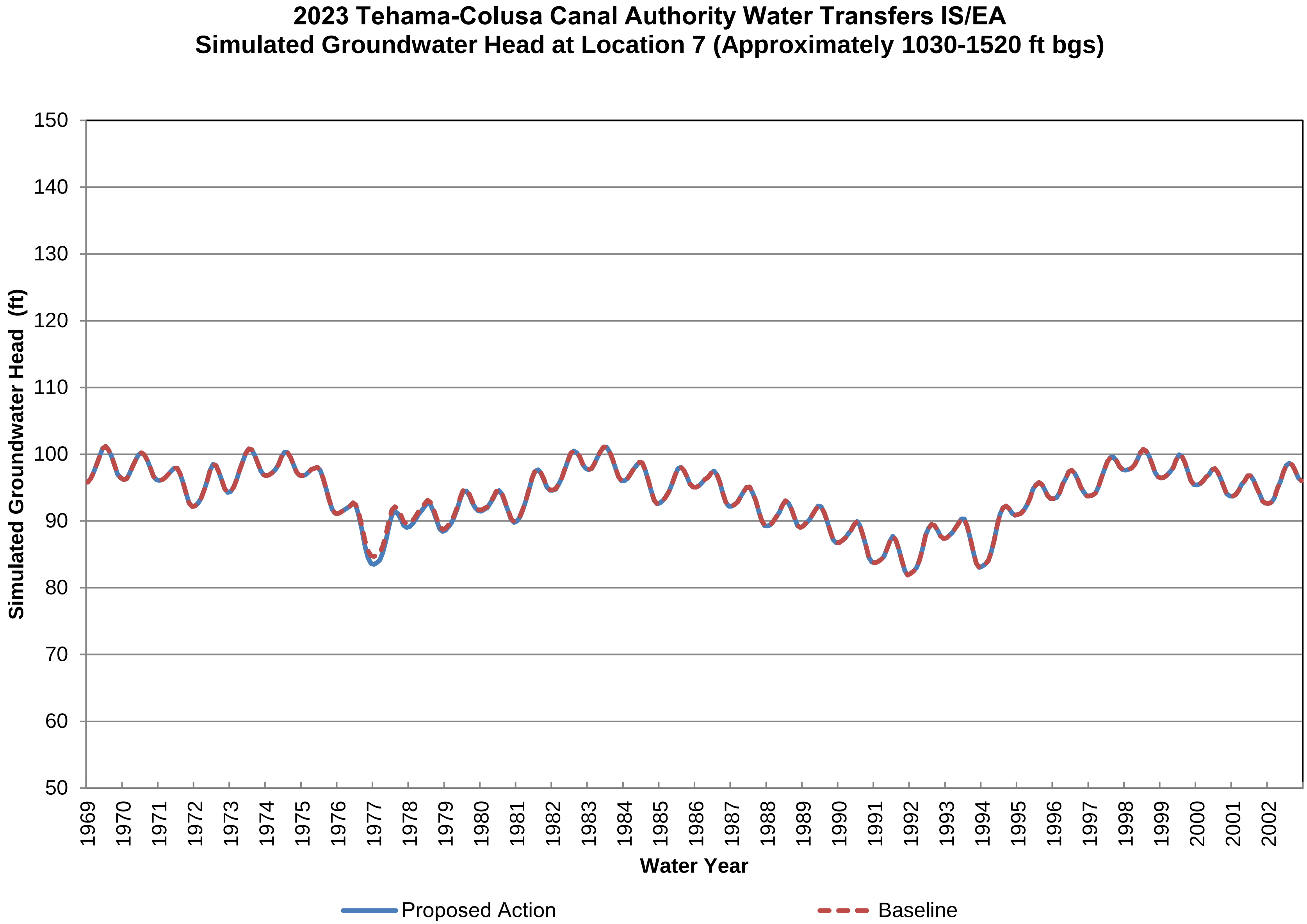
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 7 (Approximately 760-1030 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 7 (Approximately 1030-1520 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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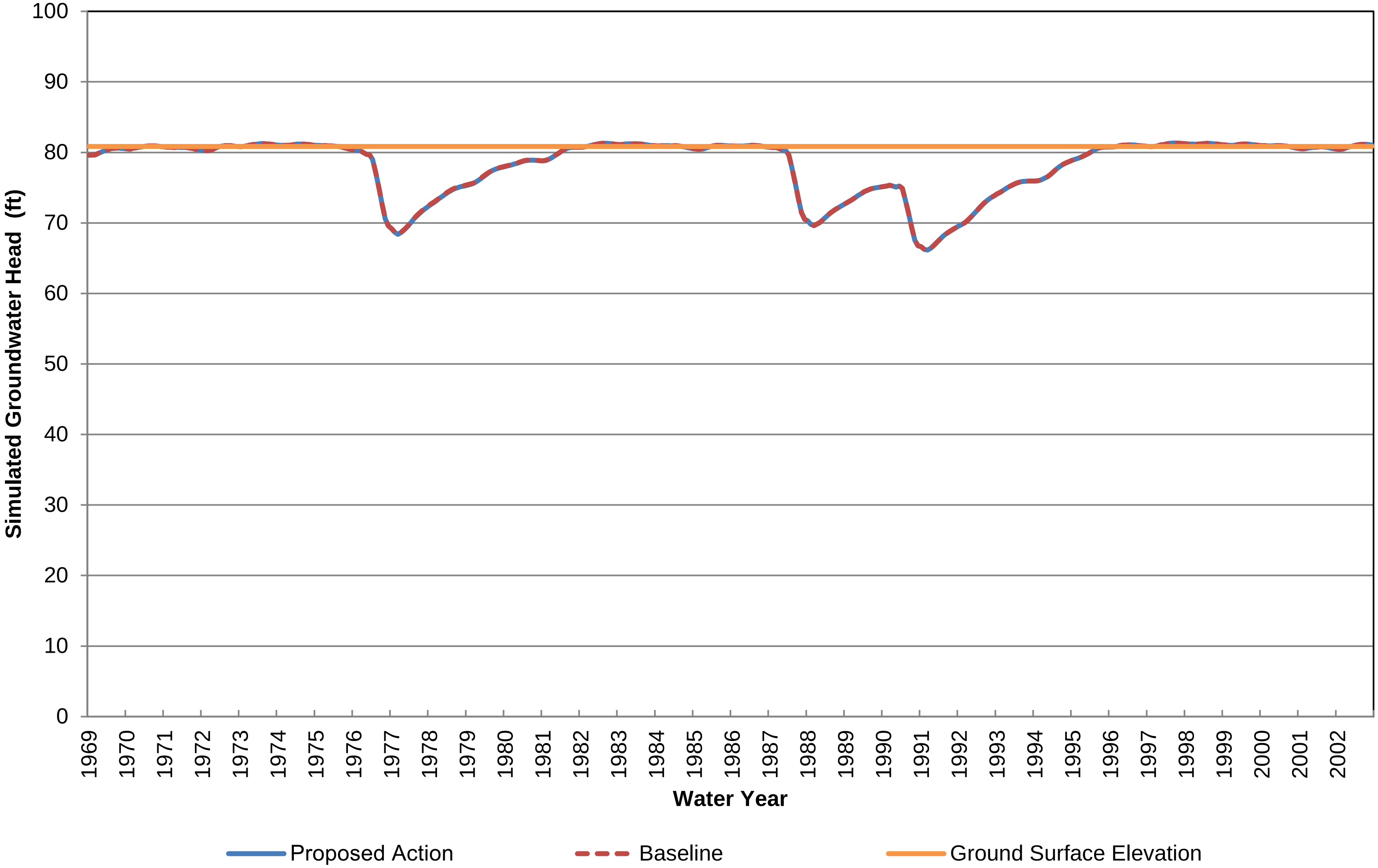
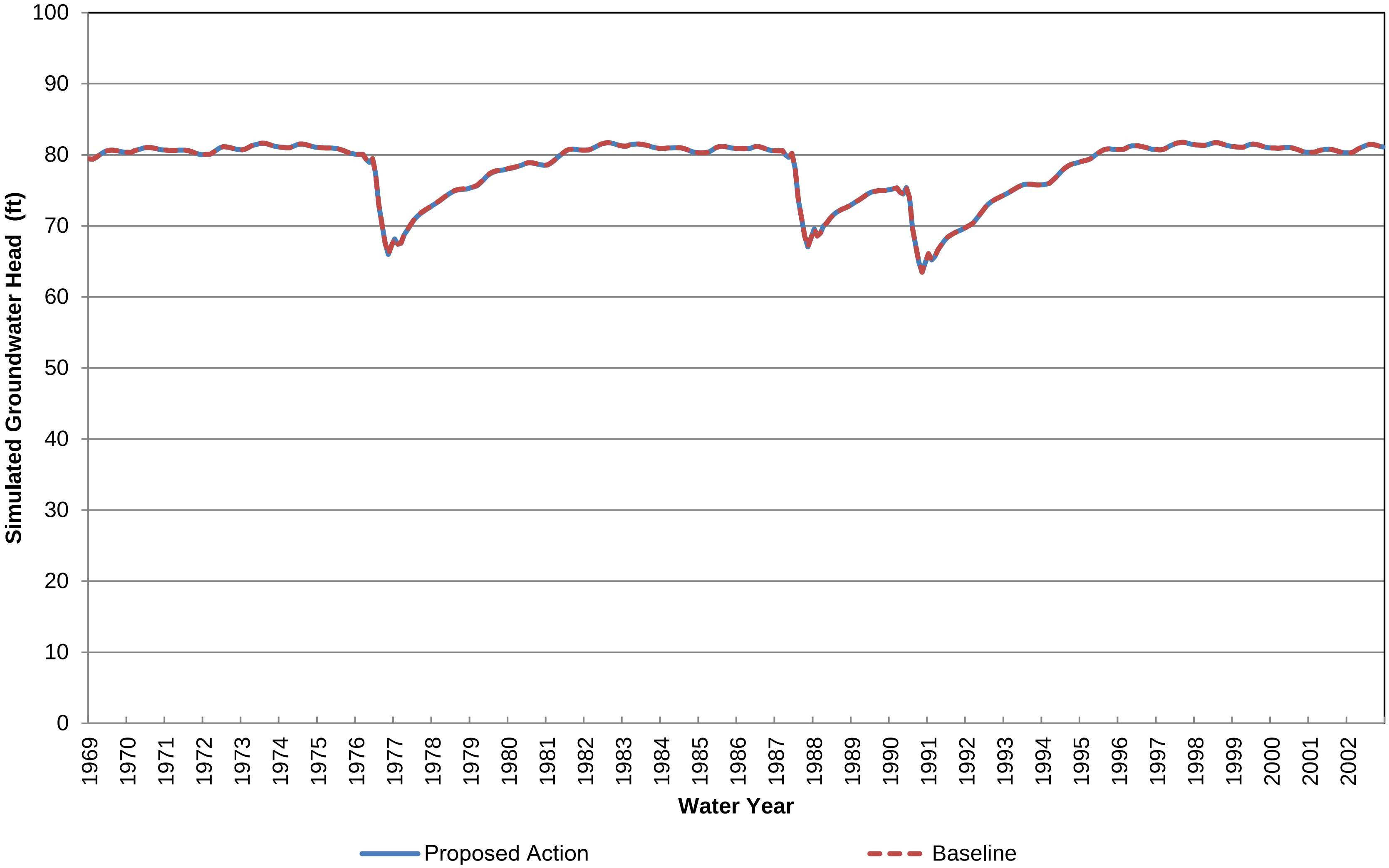
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

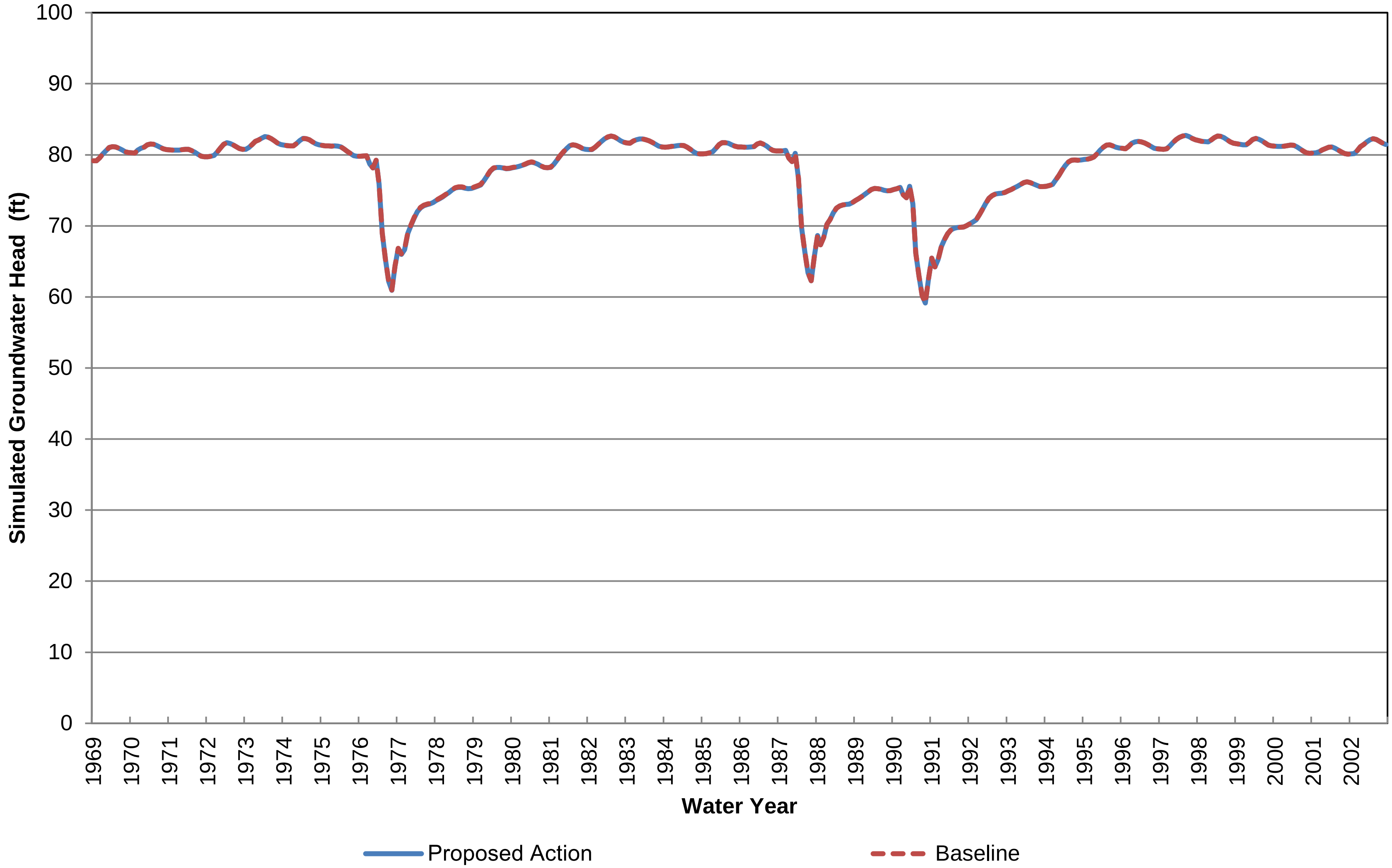
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 8 (Approximately 0-70 ft bgs)



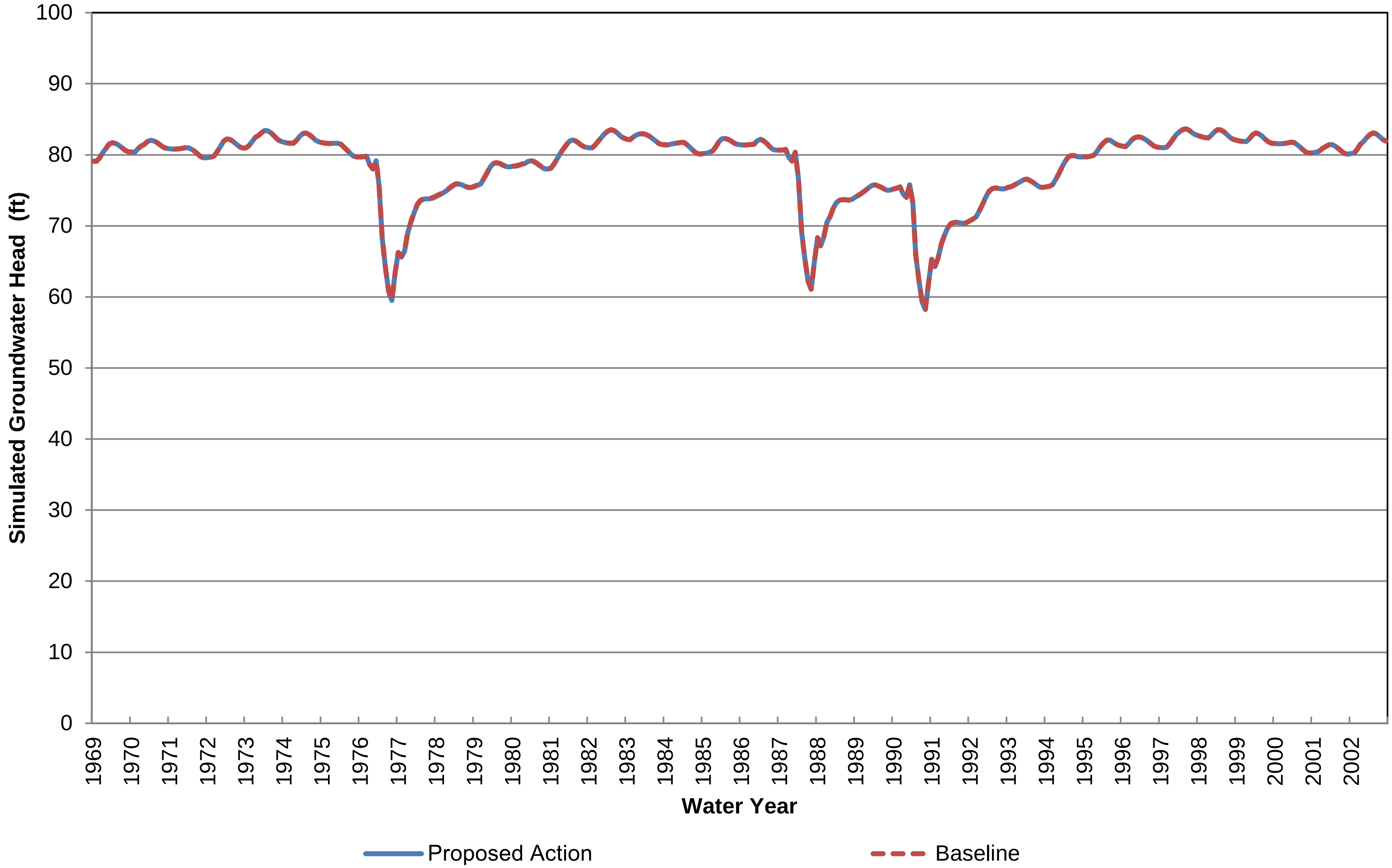
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 8 (Approximately 70-200 ft bgs)

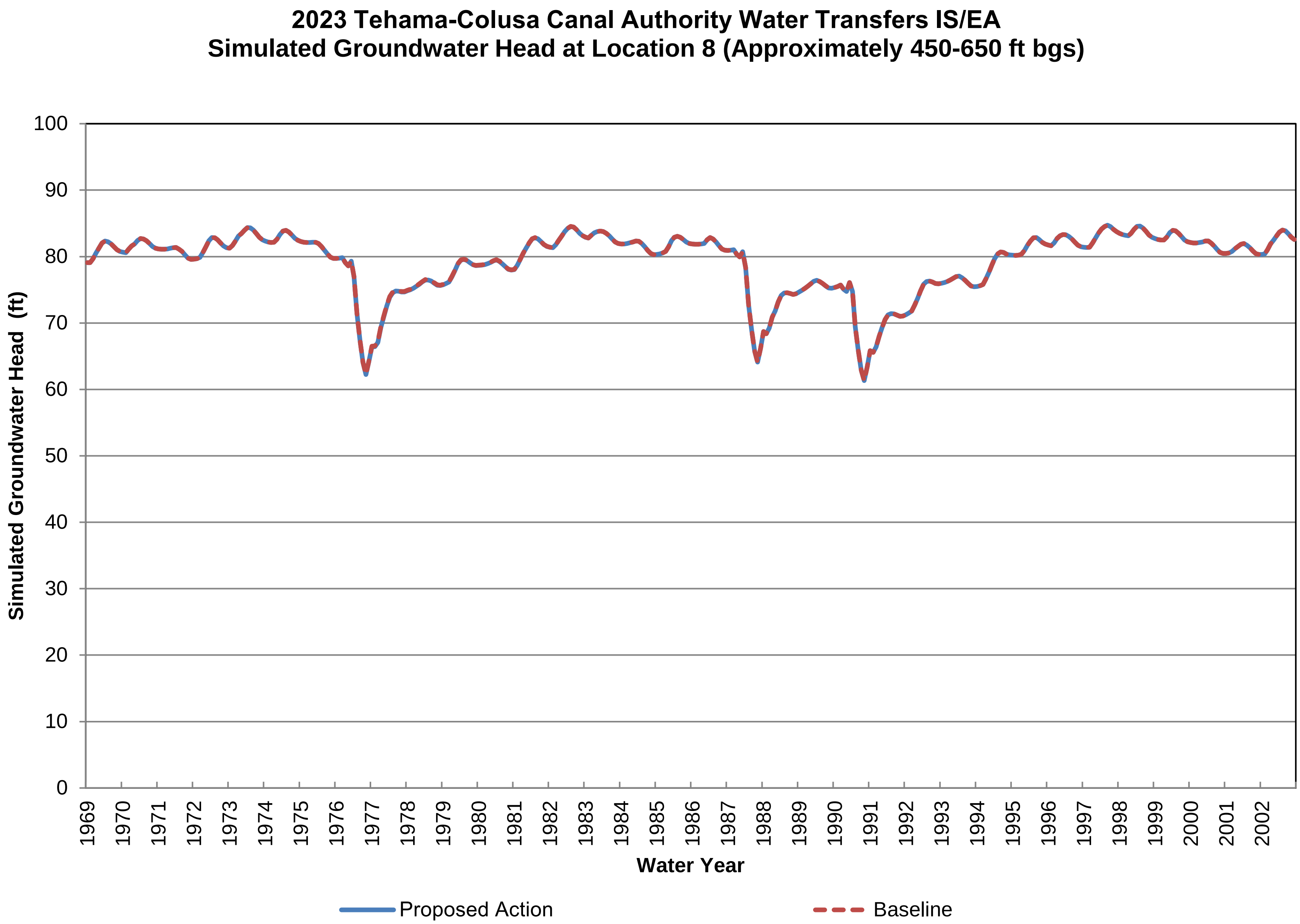


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 8 (Approximately 200-330 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 8 (Approximately 330-450 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 8 (Approximately 450-650 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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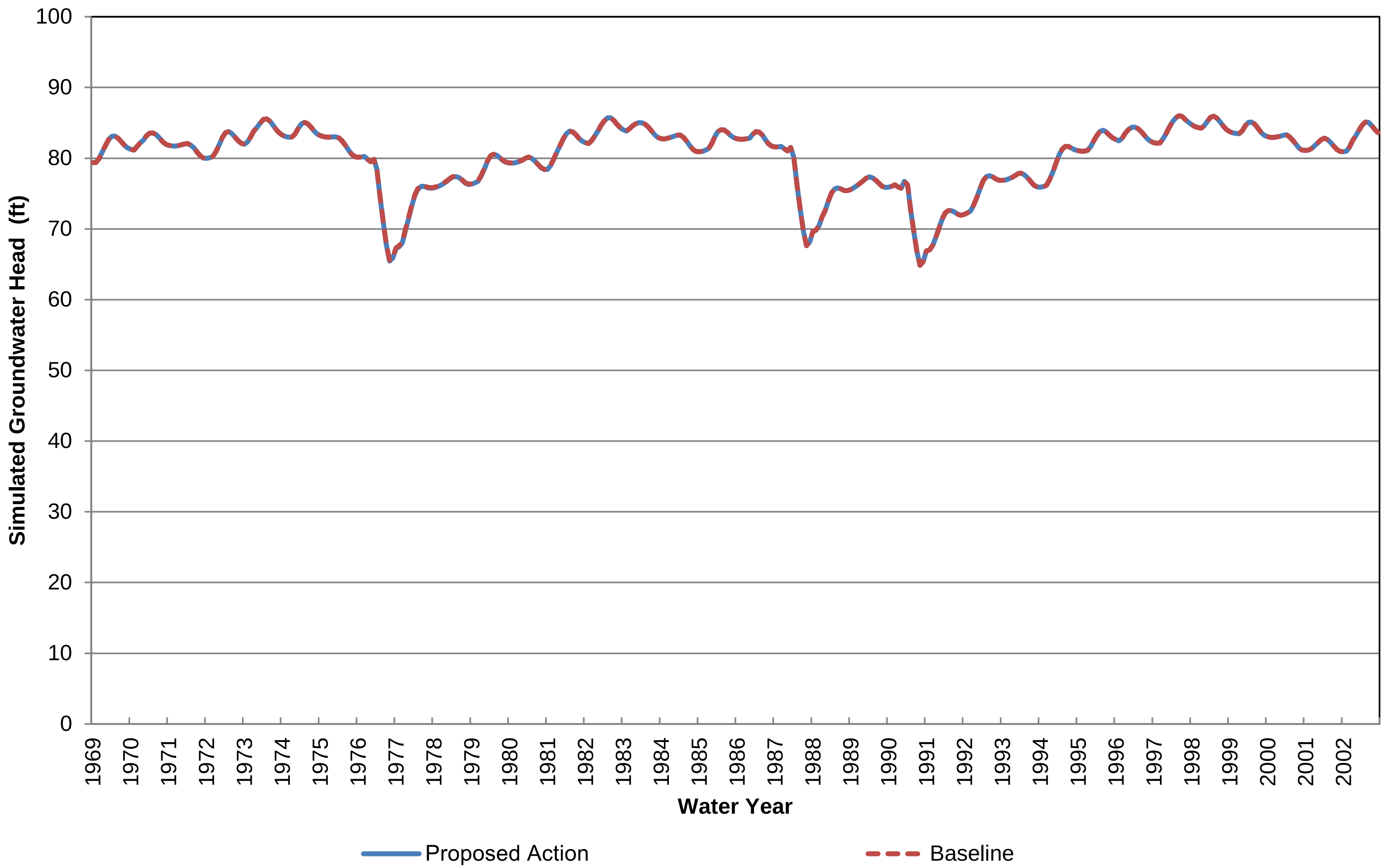
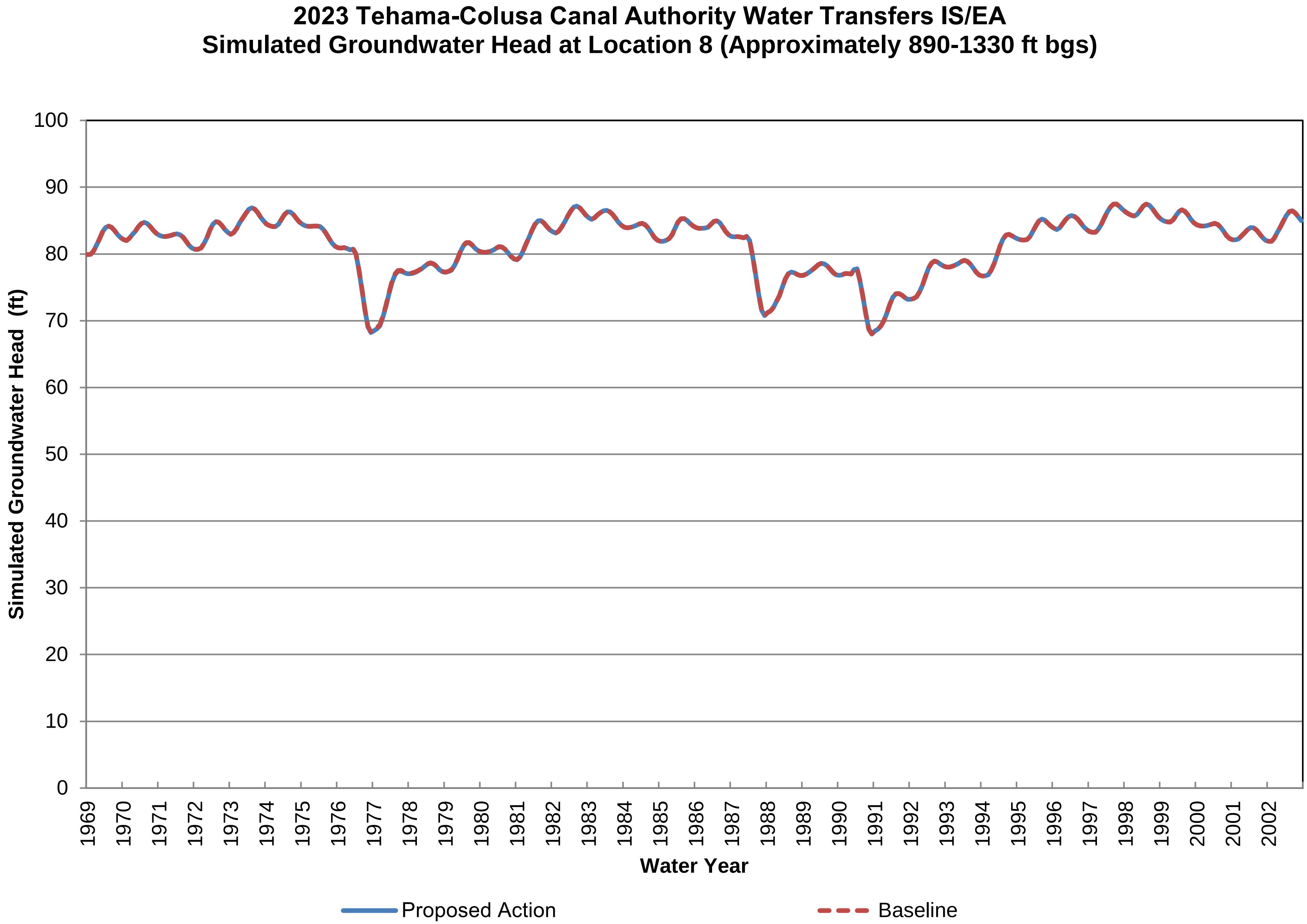
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 8 (Approximately 650-890 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 8 (Approximately 890-1330 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1997
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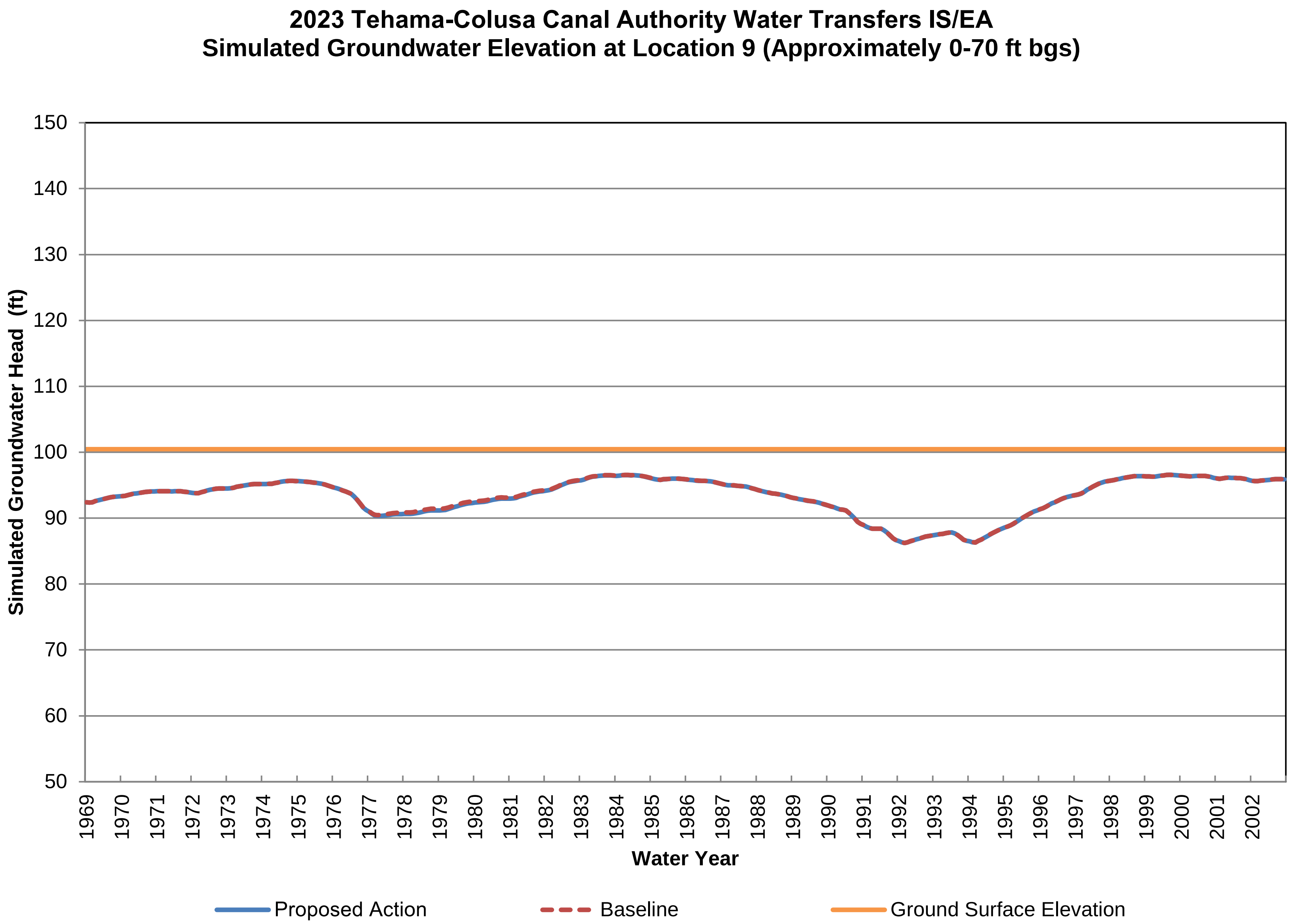
1999
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 9 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
1973
1974
1975
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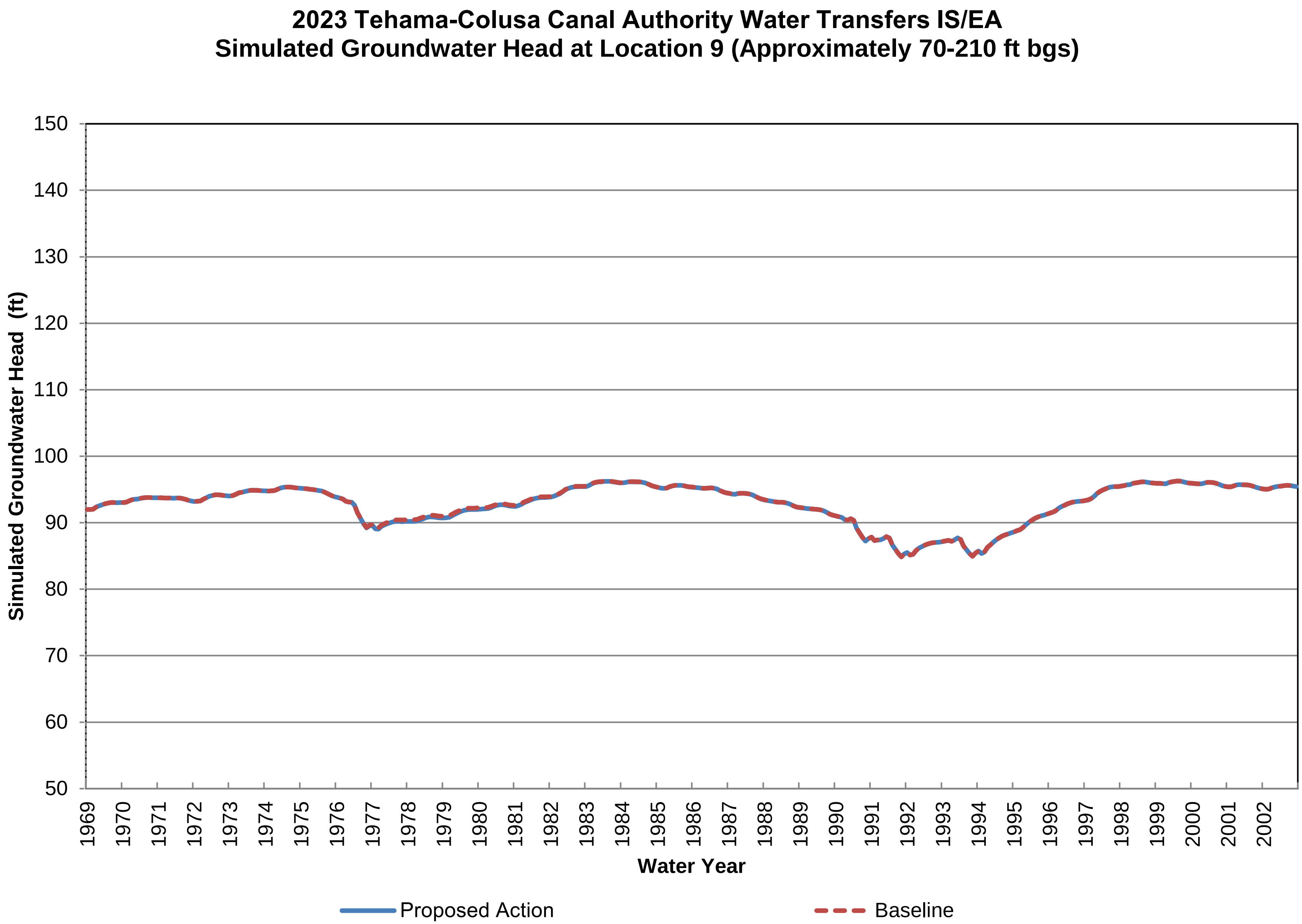
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 9 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
1973
1974
1975
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1997
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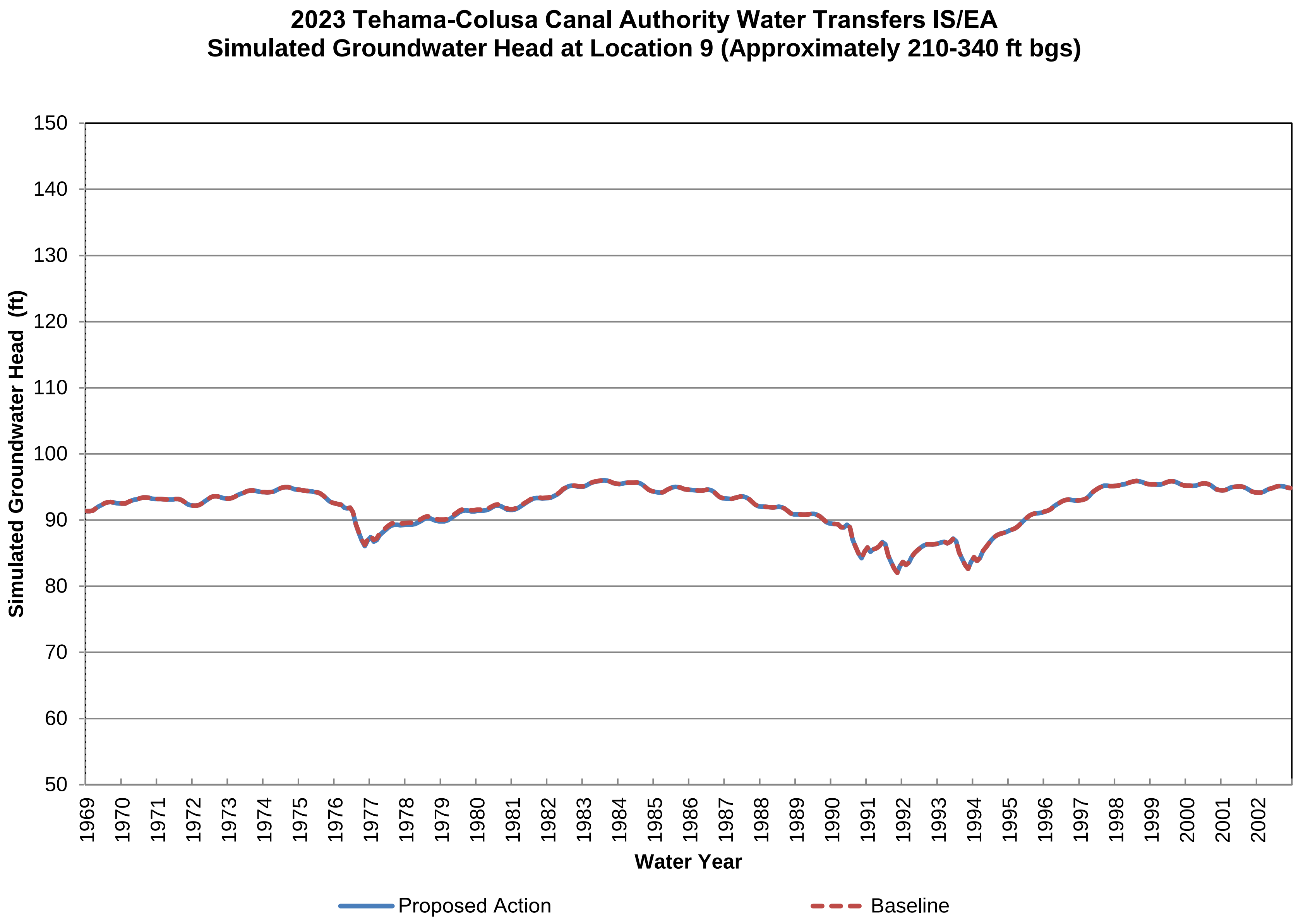
1999
2000
2001
2002
Water Year
Proposed Action
Baseline



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 9 (Approximately 210-340 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
1973
1974
1975
1976
1977
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1994
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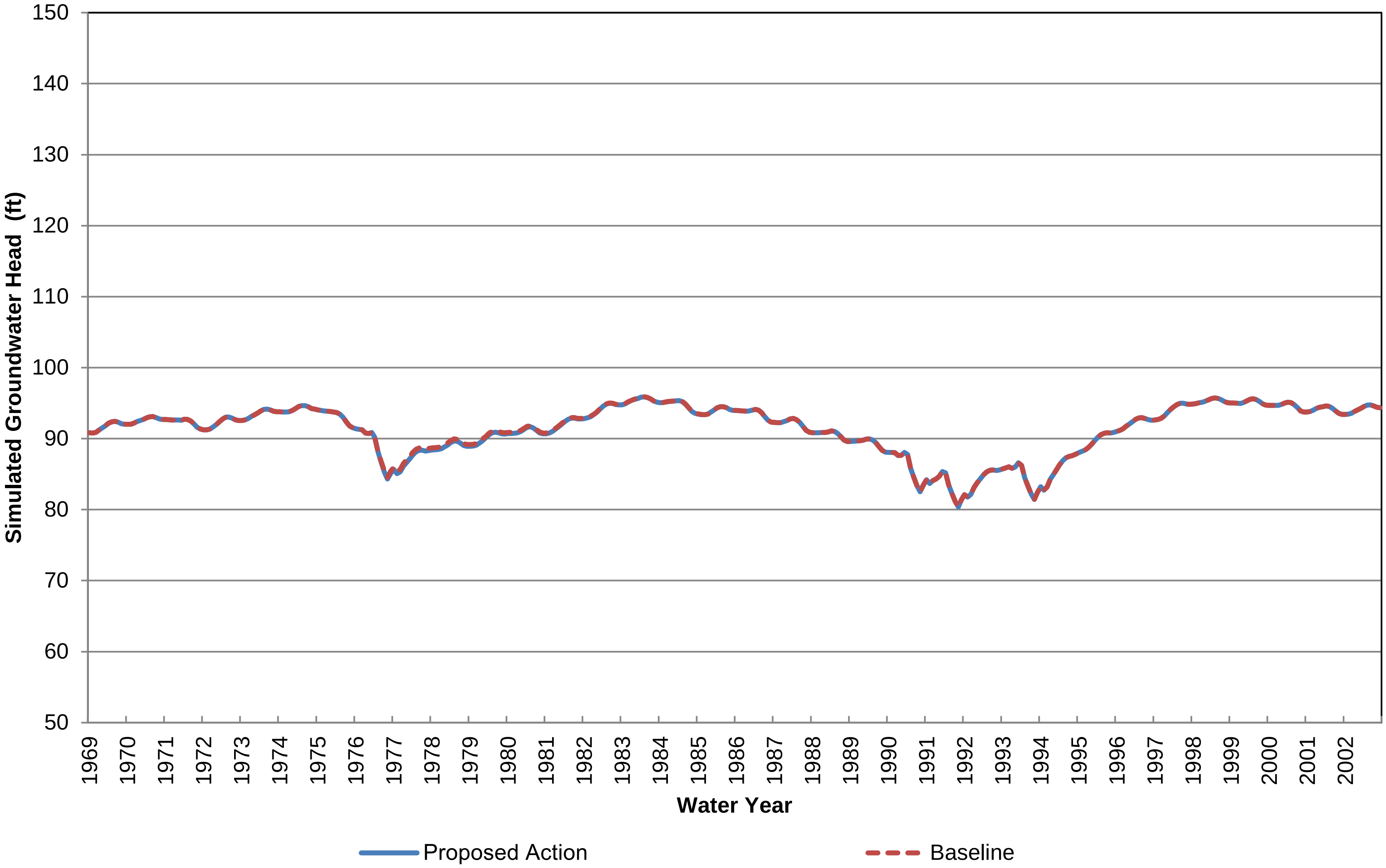
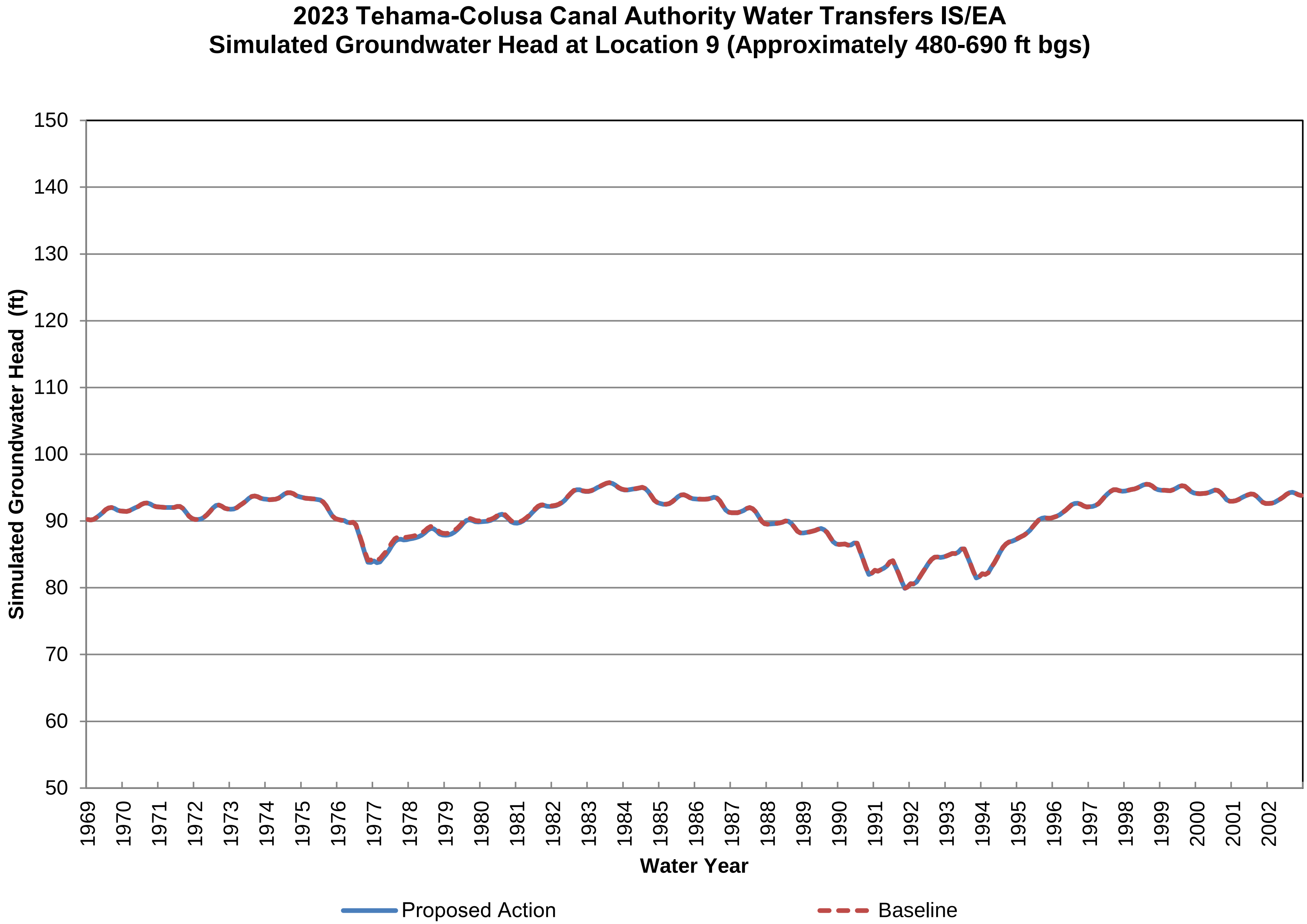
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 9 (Approximately 340-480 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 9 (Approximately 480-690 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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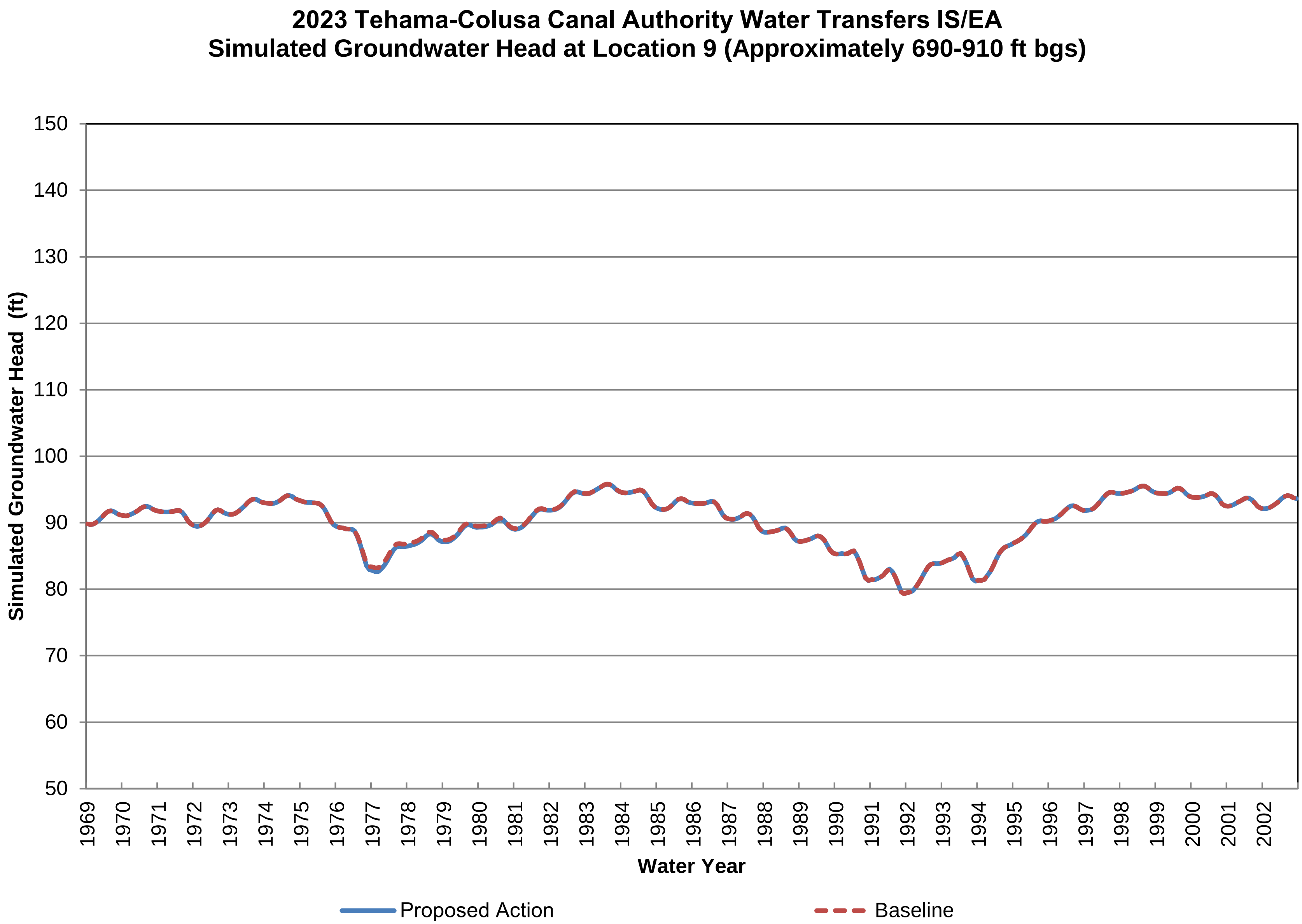
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 9 (Approximately 690-910 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1969
1970
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1972
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1974
1975
1976
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1978
1979
1980
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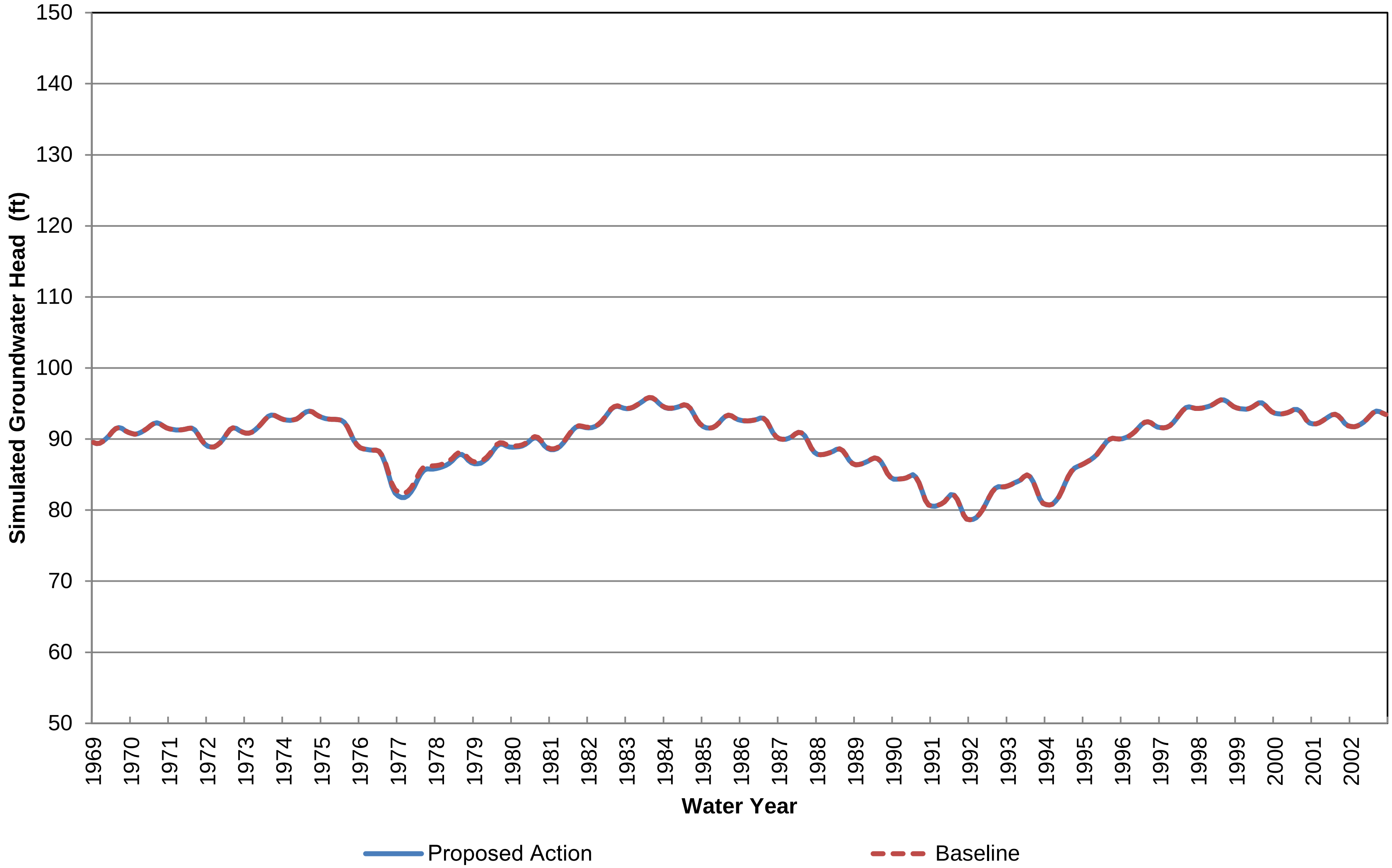
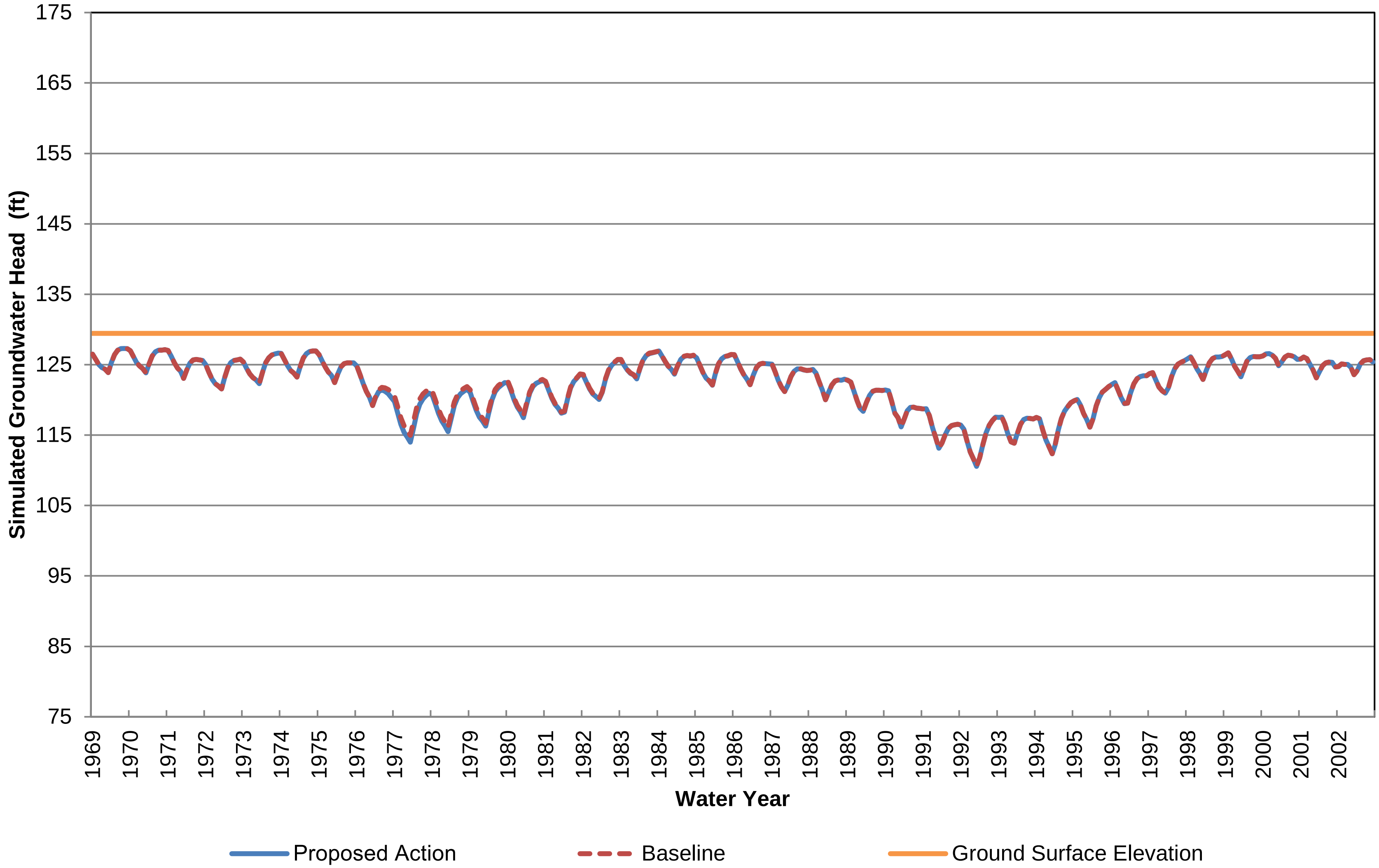
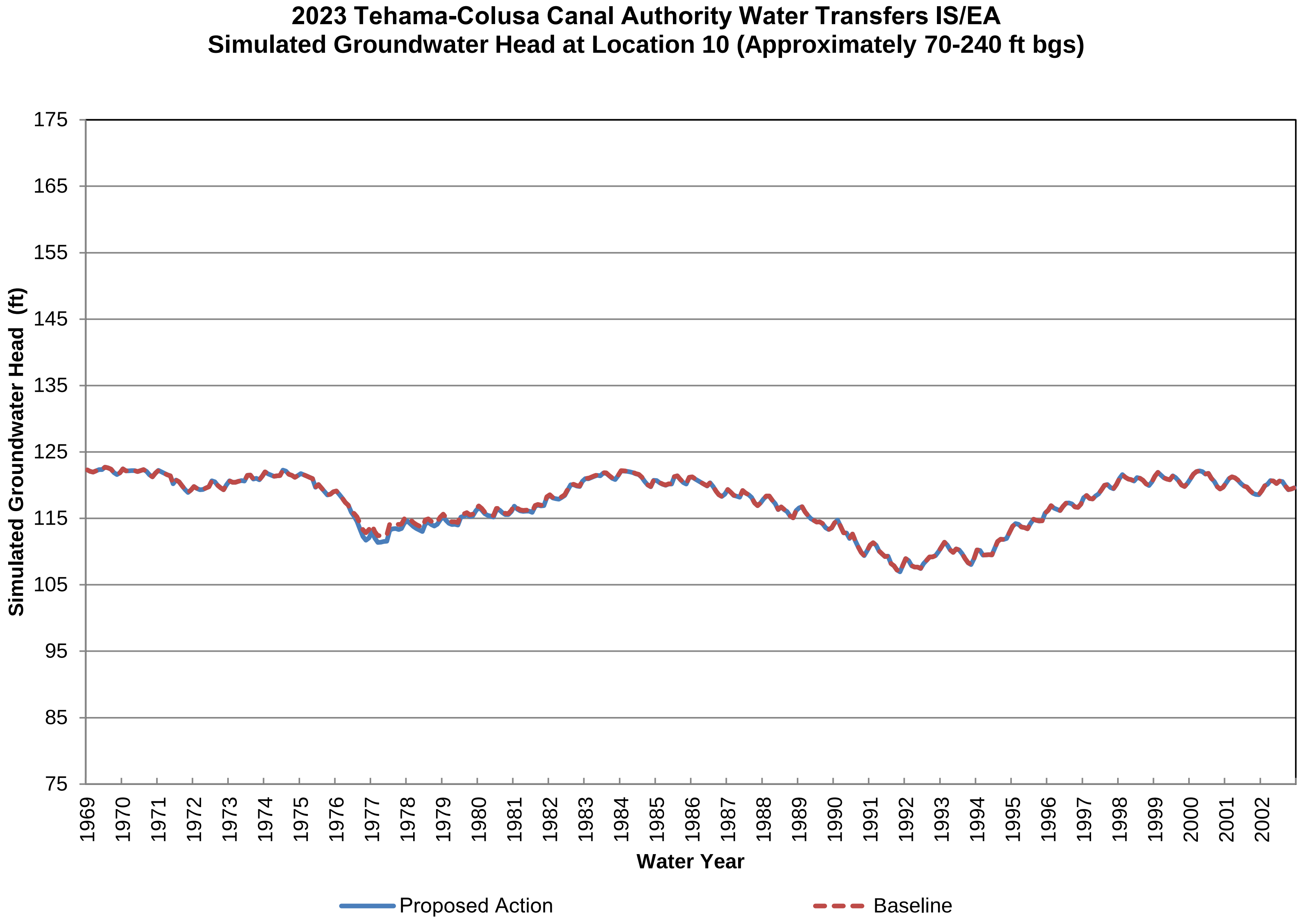
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 9 (Approximately 910-1250 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 10 (Approximately 0-70 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 10 (Approximately 70-240 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1969
1970
1971
1972
1973
1974
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1978
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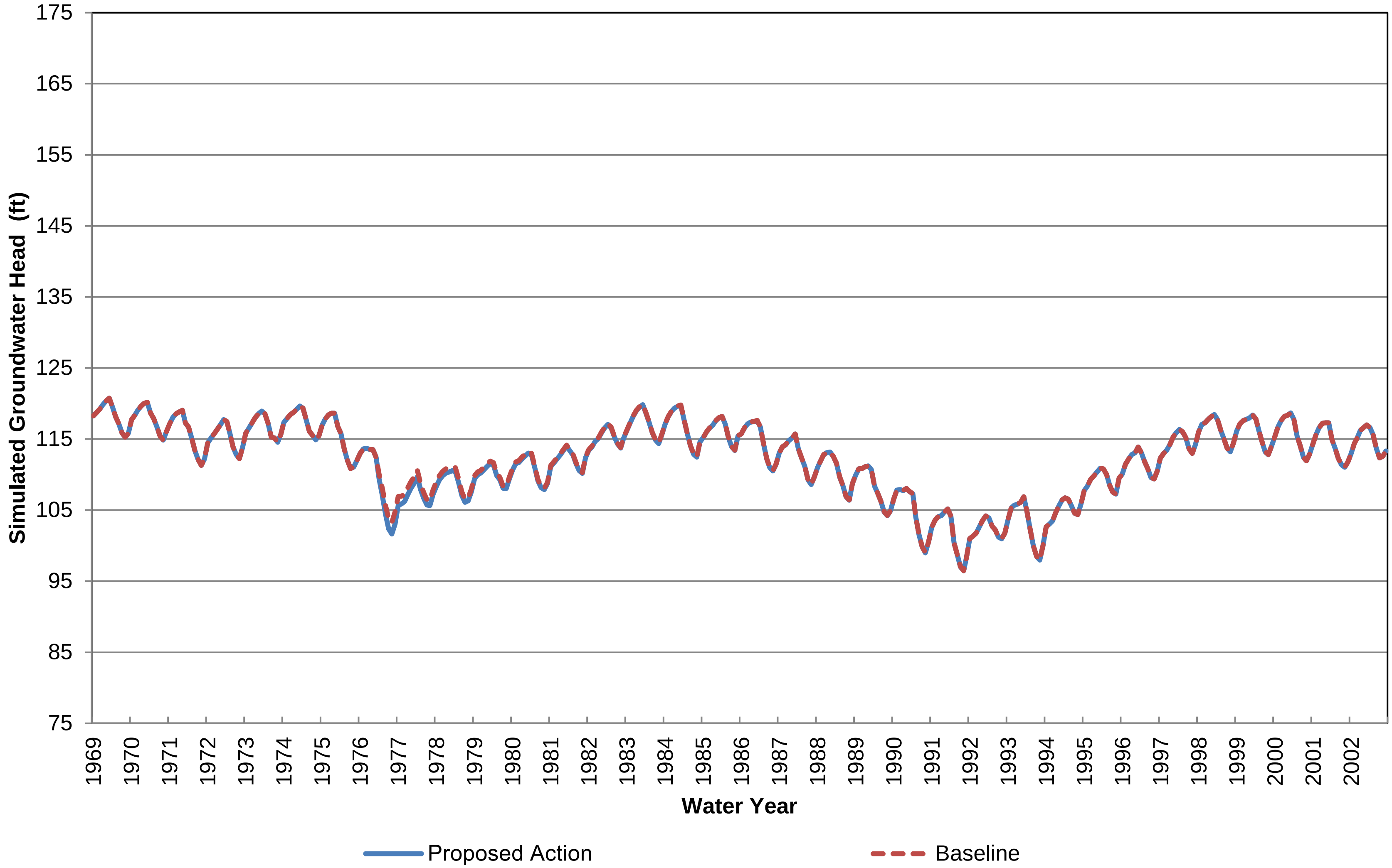
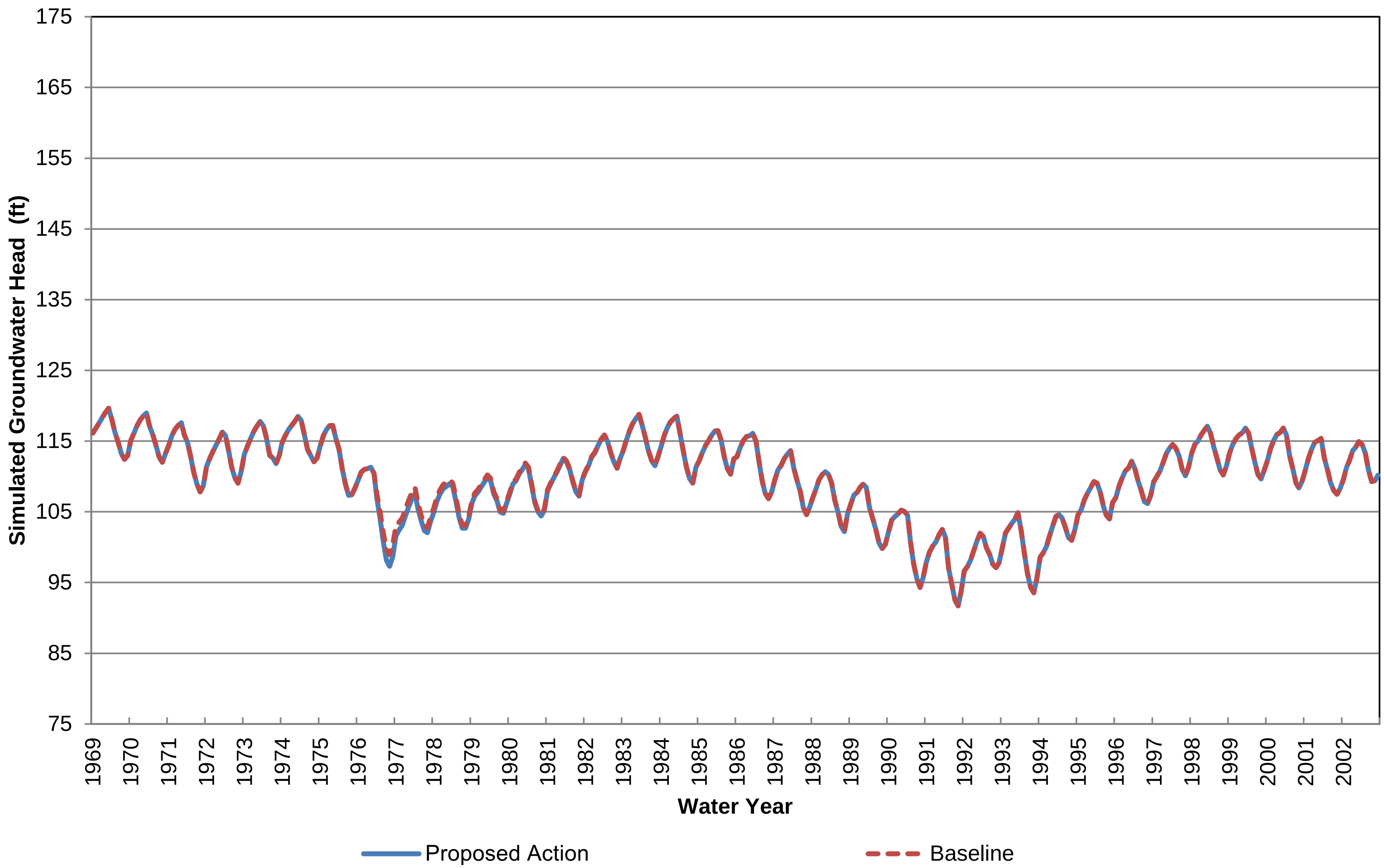
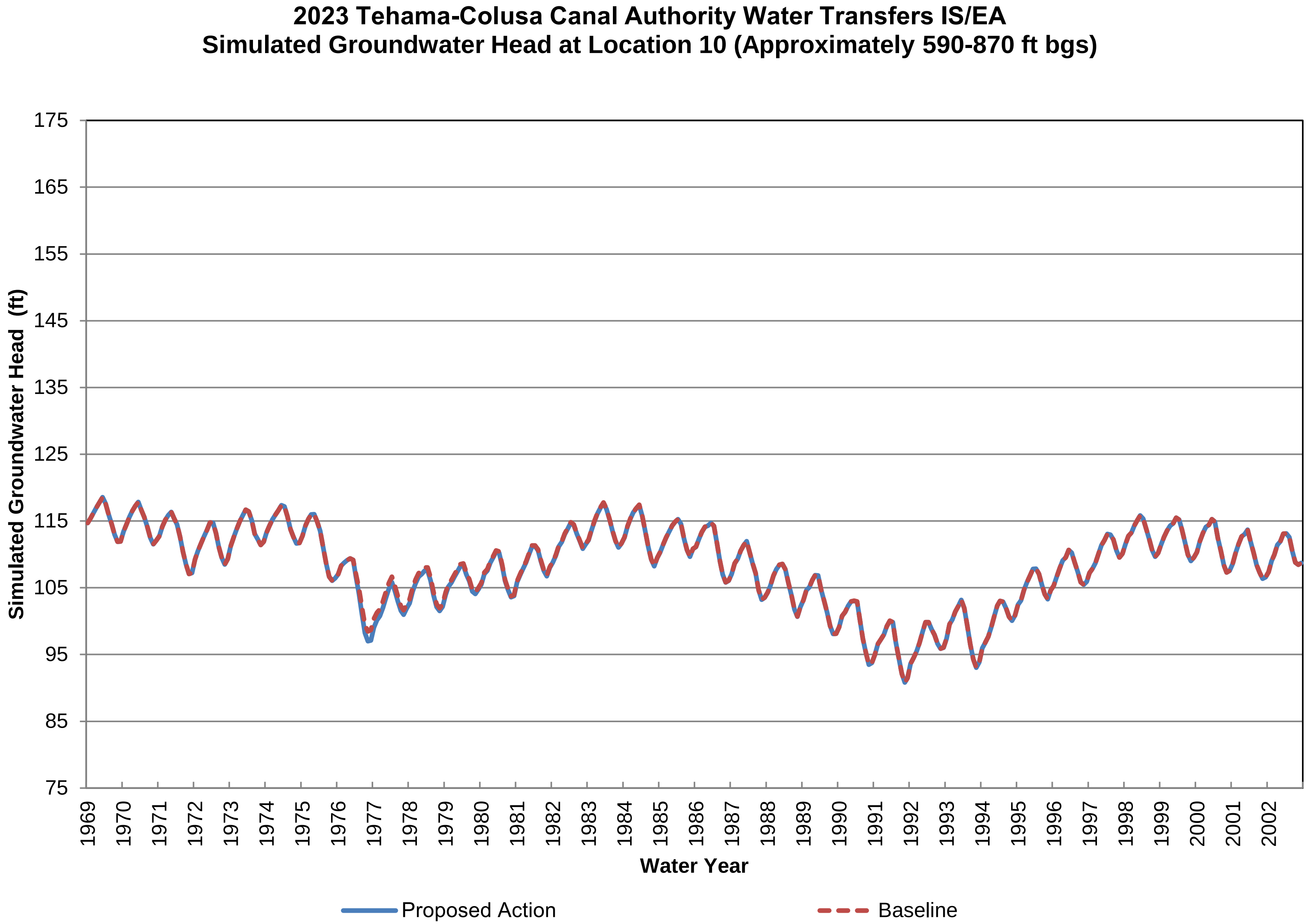
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 10 (Approximately 240-420 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 10 (Approximately 420-590 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 10 (Approximately 590-870 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1969
1970
1971
1972
1973
1974
1975
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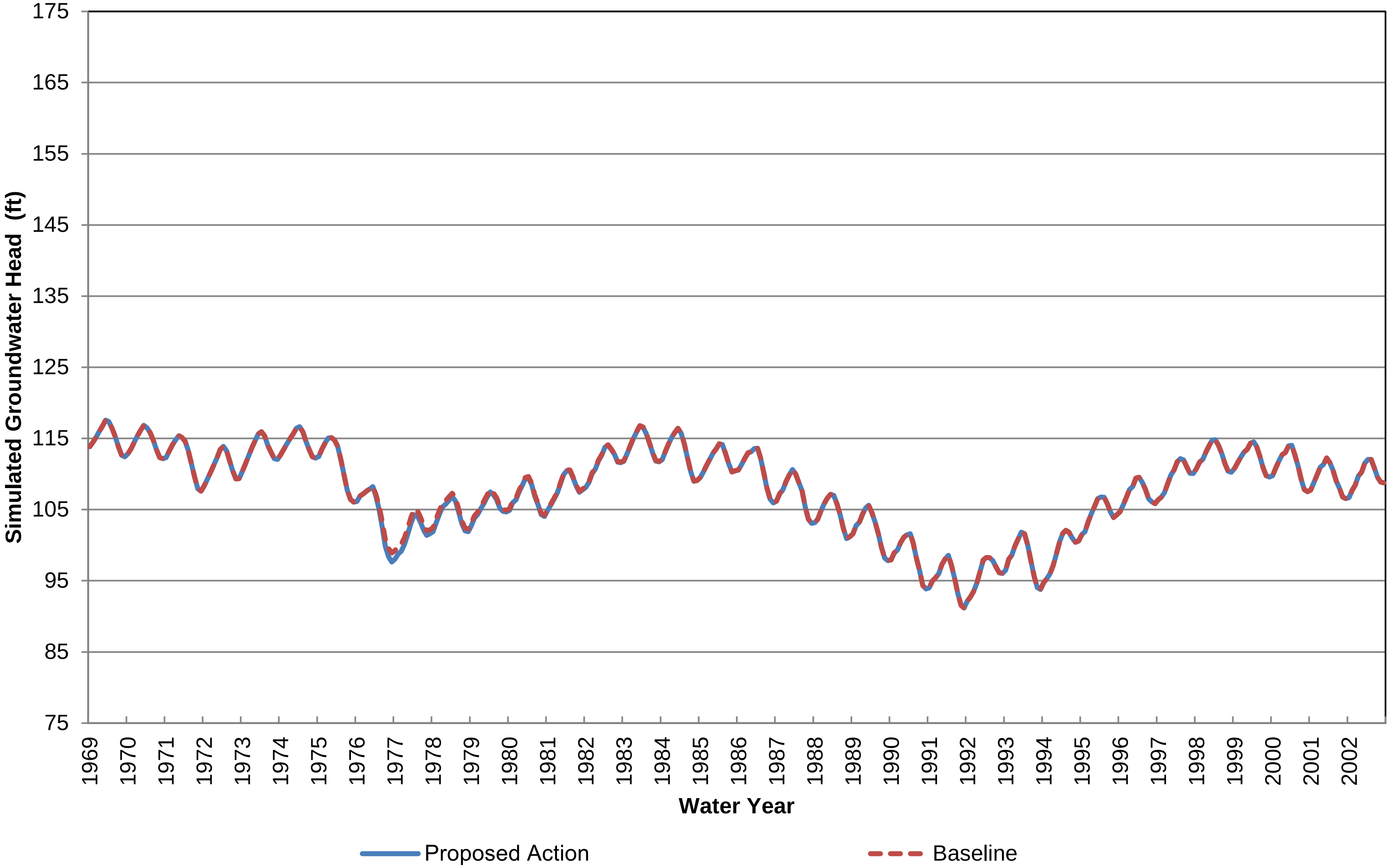
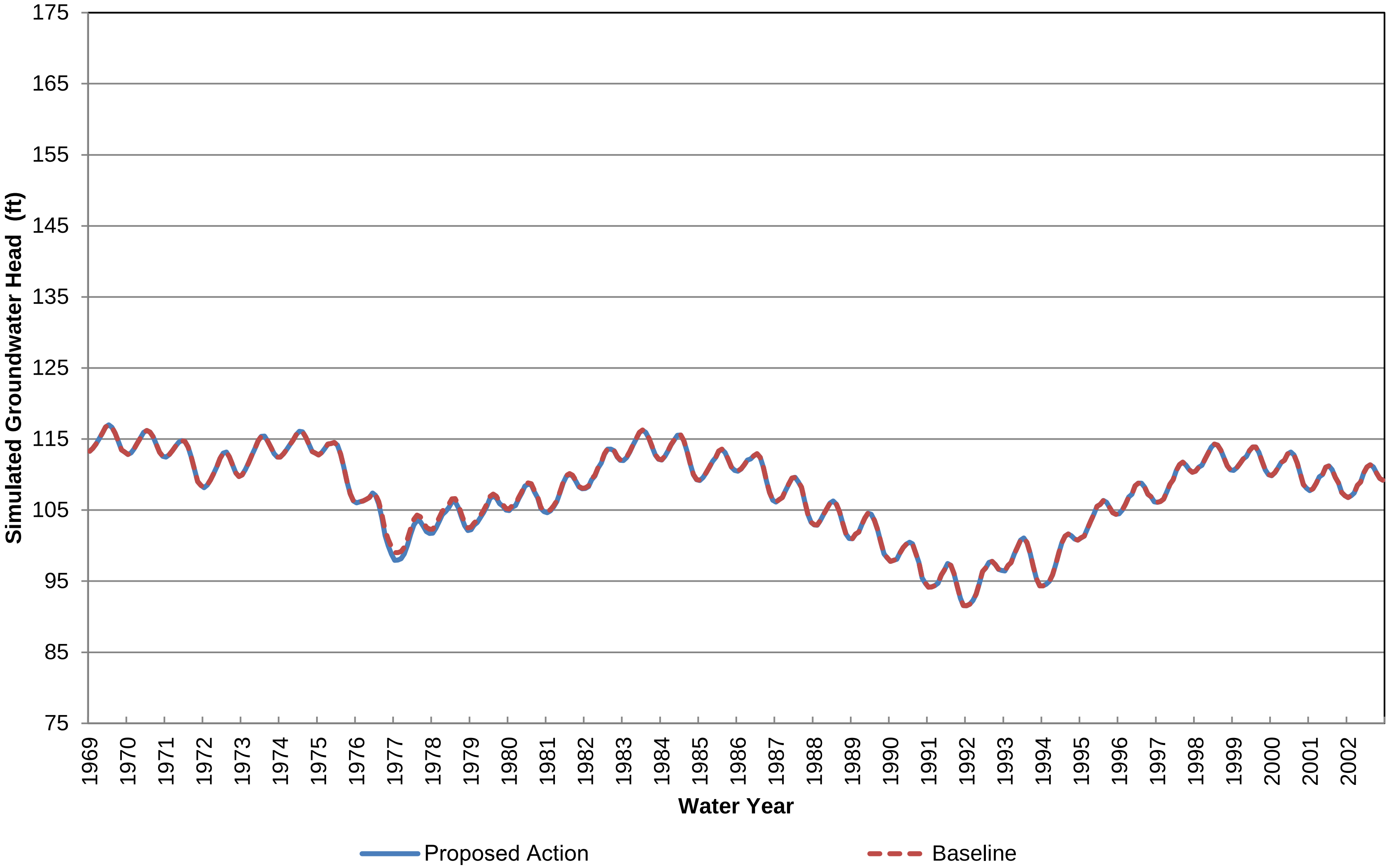
2001
2002
Water Year
Proposed Action
Baseline

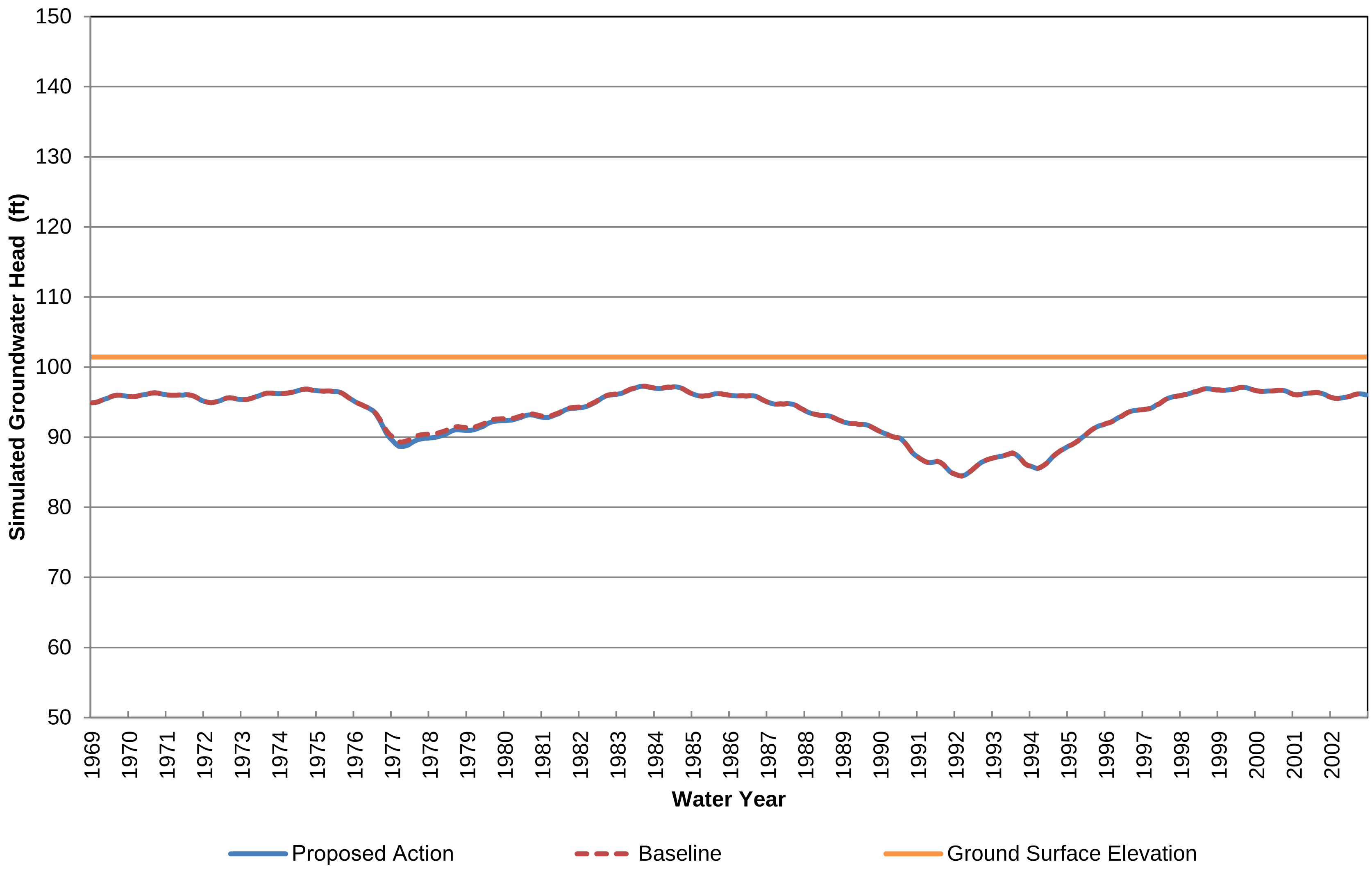
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 10 (Approximately 870-1160 ft bgs)



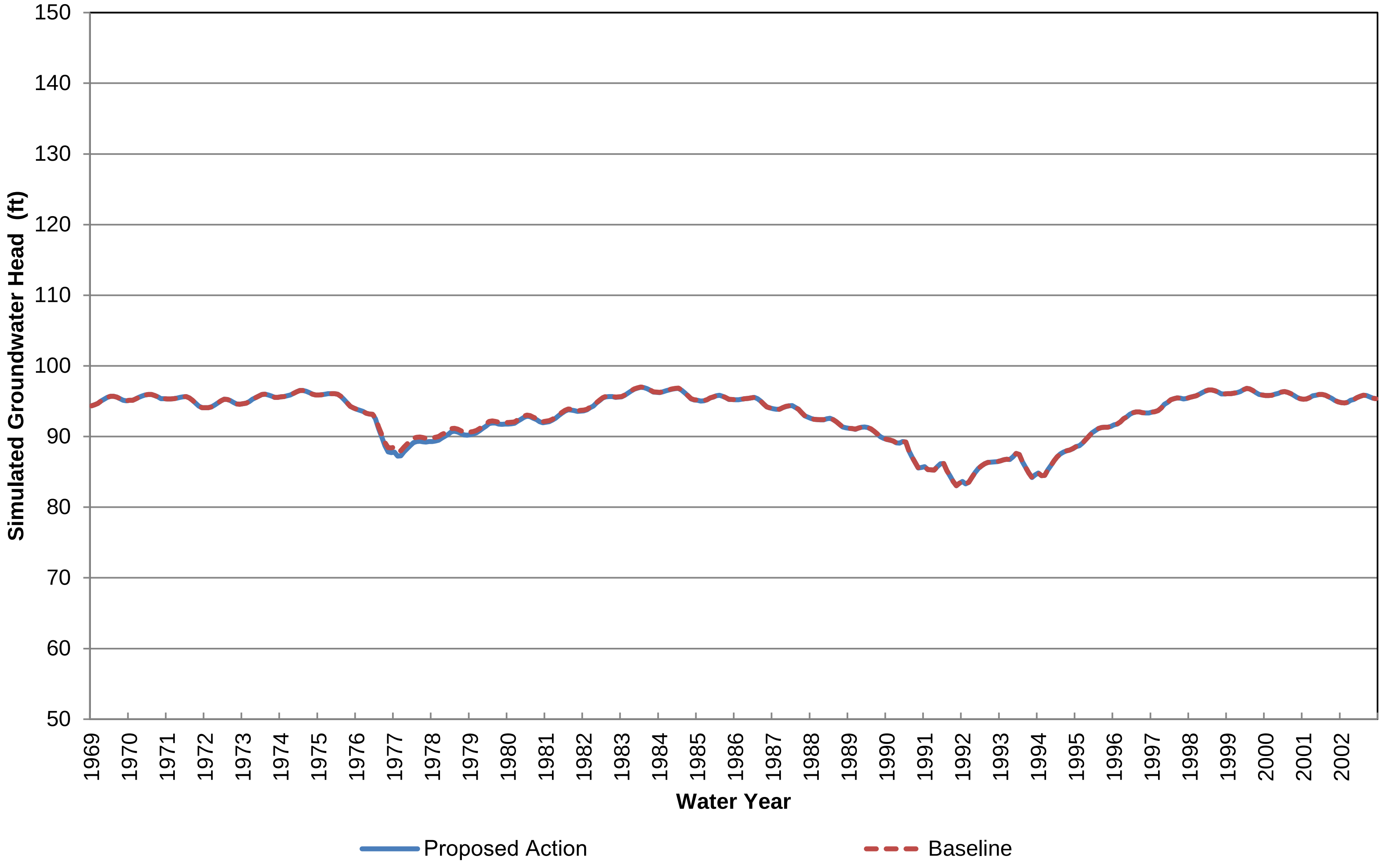
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 10 (Approximately 1160-1590 ft bgs)



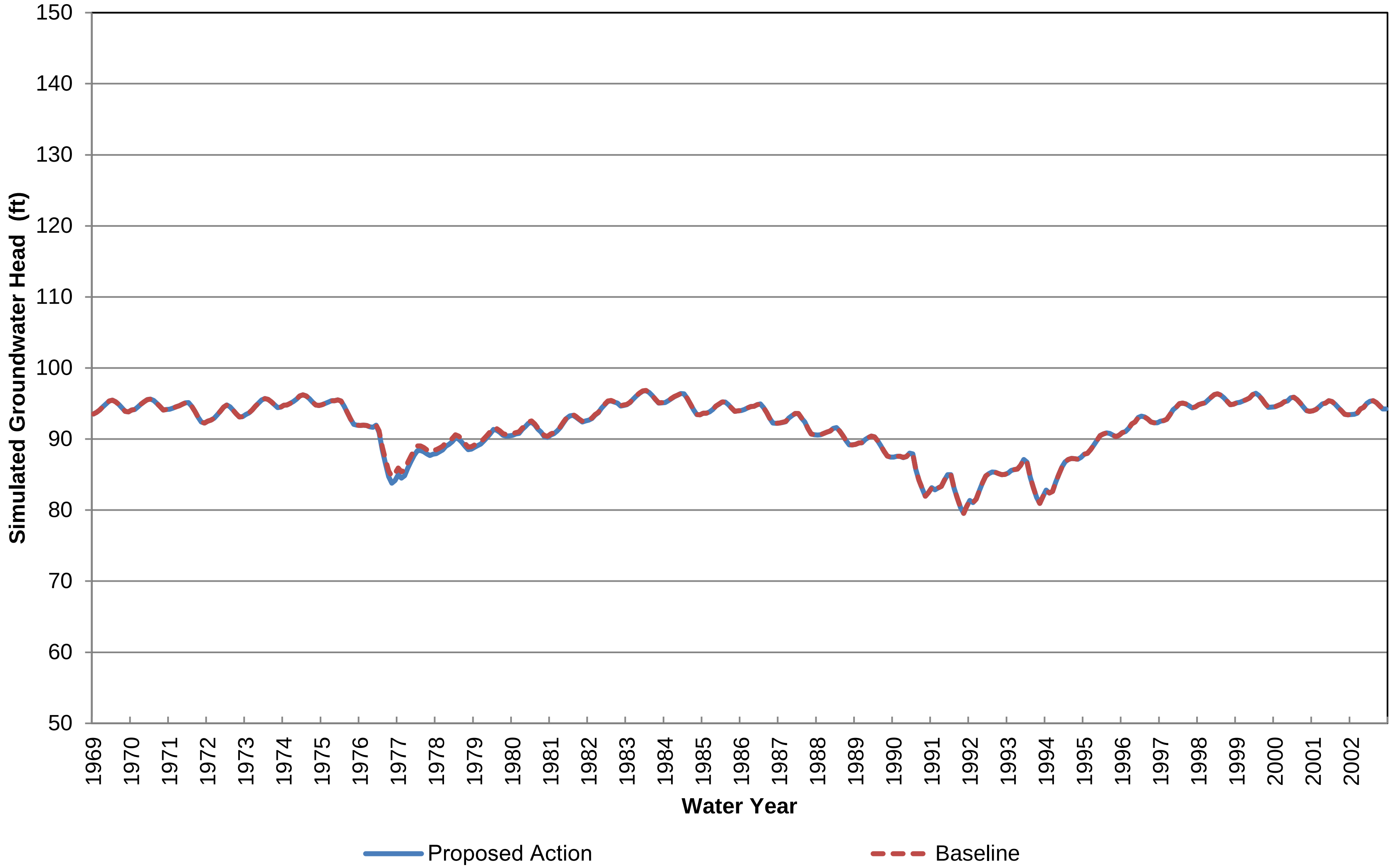
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 11 (Approximately 0-70 ft bgs)



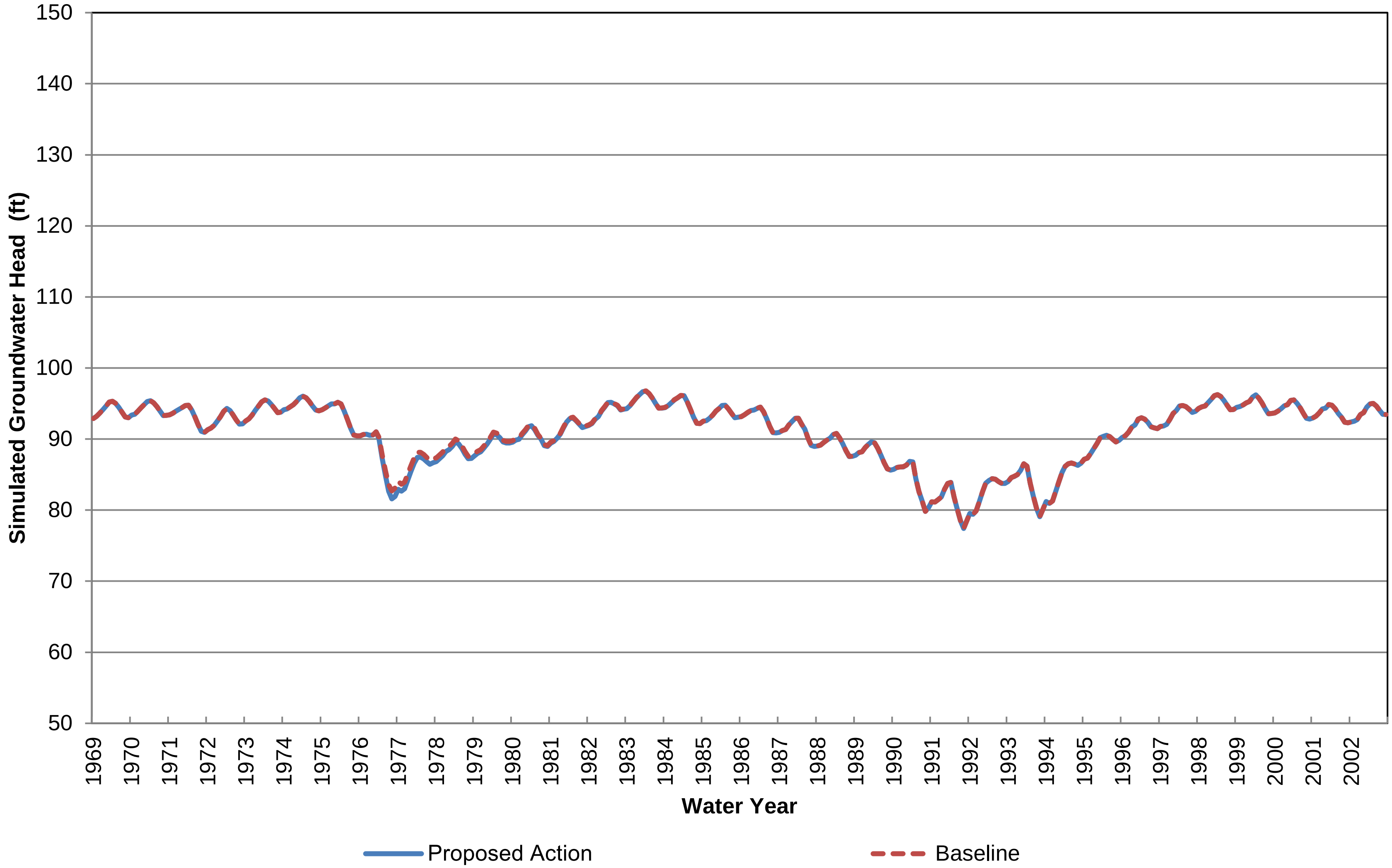
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 11 (Approximately 70-260 ft bgs)



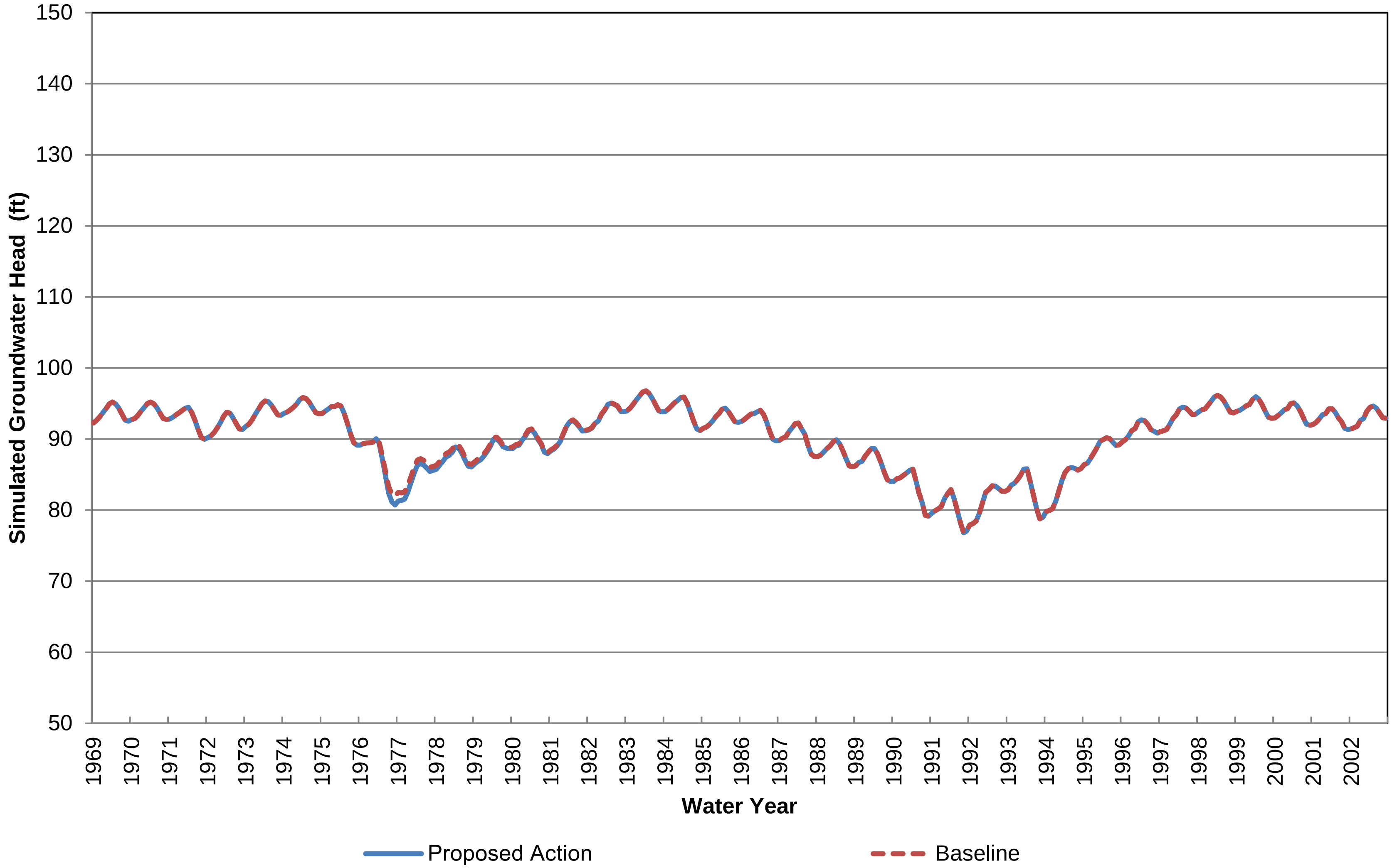
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 11 (Approximately 260-450 ft bgs)

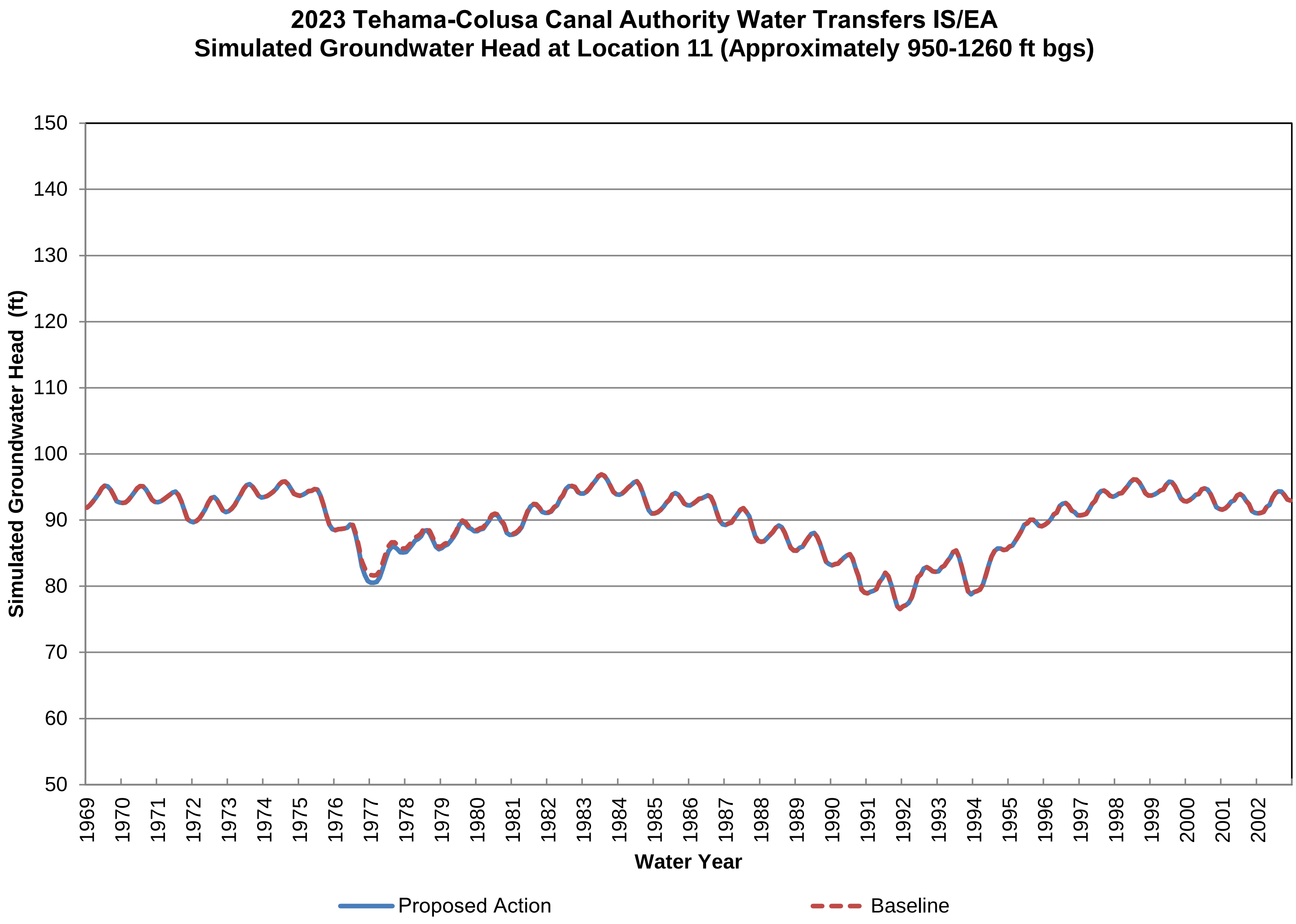


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 11 (Approximately 450-640 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 11 (Approximately 640-950 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 11 (Approximately 950-1260 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
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1969
1970
1971
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1974
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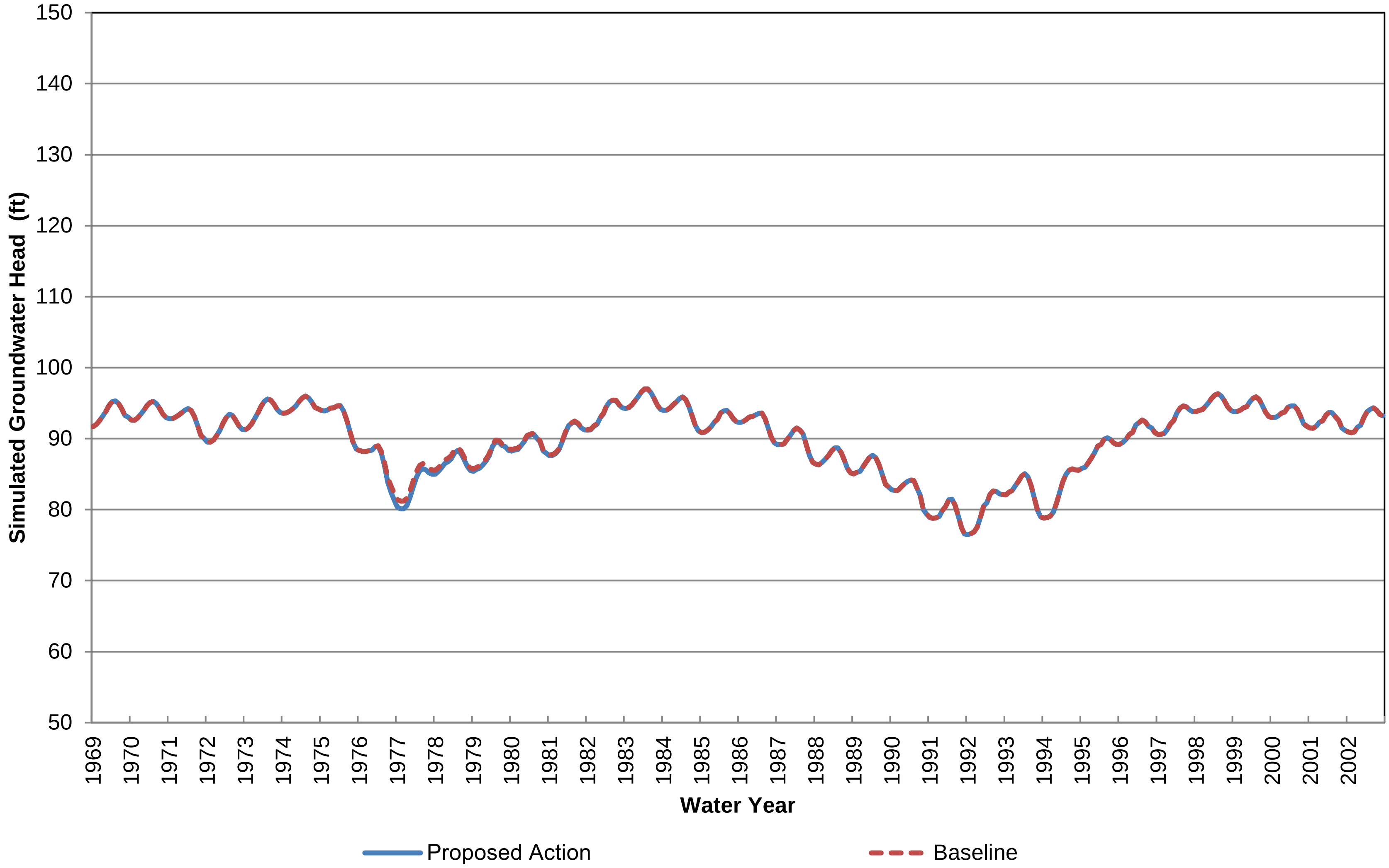
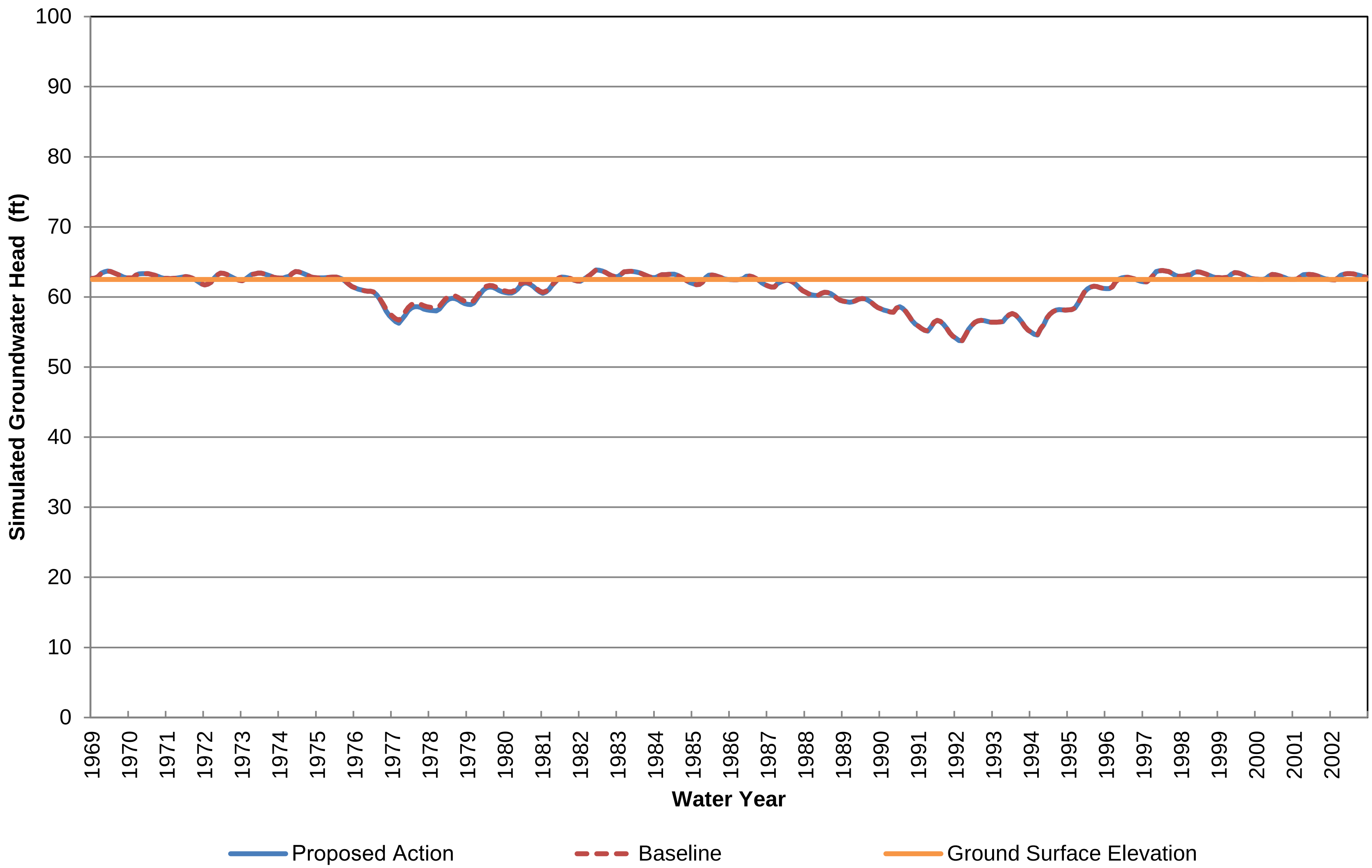
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

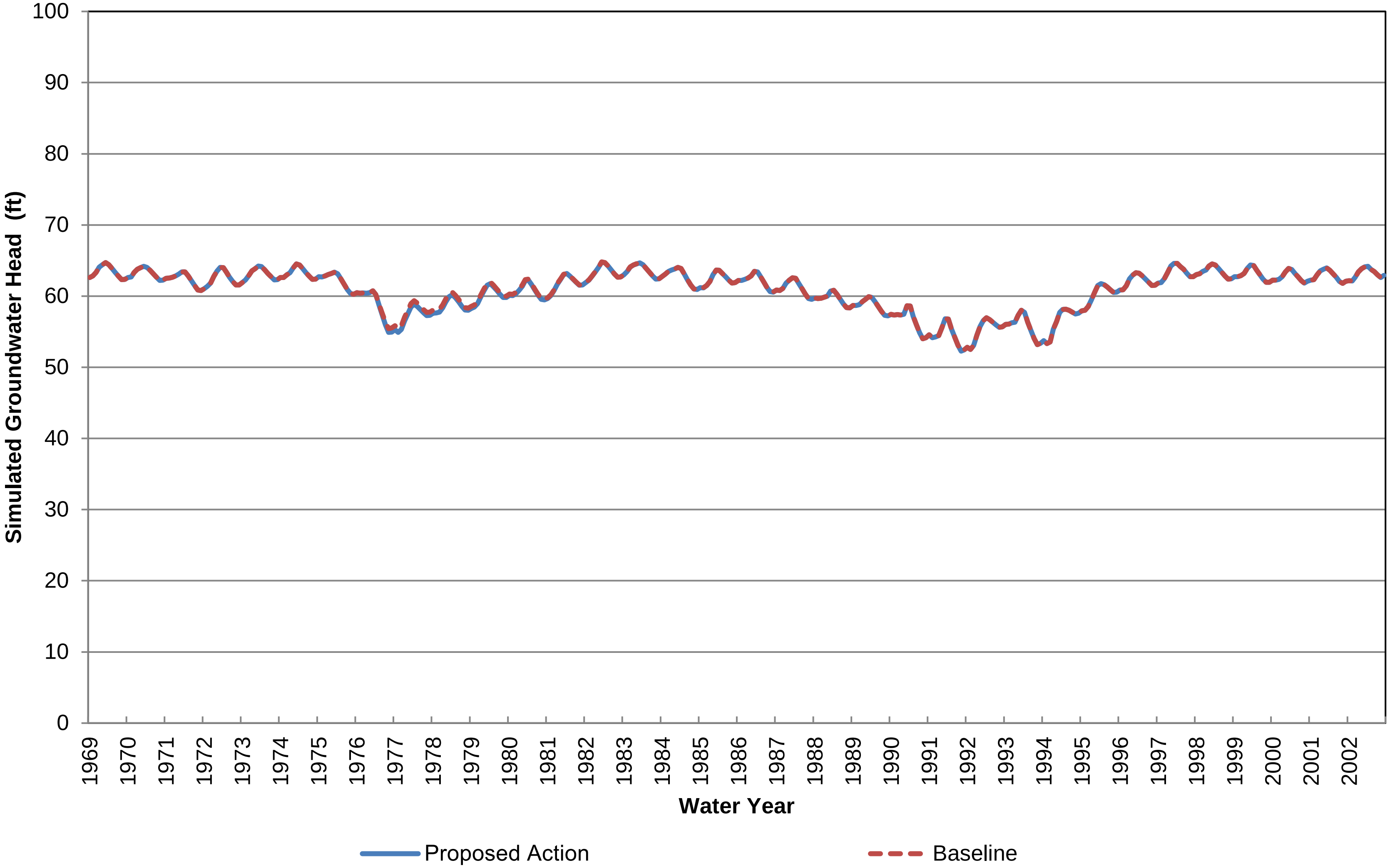
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 11 (Approximately 1260-1740 ft bgs)



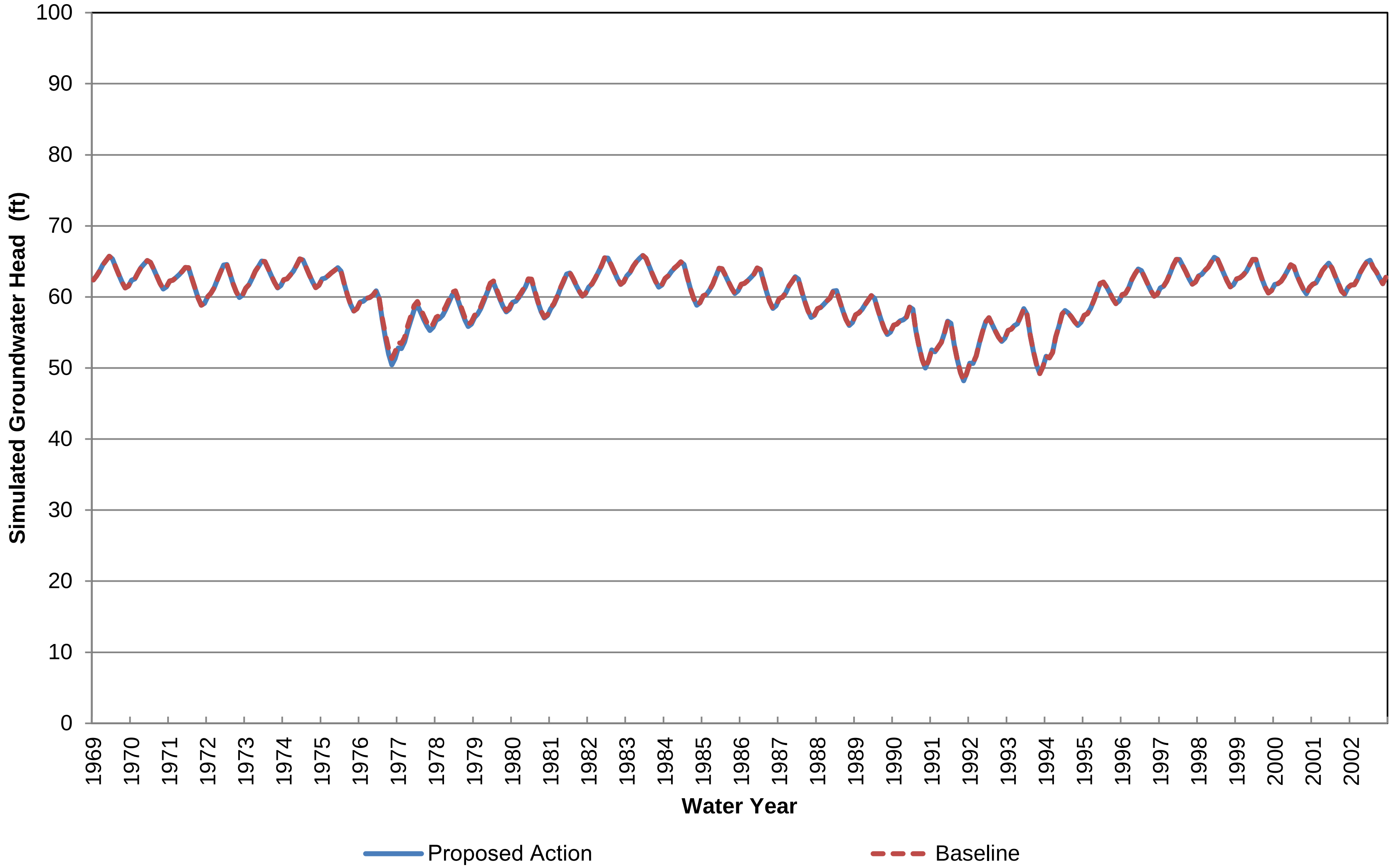
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 12 (Approximately 0-70 ft bgs)



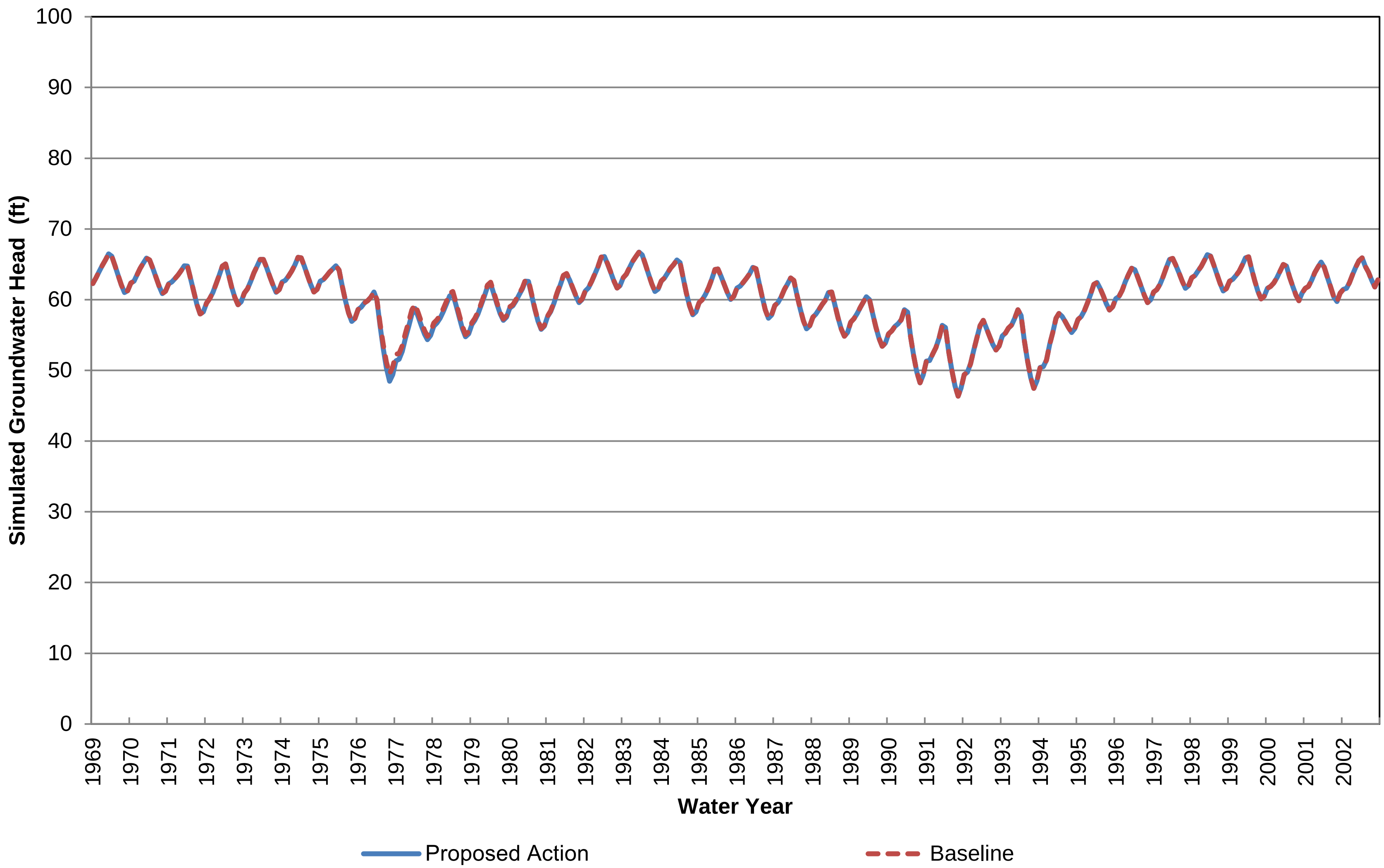
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 12 (Approximately 70-260 ft bgs)



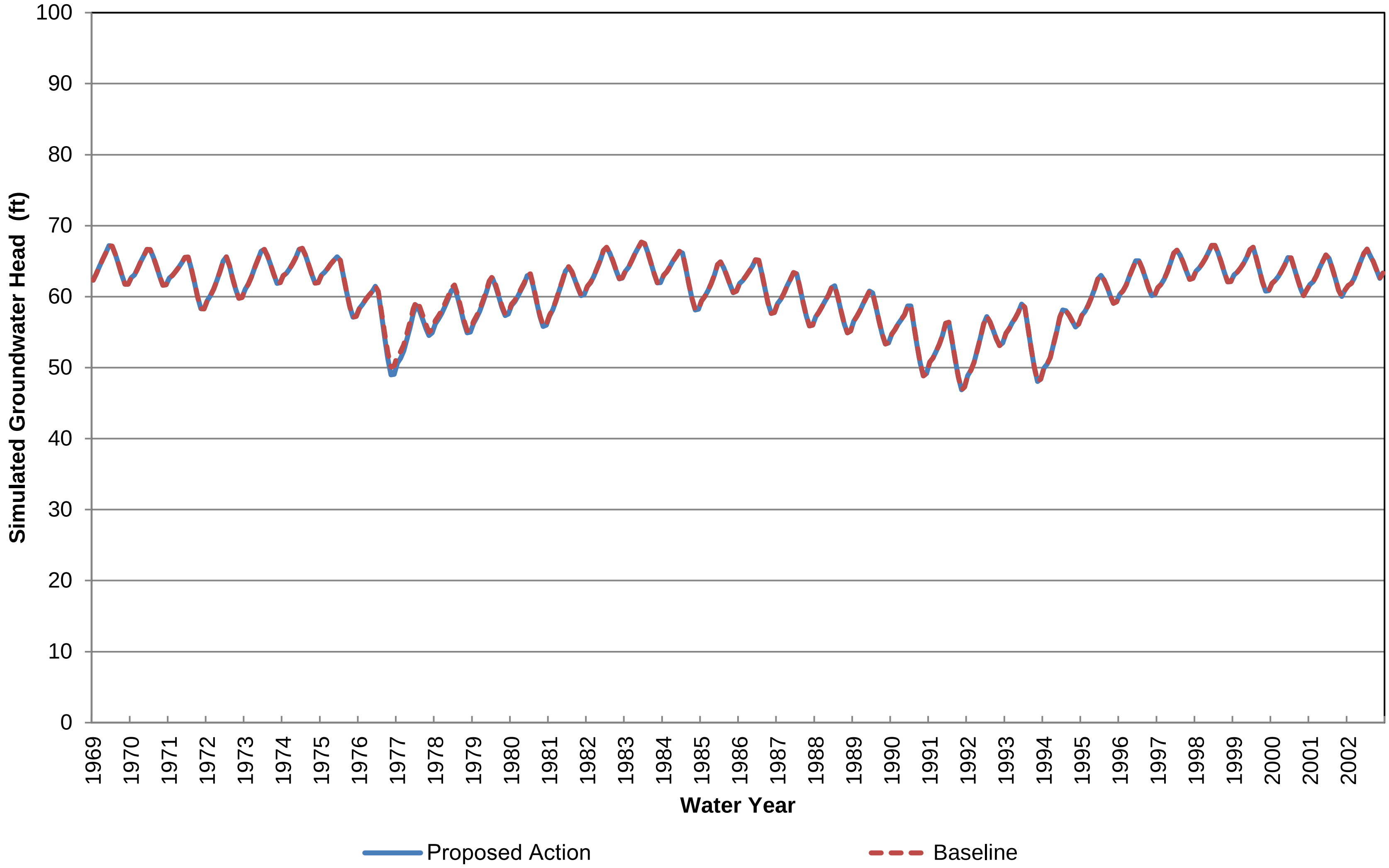
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 12 (Approximately 260-440 ft bgs)



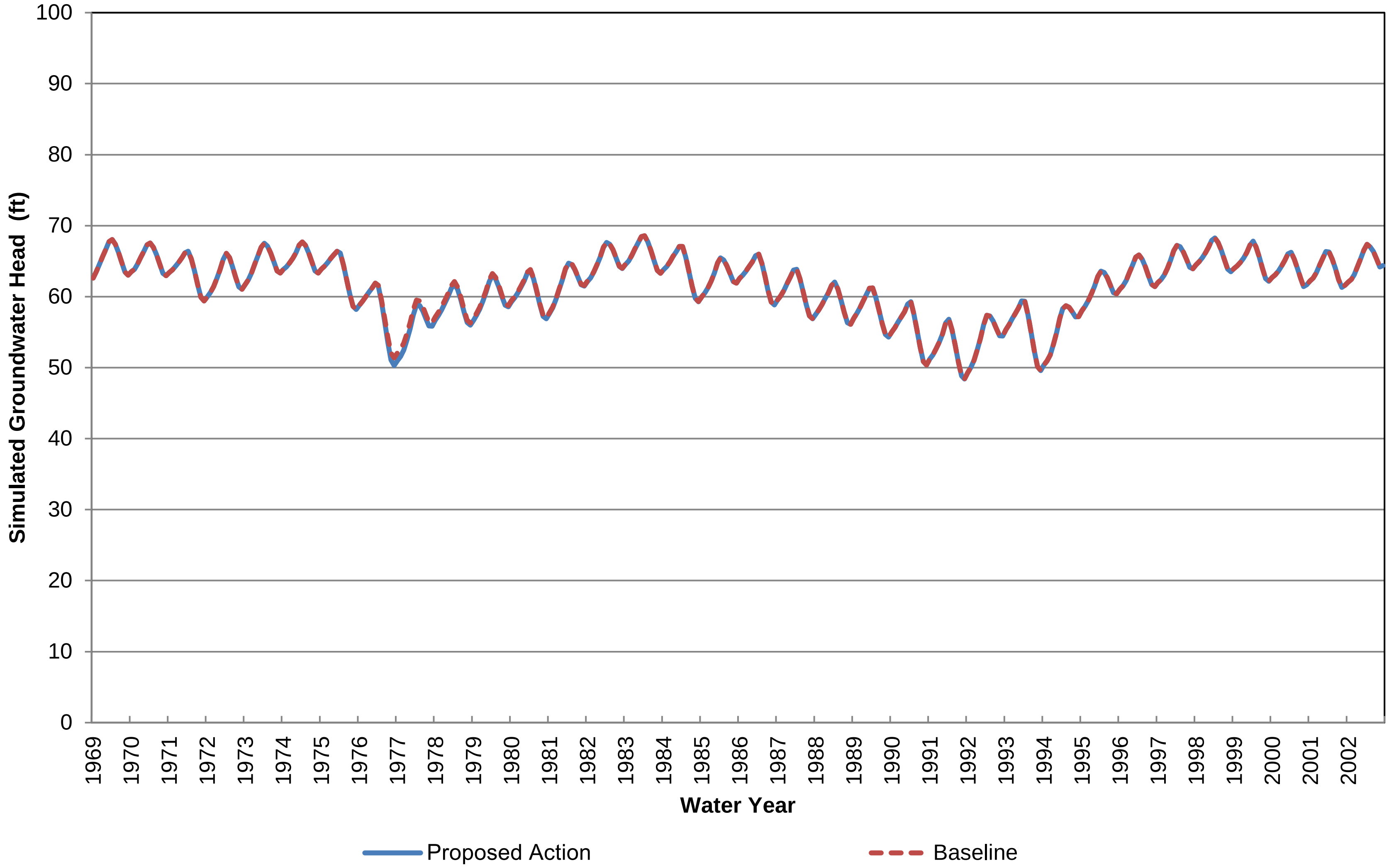
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 12 (Approximately 440-630 ft bgs)



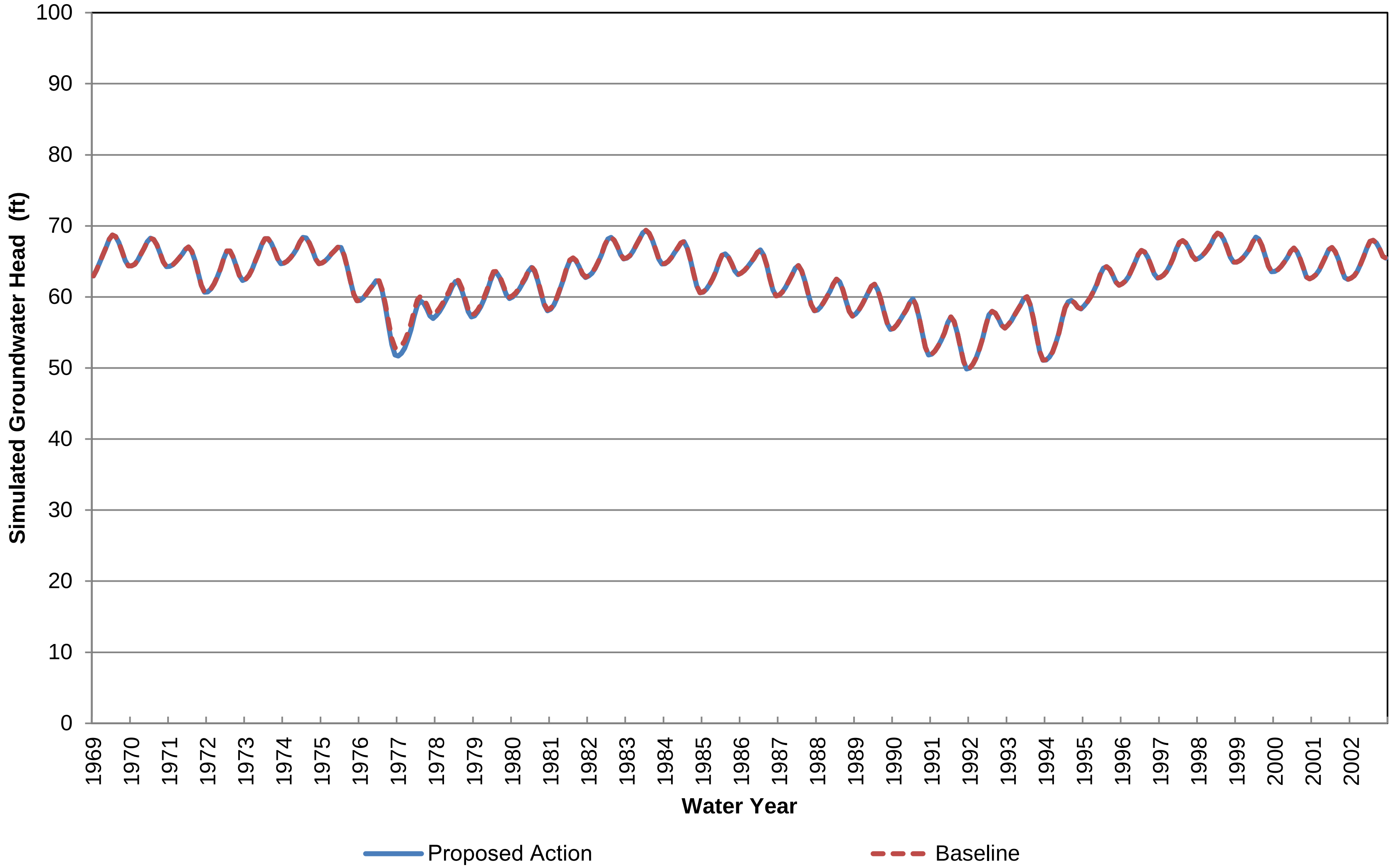
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 12 (Approximately 630-930 ft bgs)



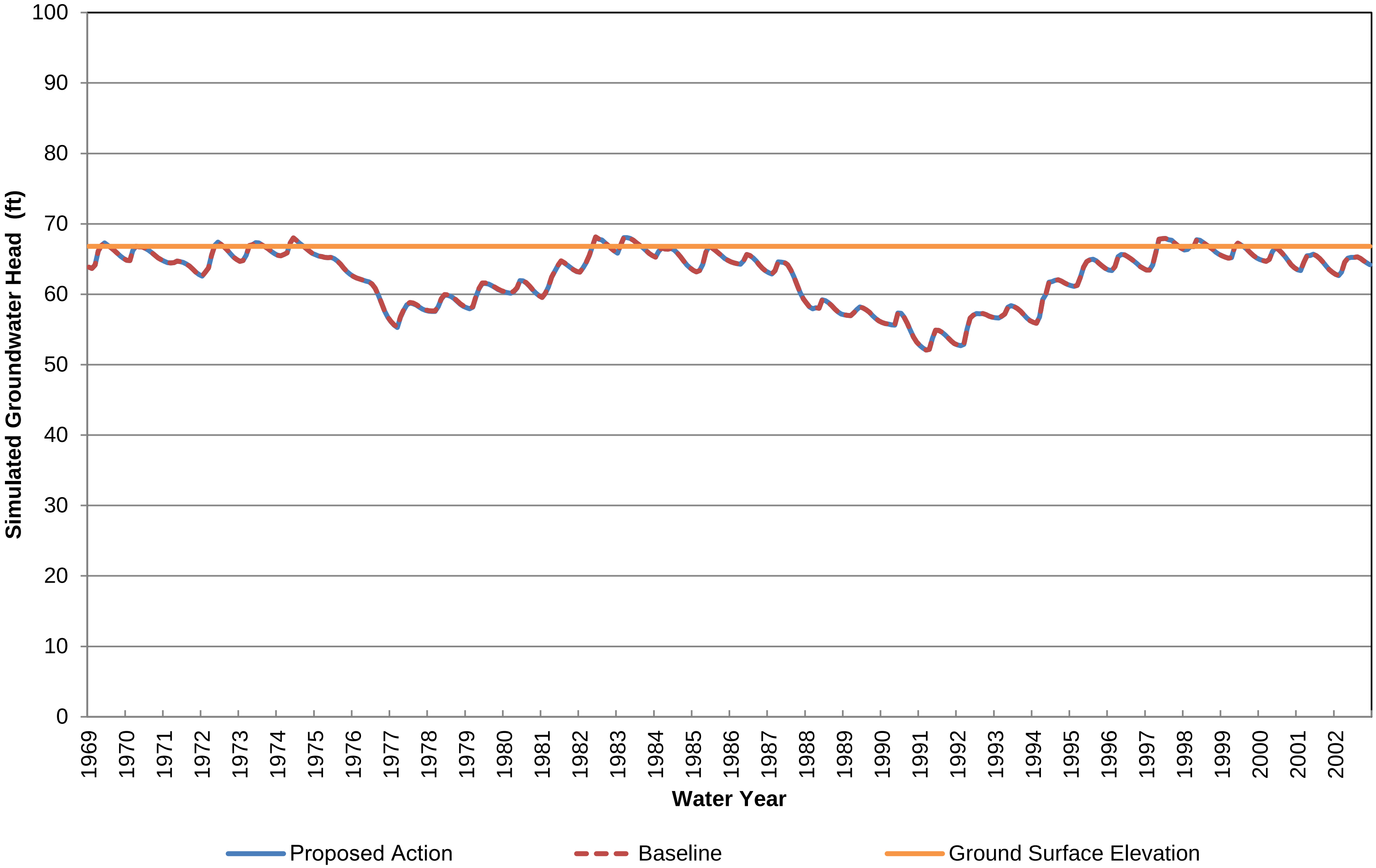
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 12 (Approximately 930-1240 ft bgs)



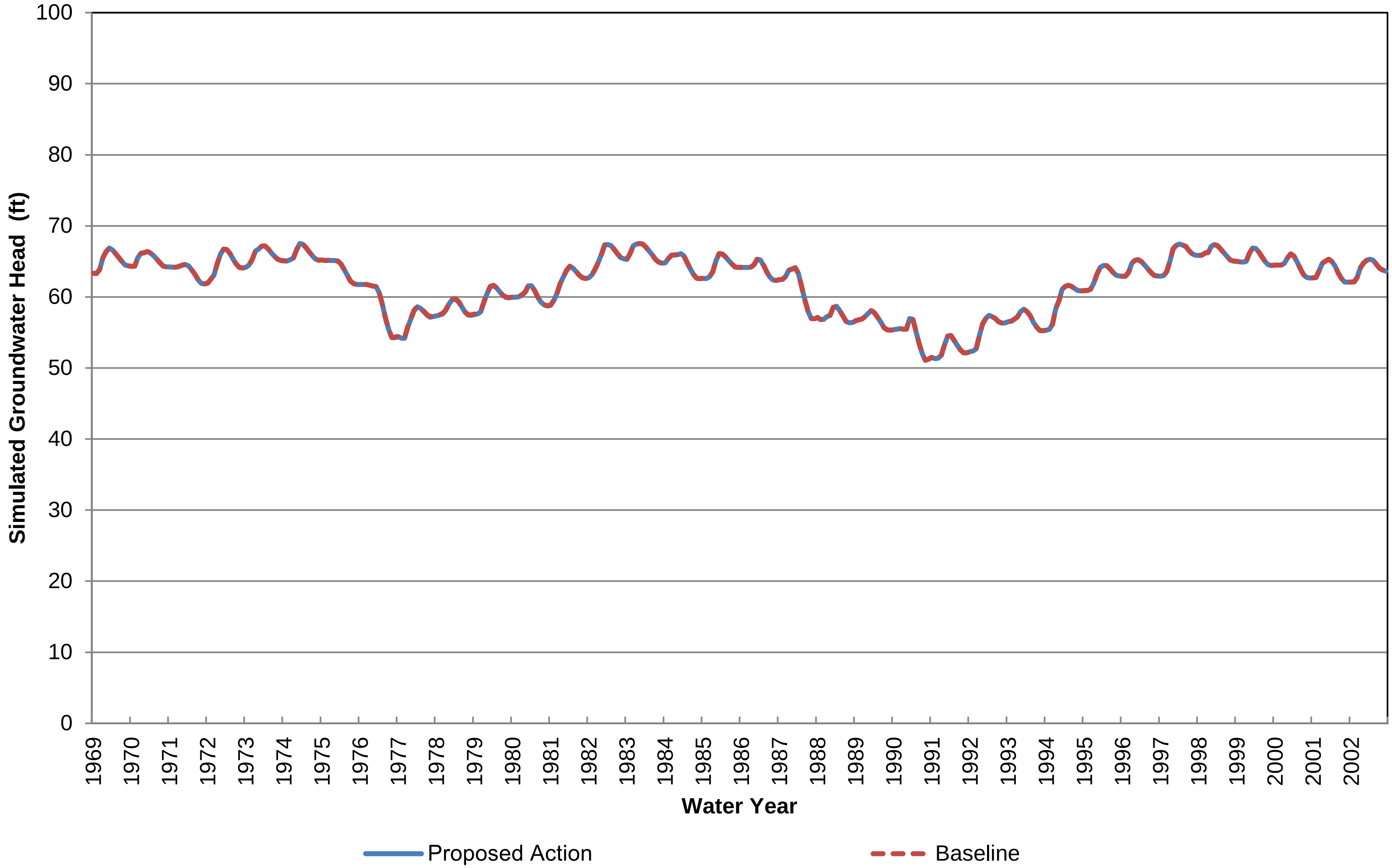
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 12 (Approximately 1240-1700 ft bgs)



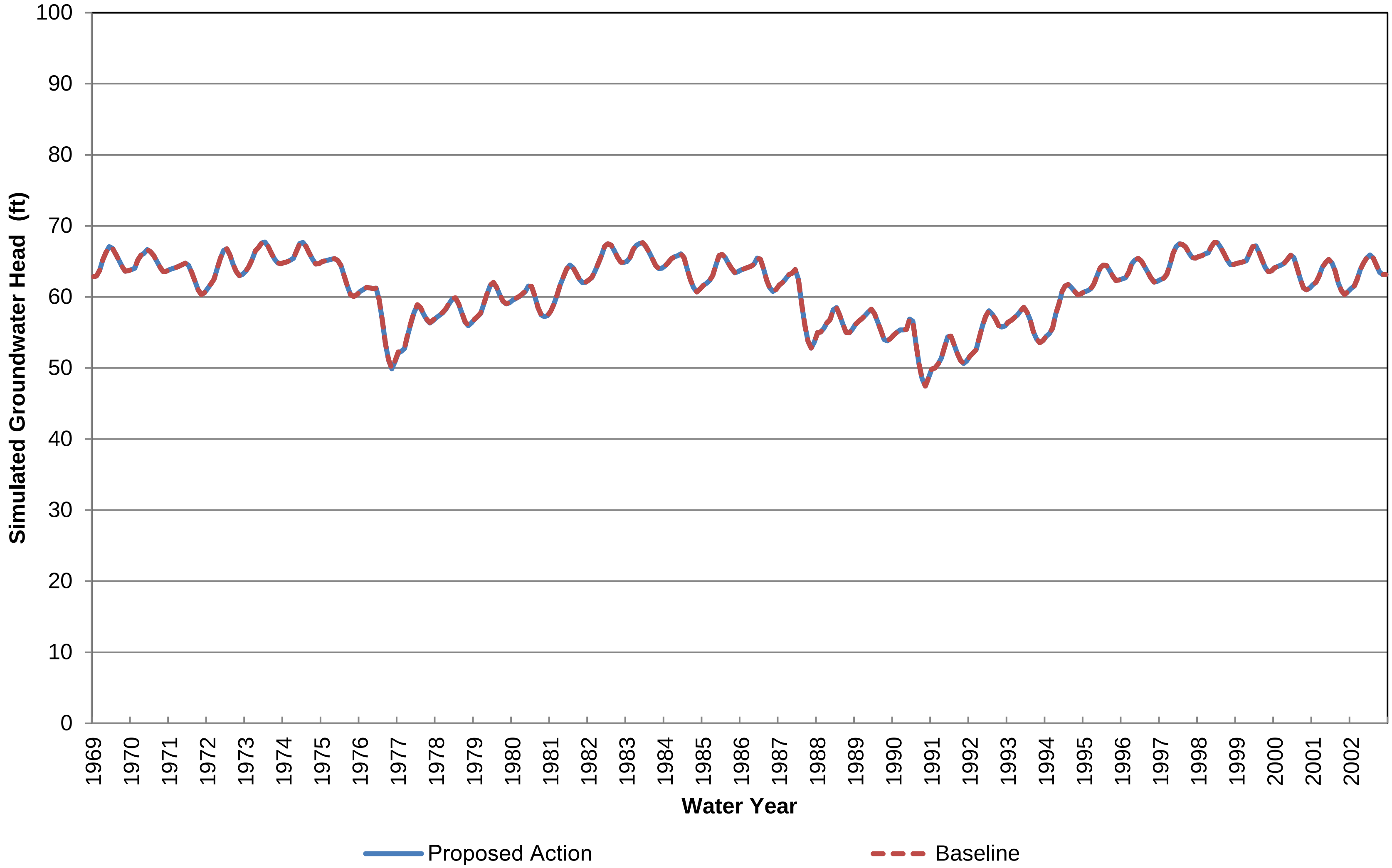
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 13 (Approximately 0-70 ft bgs)

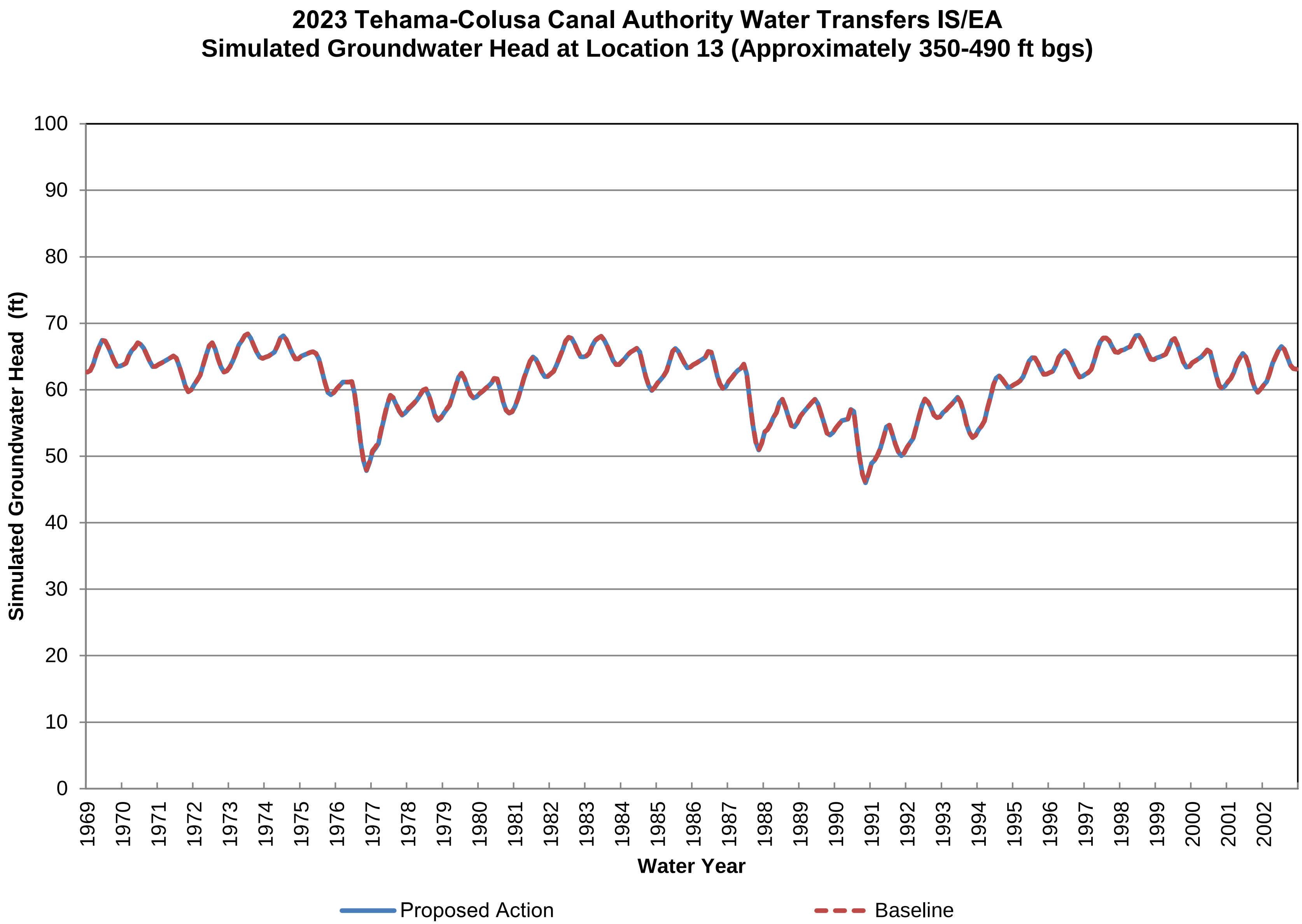


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 13 (Approximately 70-210 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 13 (Approximately 210-350 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 13 (Approximately 350-490 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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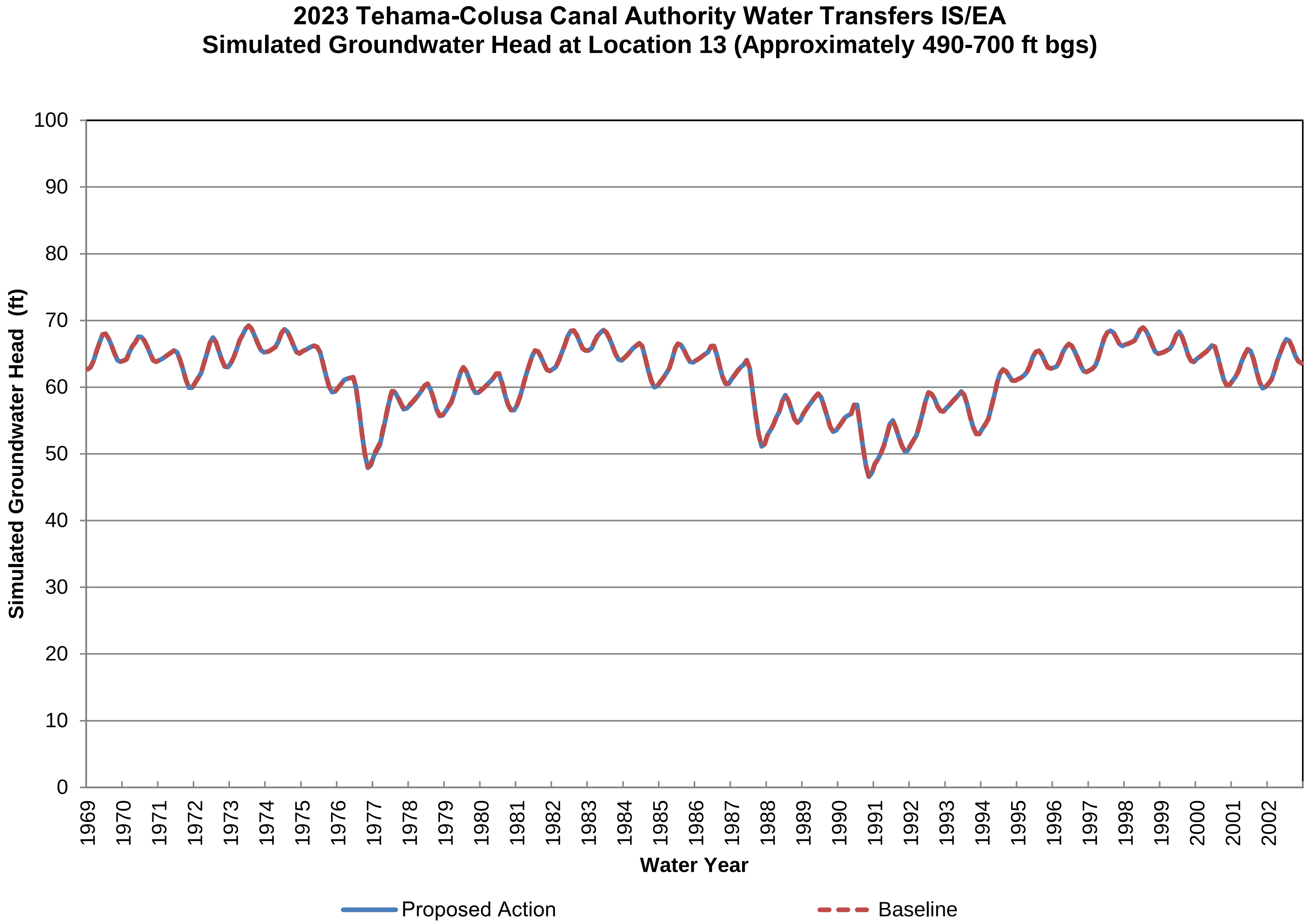
1999
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 13 (Approximately 490-700 ft bgs)
Simulated Groundwater Head (ft)
0
10
20
30
40
50
60
70
80
90
100
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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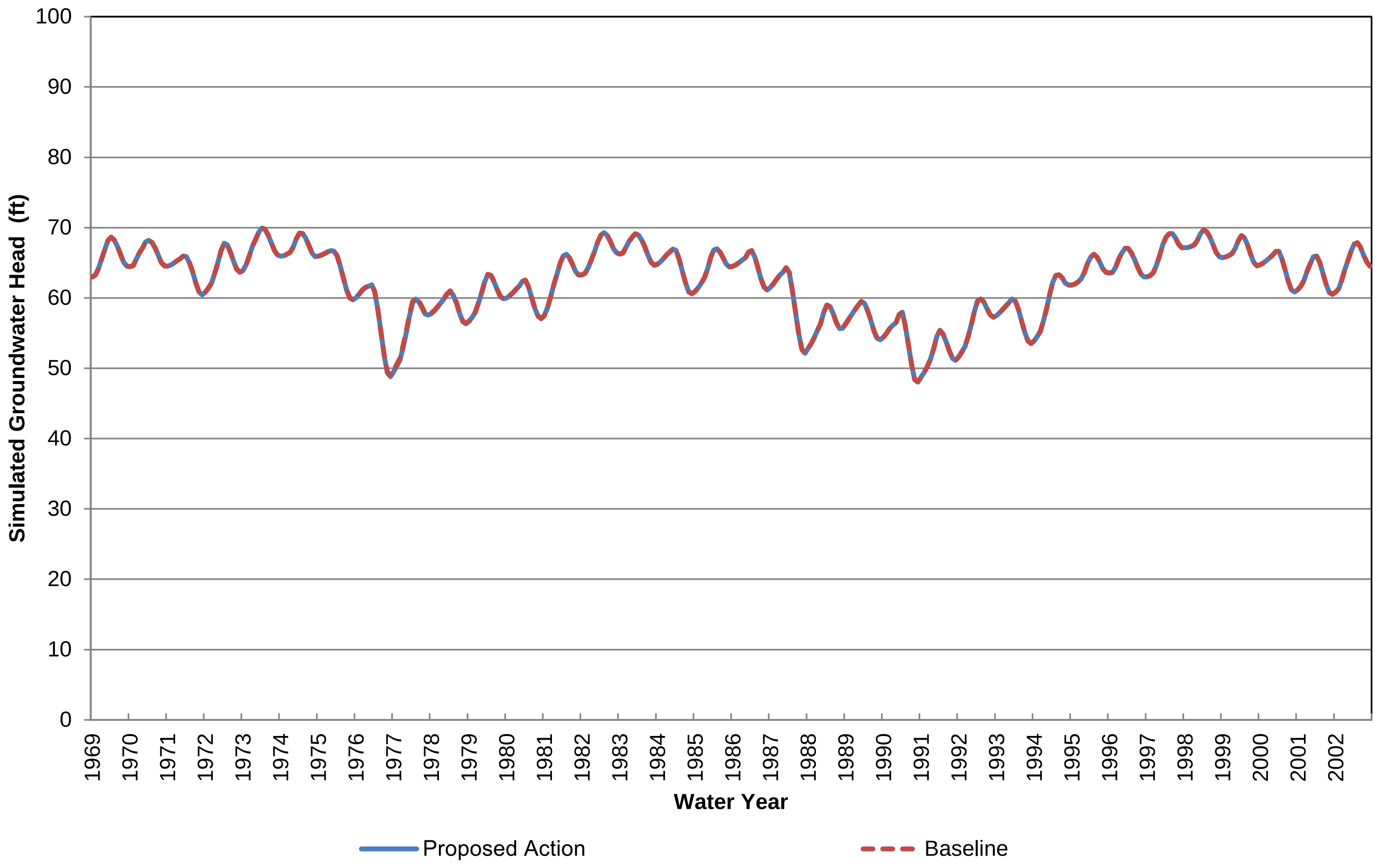
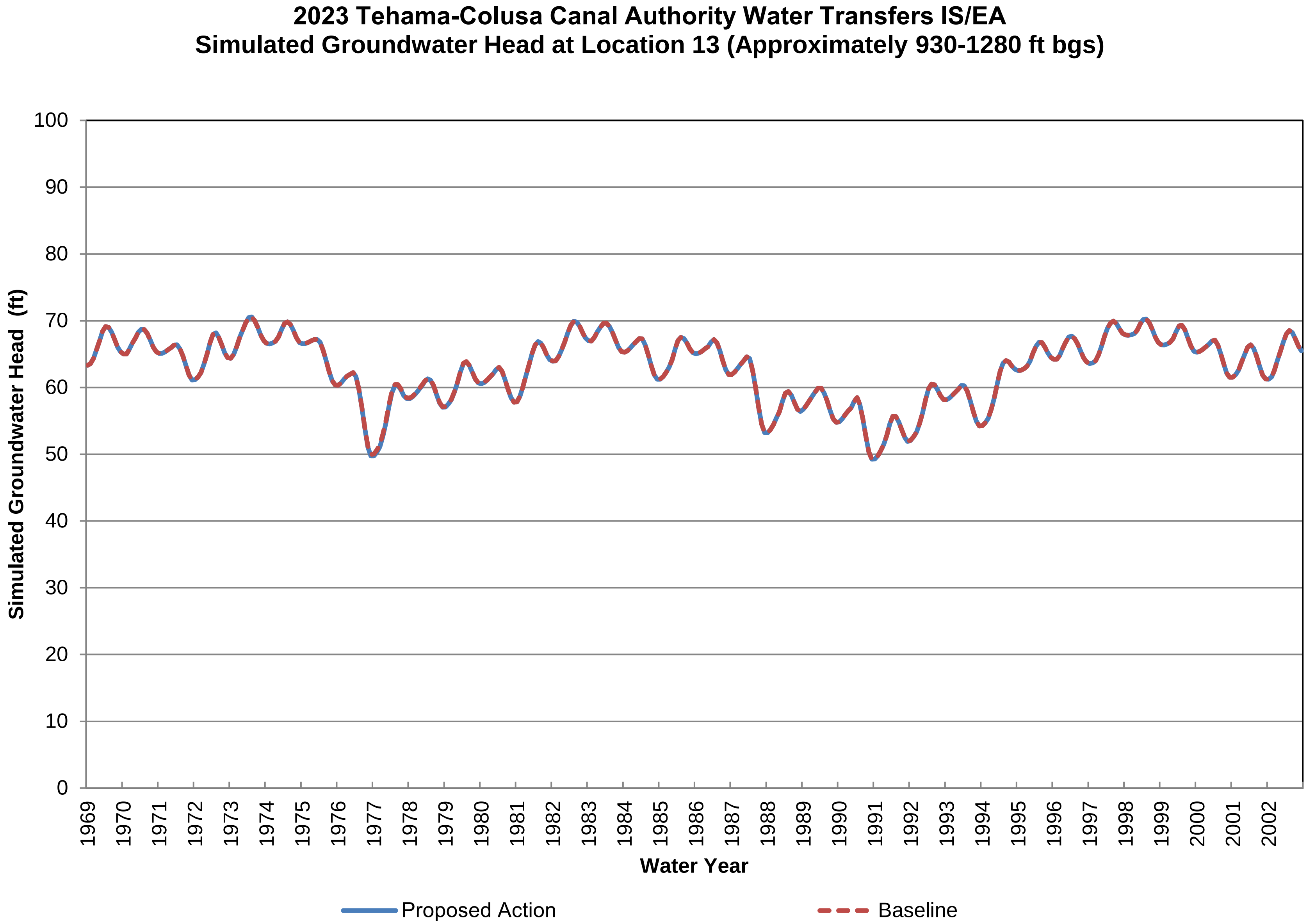
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 13 (Approximately 700-930 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 13 (Approximately 930-1280 ft bgs)
Simulated Groundwater Head (ft)
0
10
20
30
40
50
60
70
80
90
100
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
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1991
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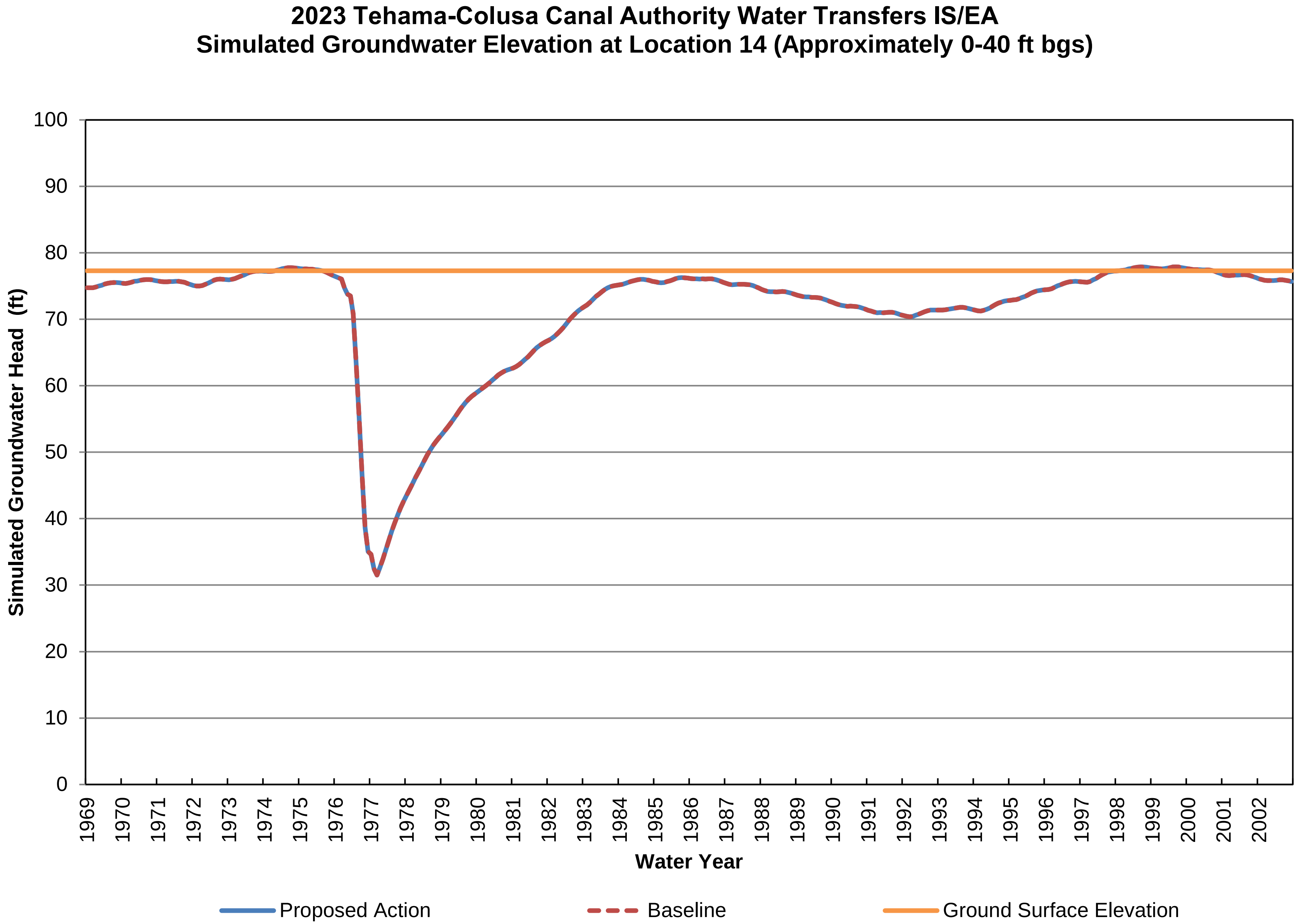
1999
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 14 (Approximately 0-40 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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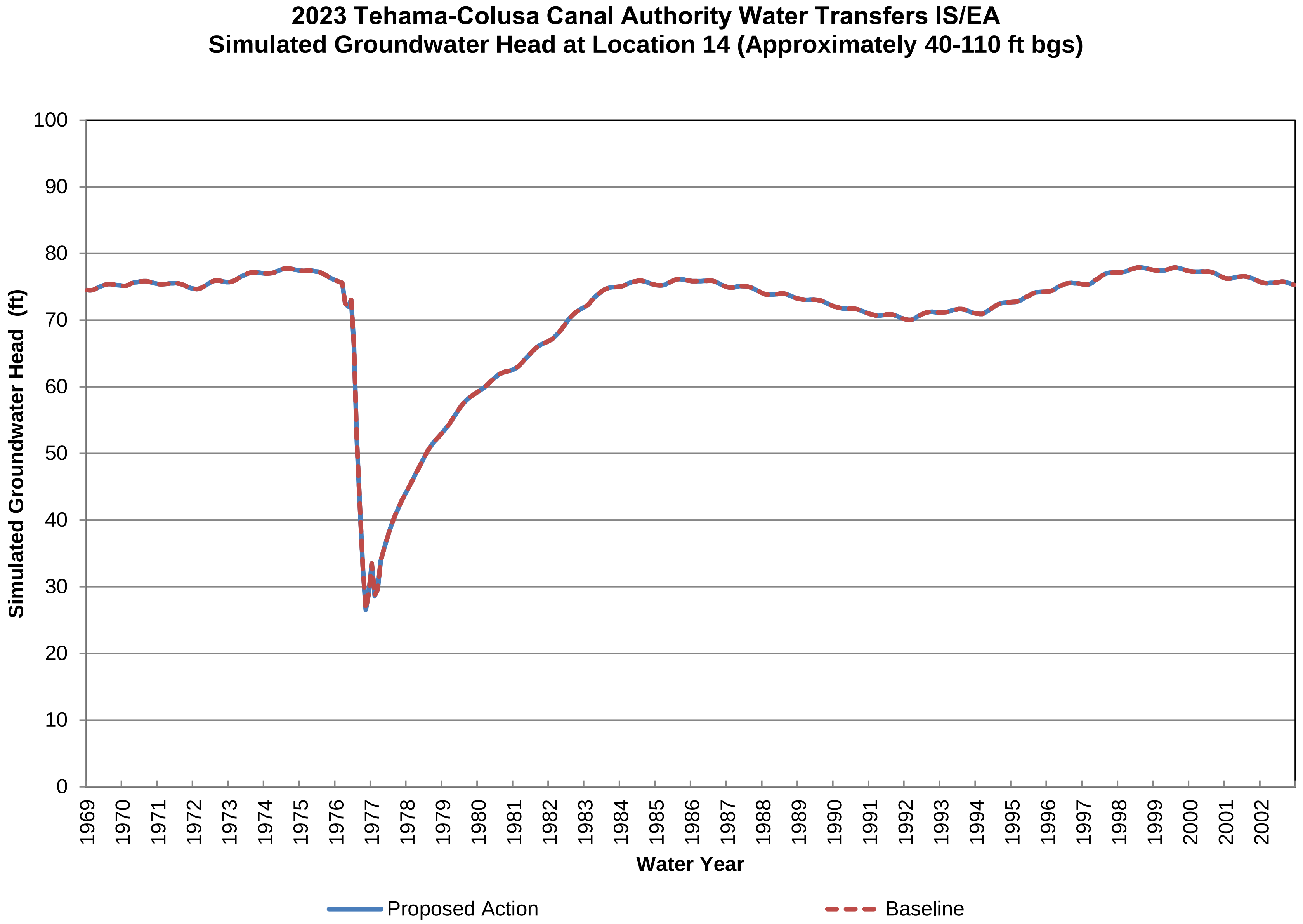
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 14 (Approximately 40-110 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
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1991
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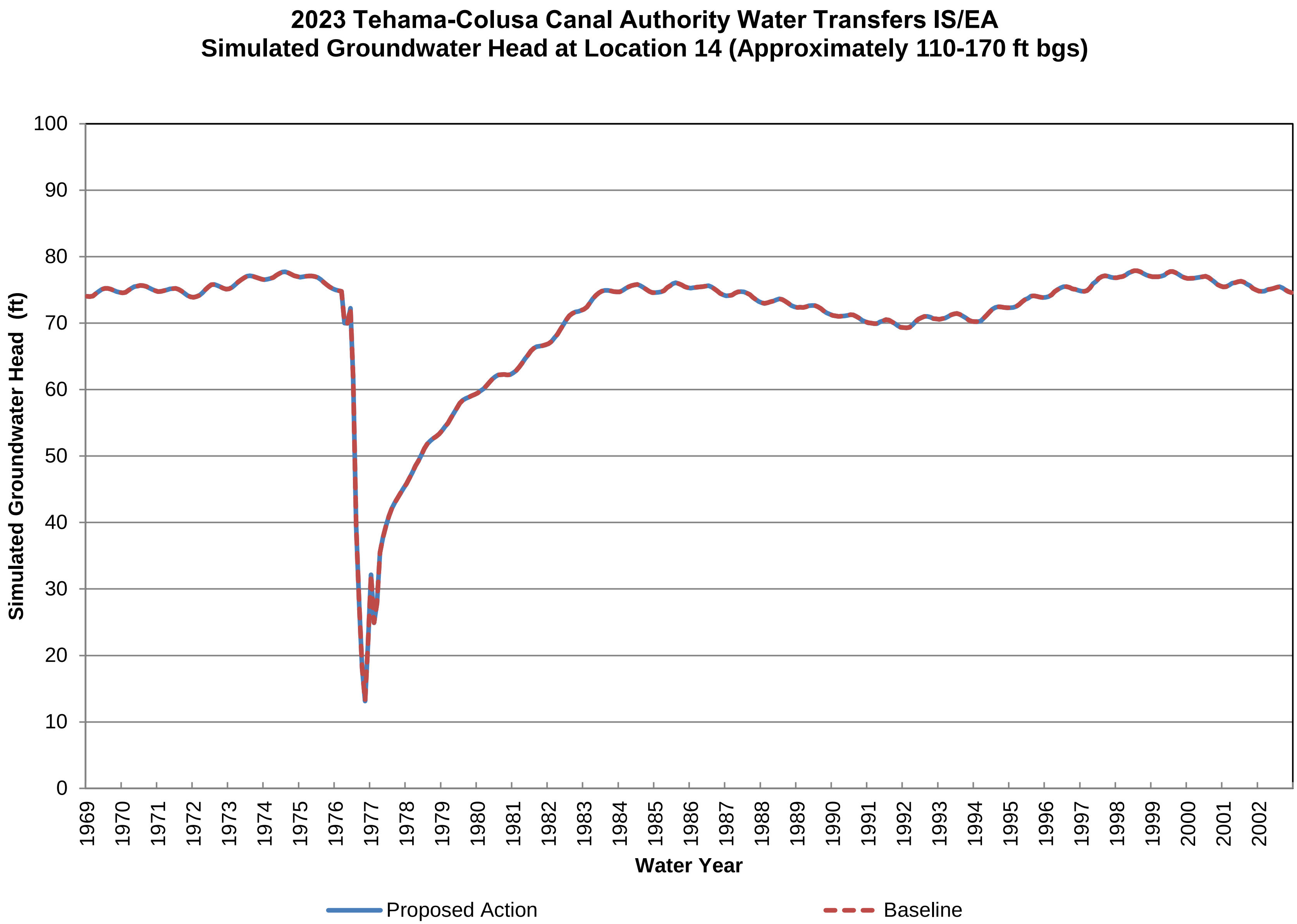
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 14 (Approximately 110-170 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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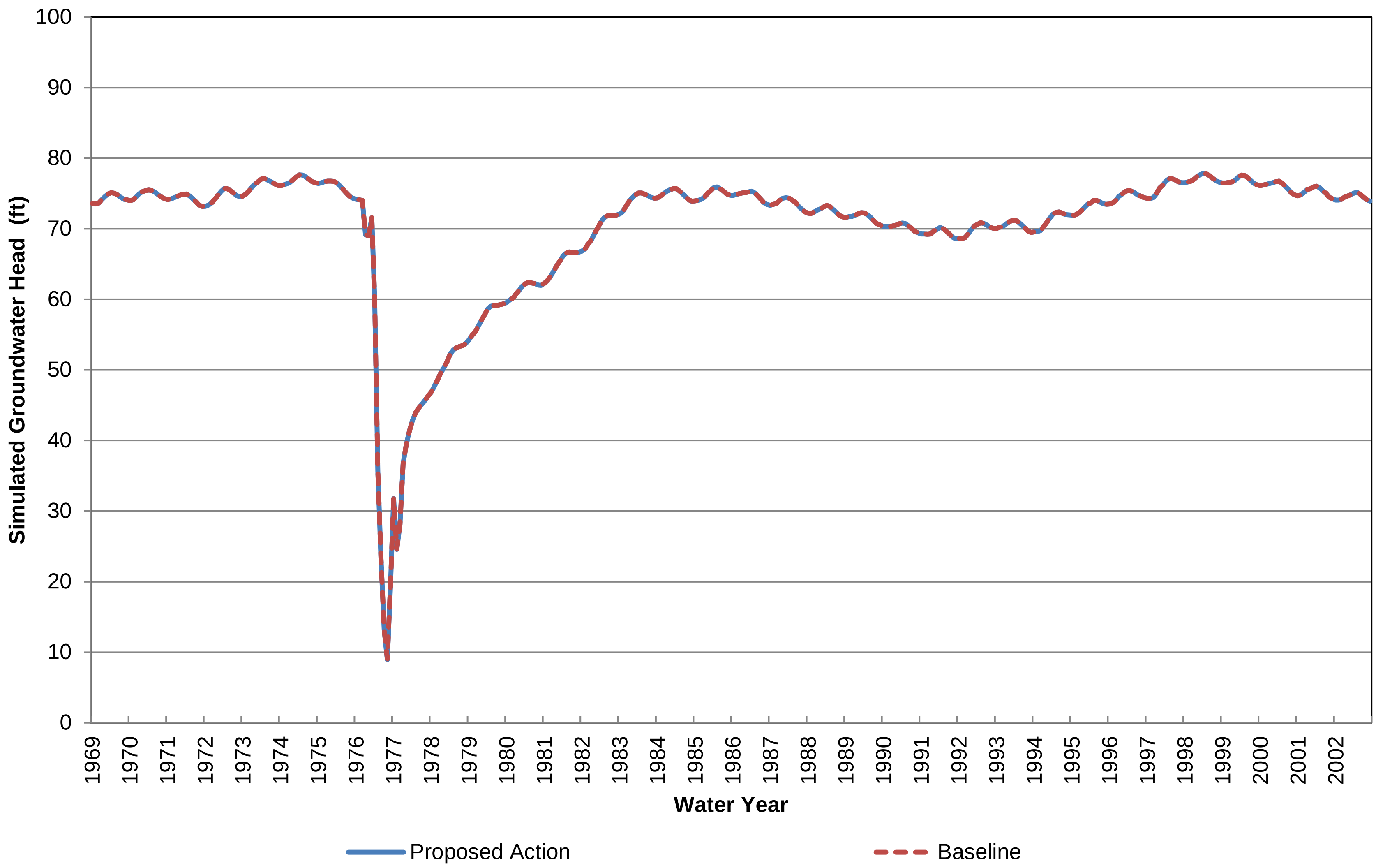
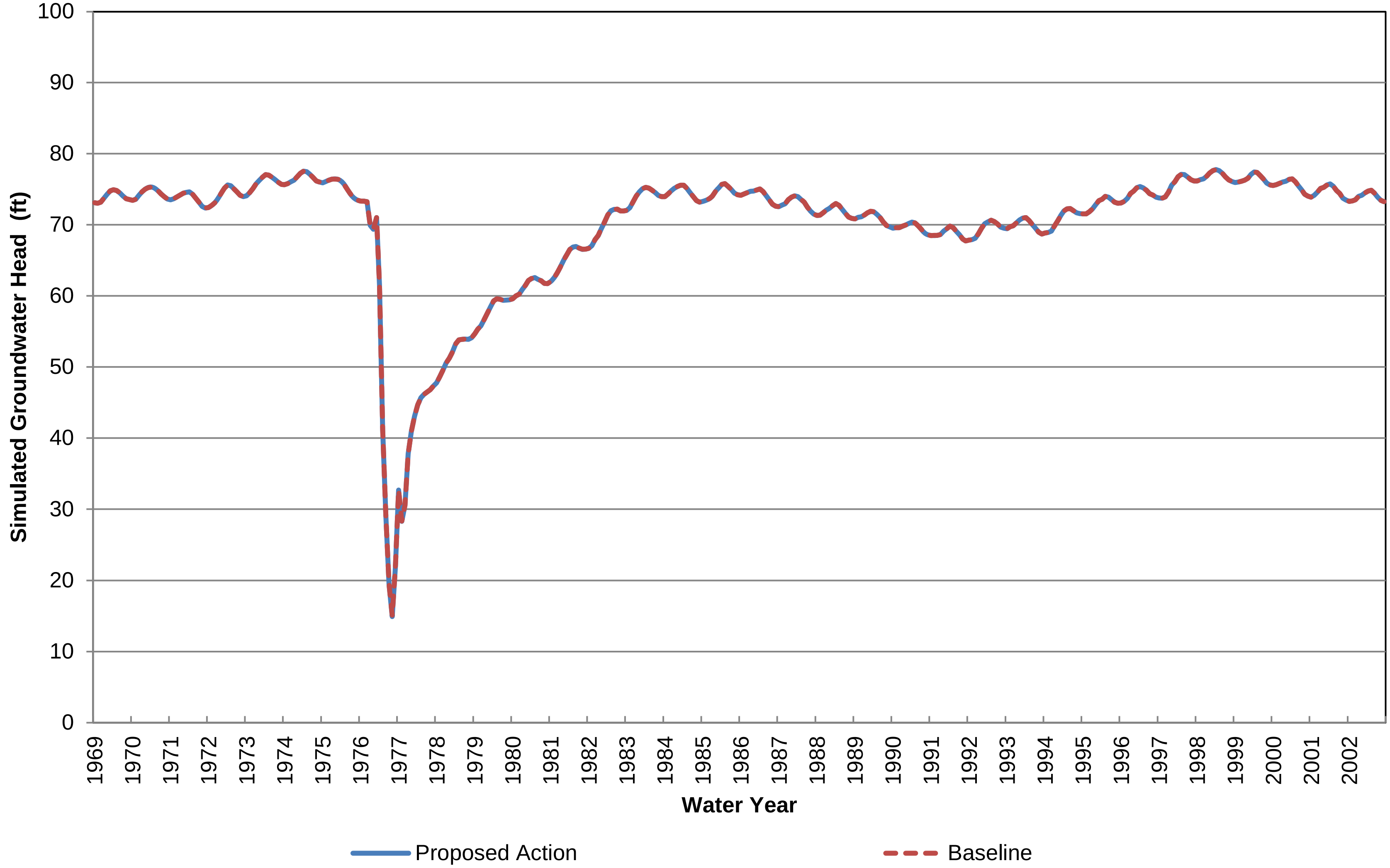
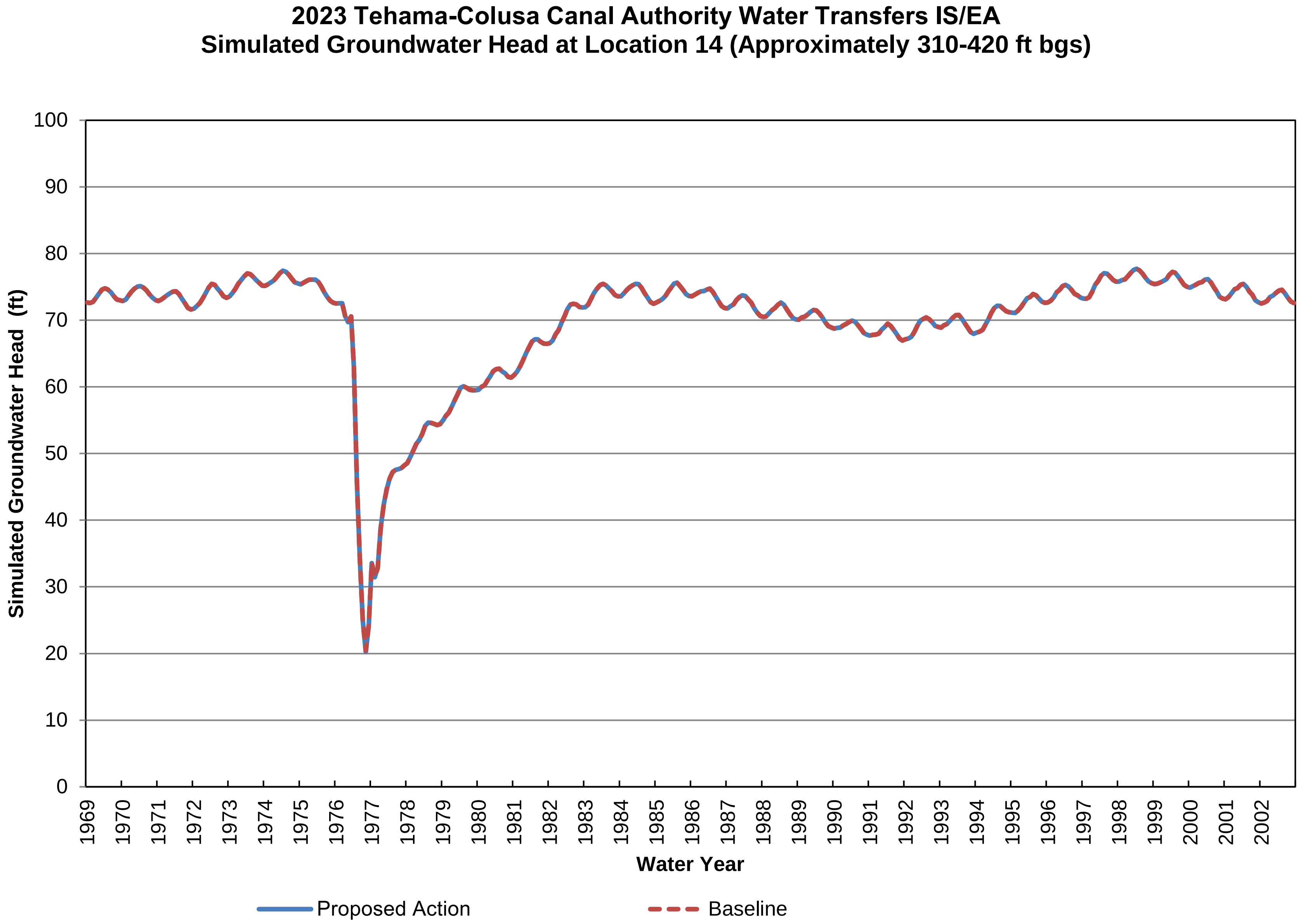
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 14 (Approximately 170-230 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 14 (Approximately 230-310 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 14 (Approximately 310-420 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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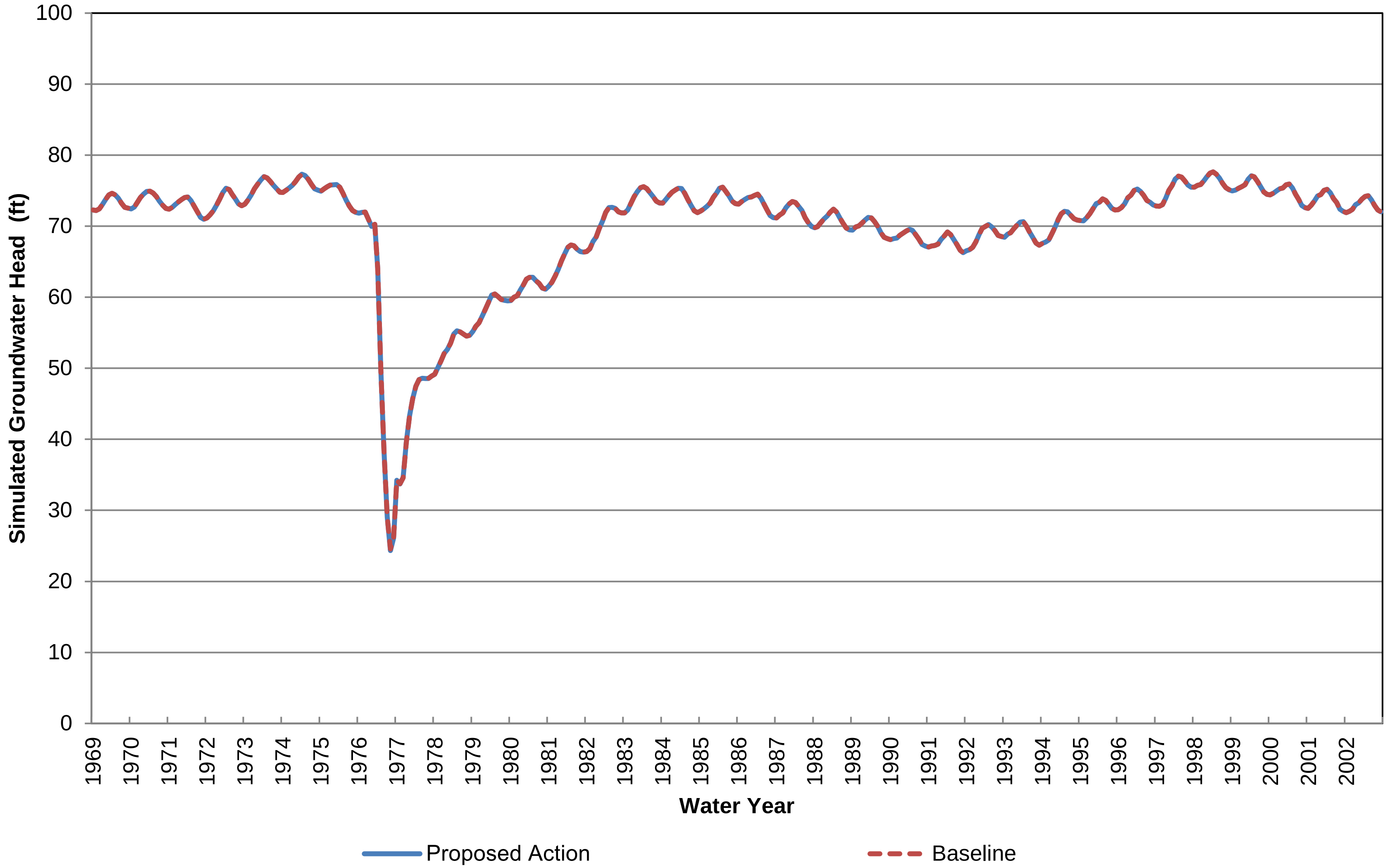
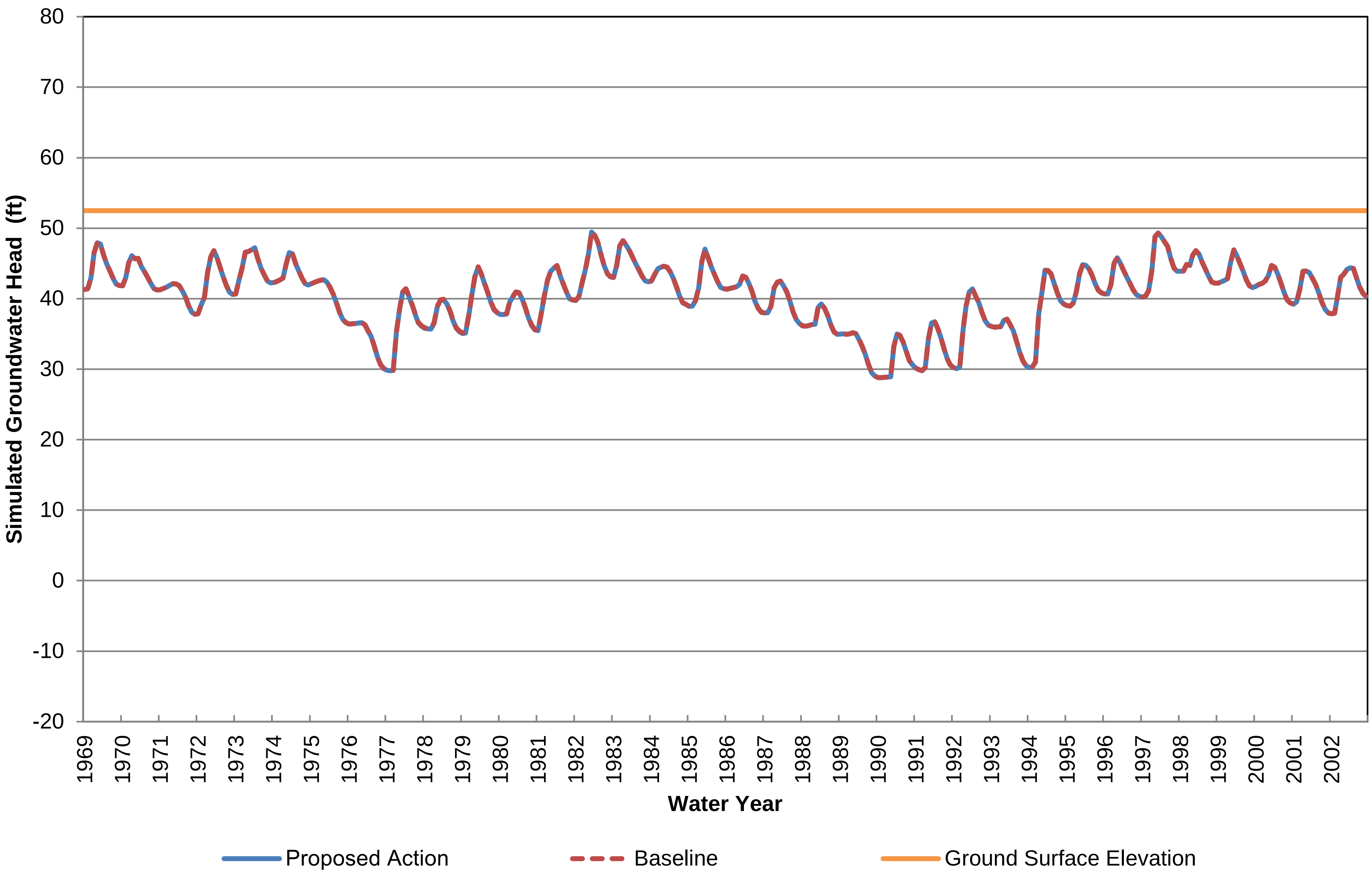
2001
2002
Water Year
Proposed Action
Baseline

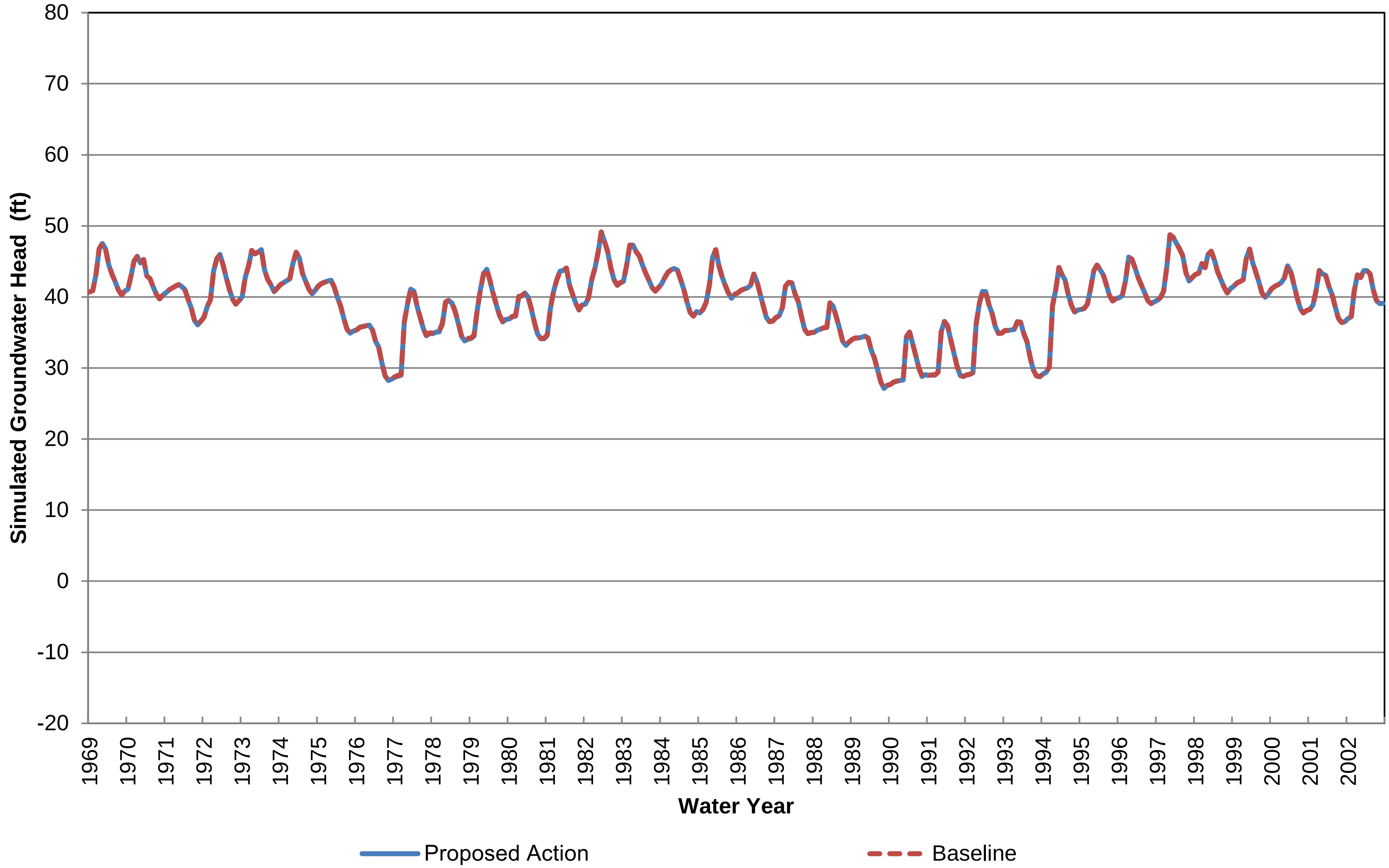
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 14 (Approximately 420-570 ft bgs)

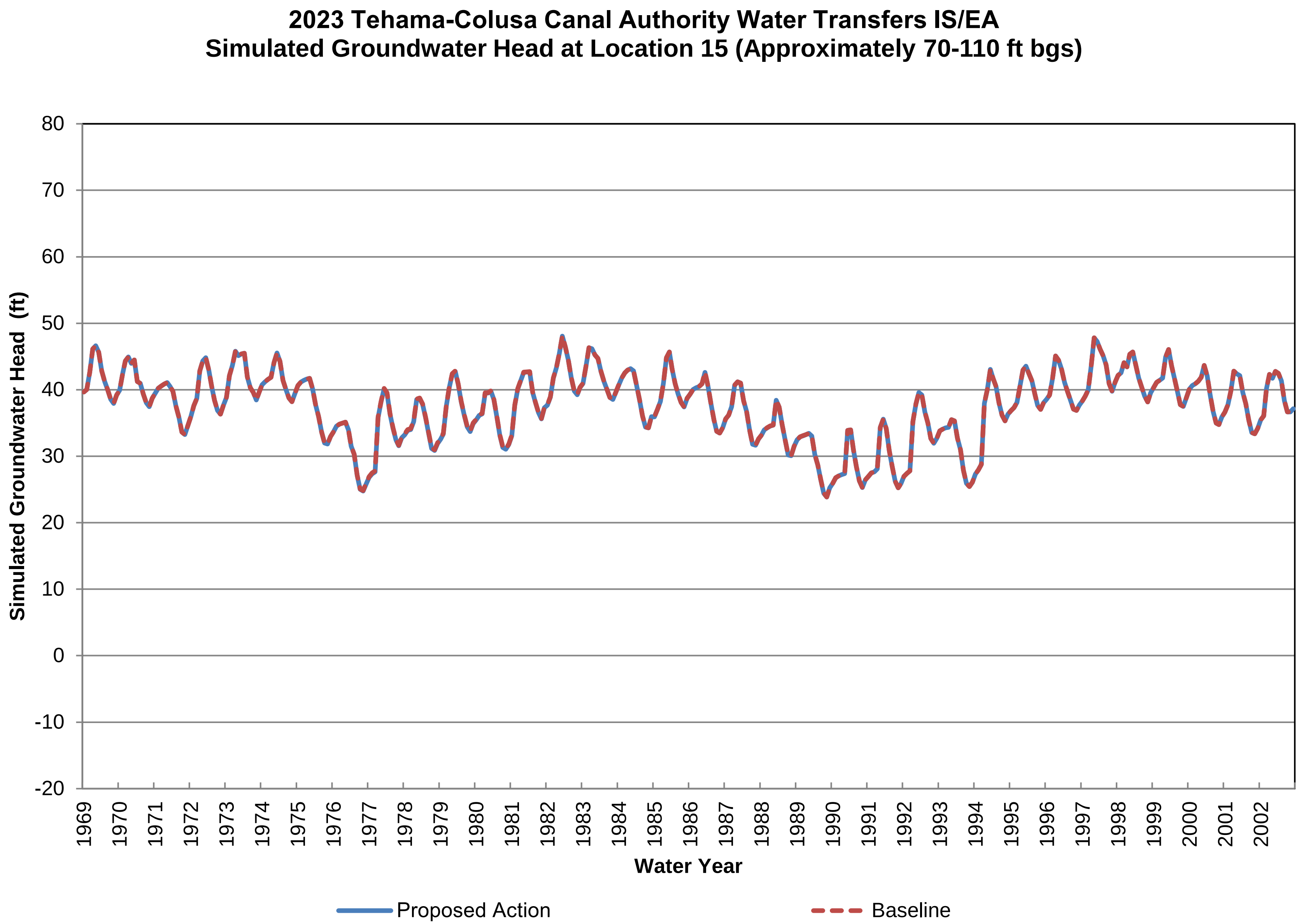


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 15 (Approximately 0-30 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 15 (Approximately 30-70 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 15 (Approximately 70-110 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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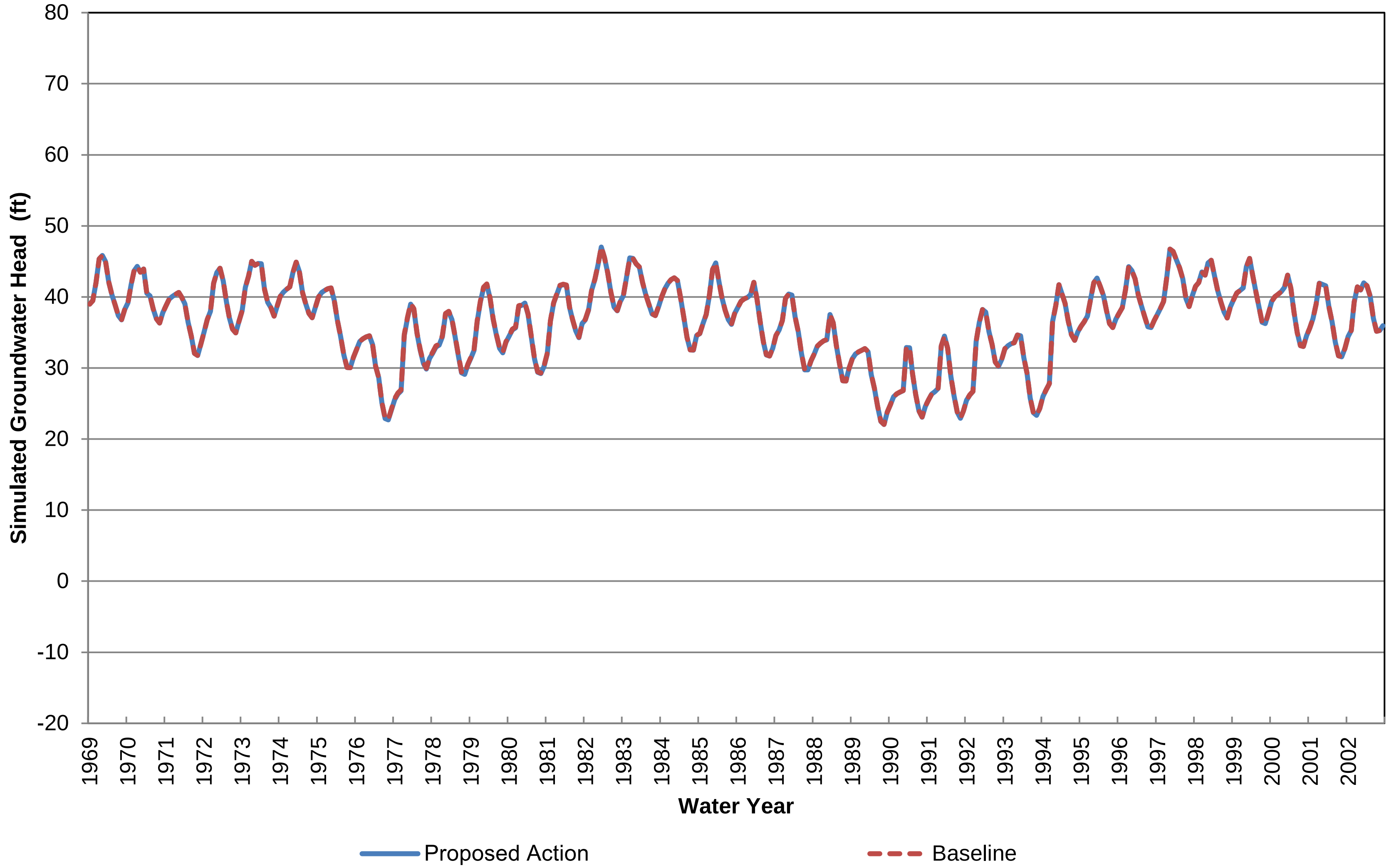
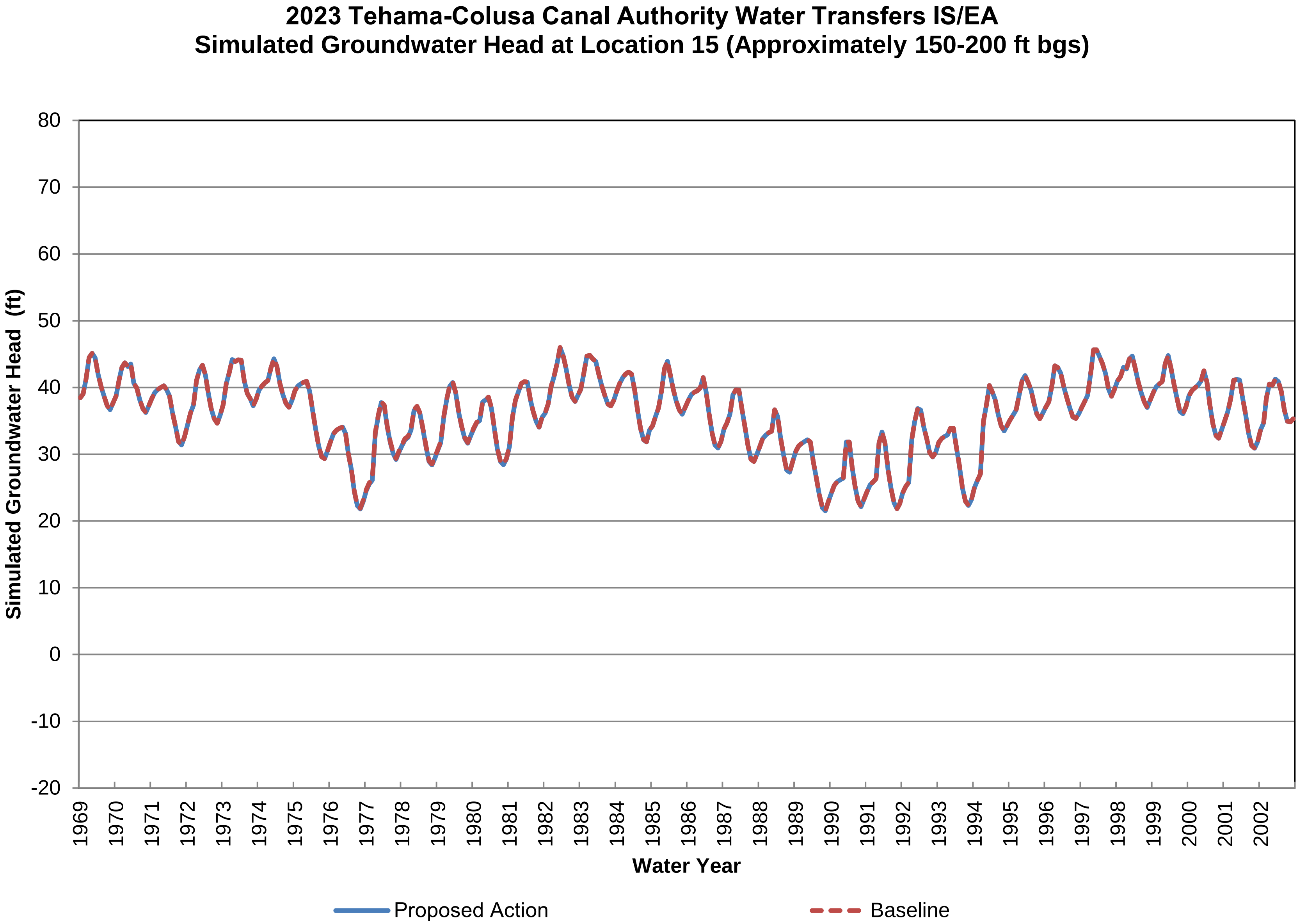
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 15 (Approximately 110-150 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 15 (Approximately 150-200 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
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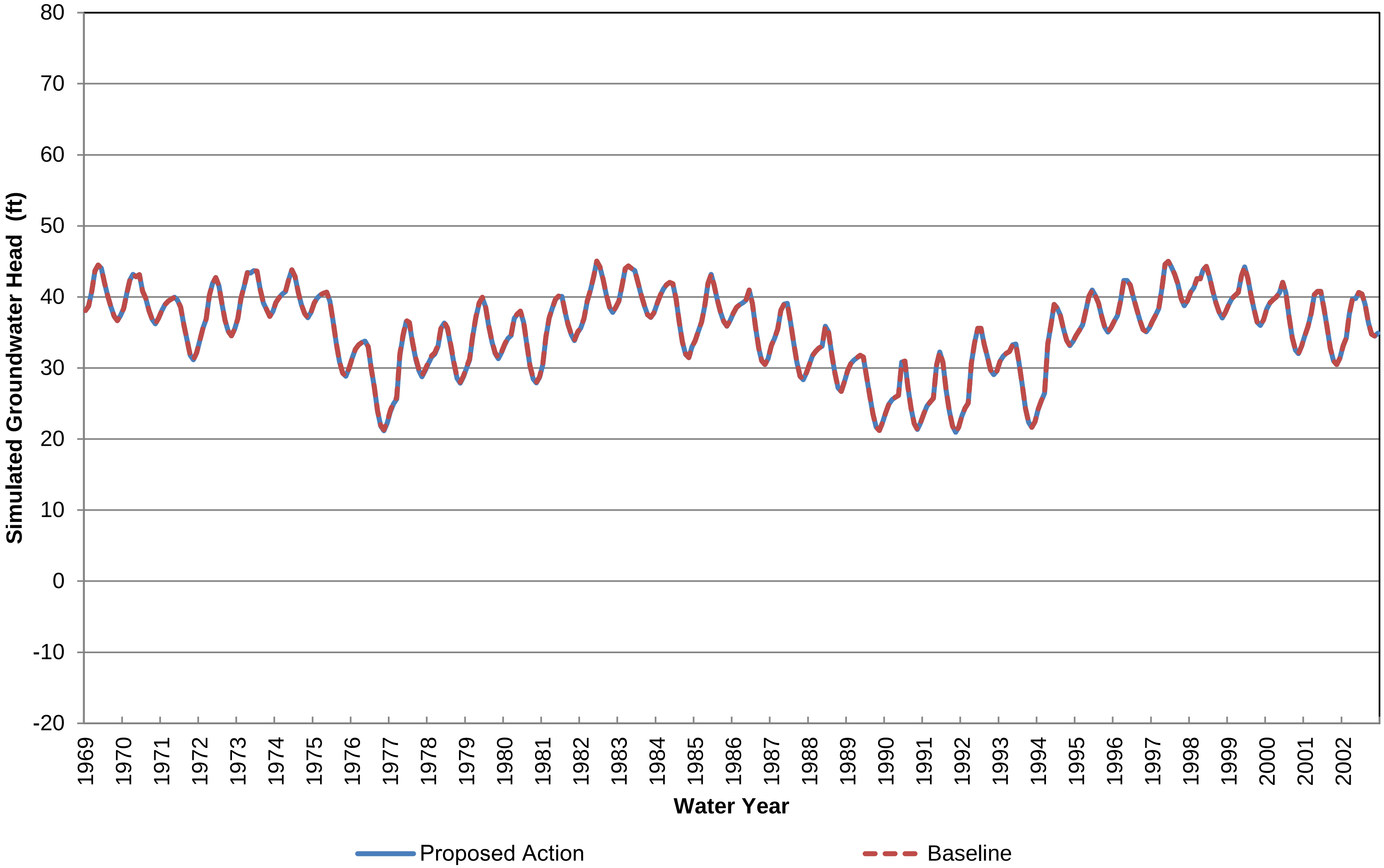
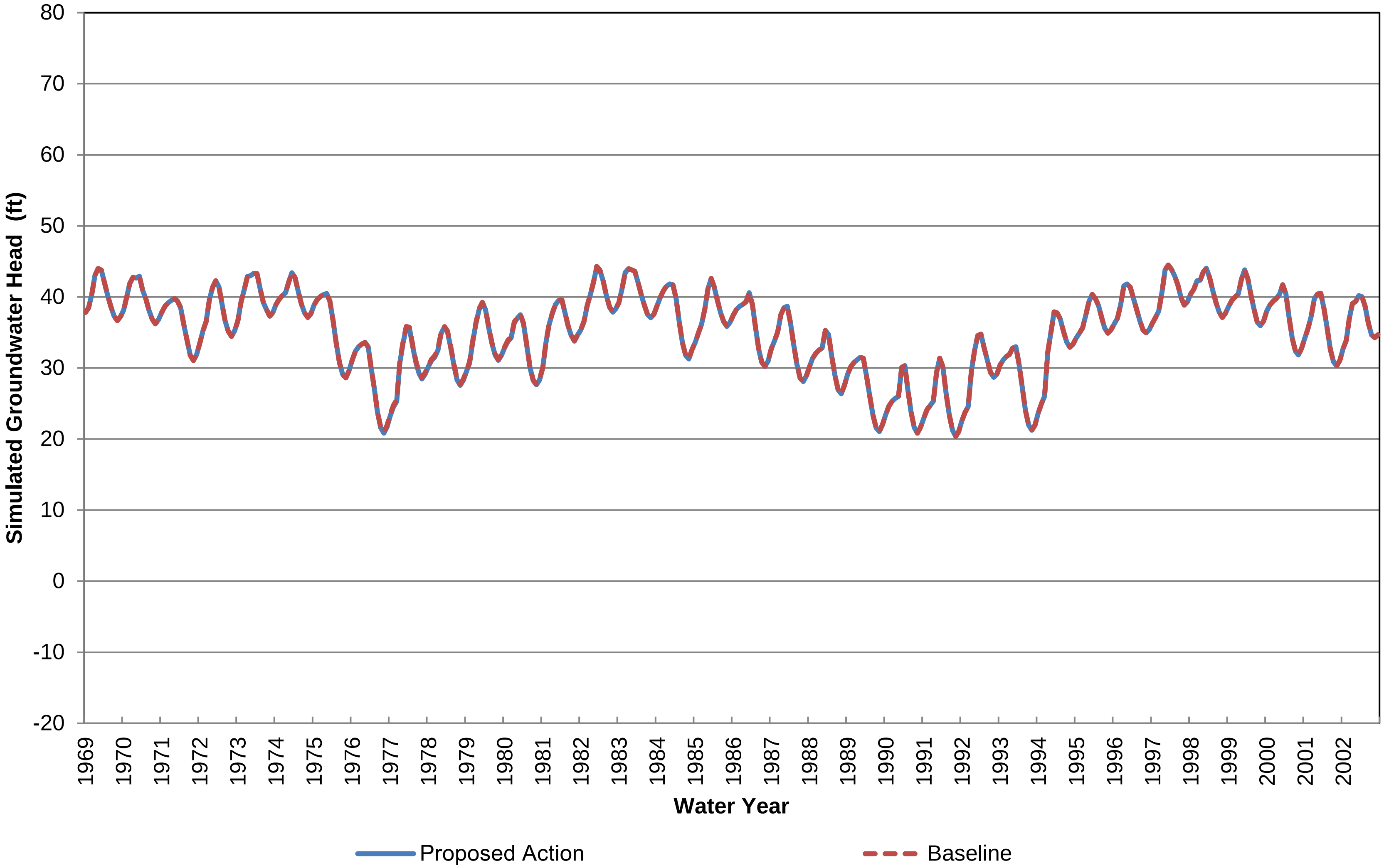
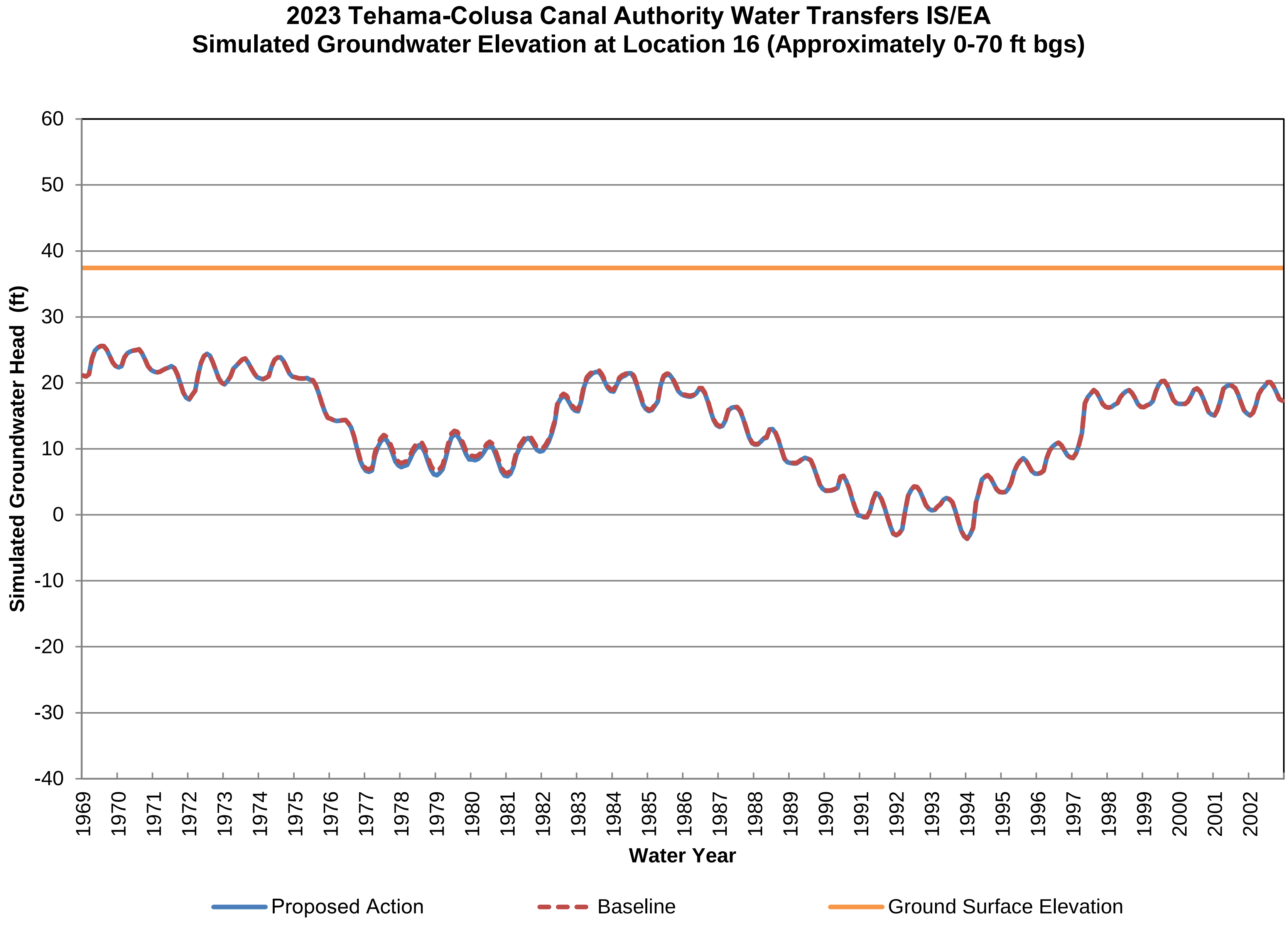
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 15 (Approximately 200-270 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 15 (Approximately 270-360 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 16 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
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1999
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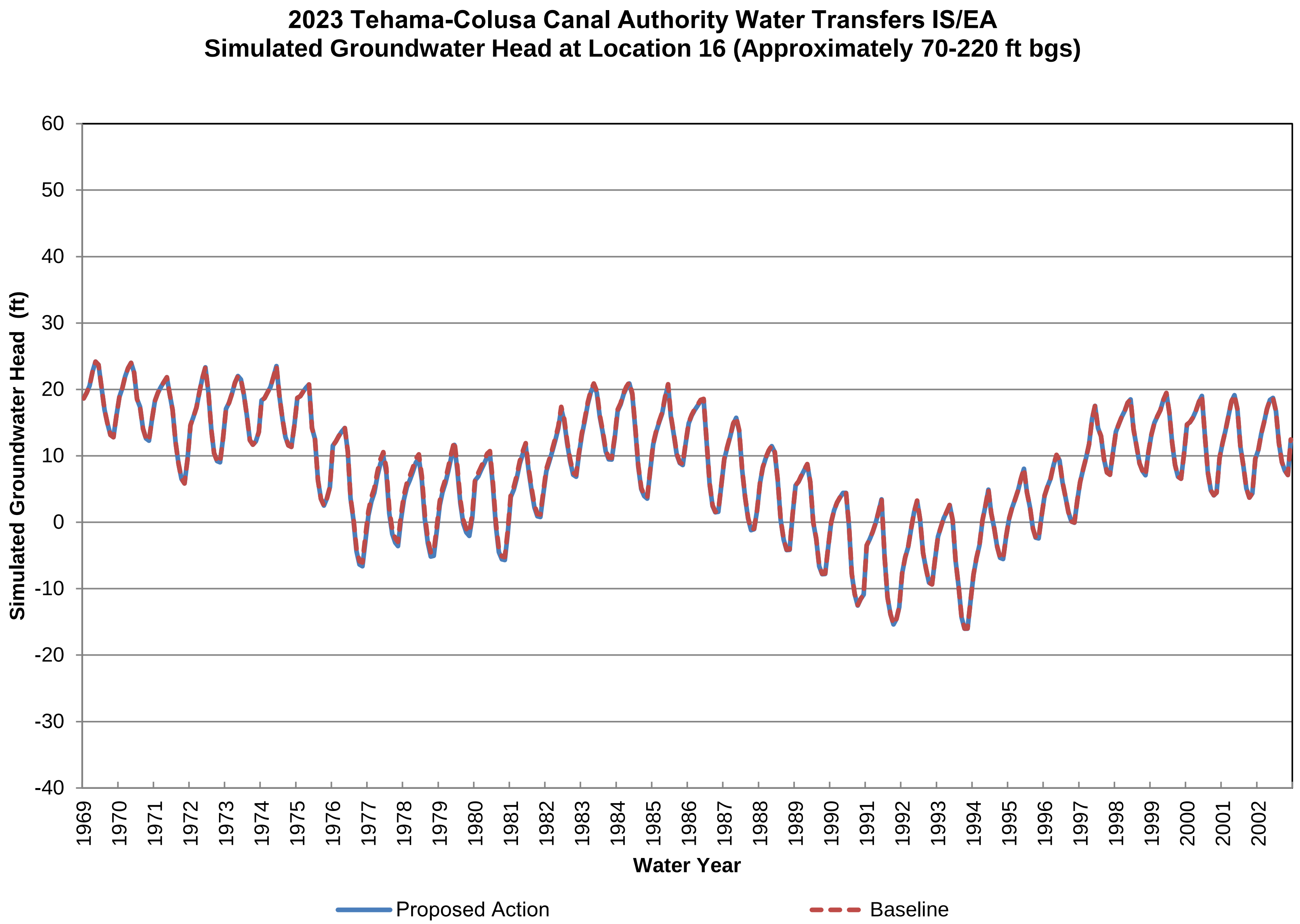
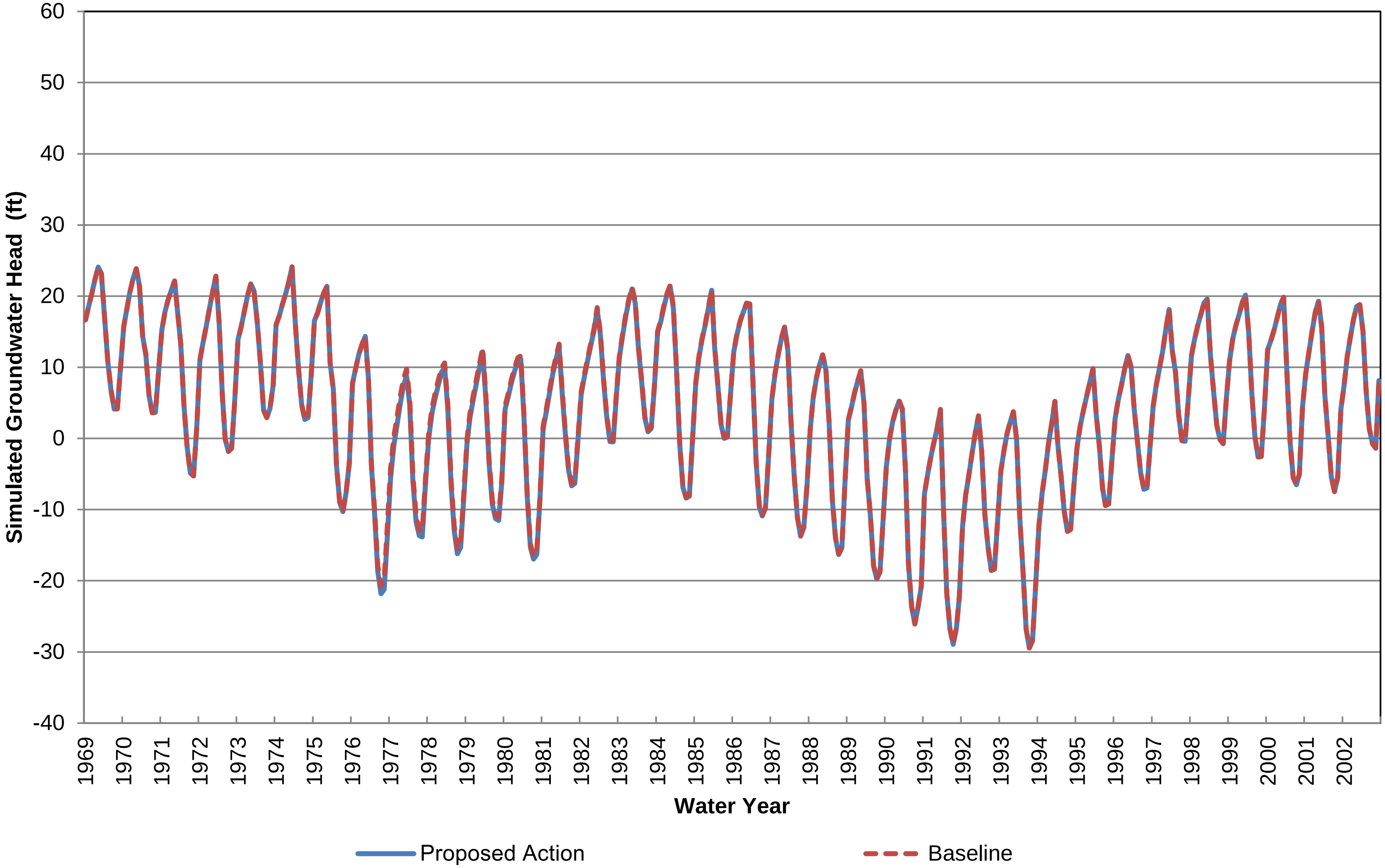
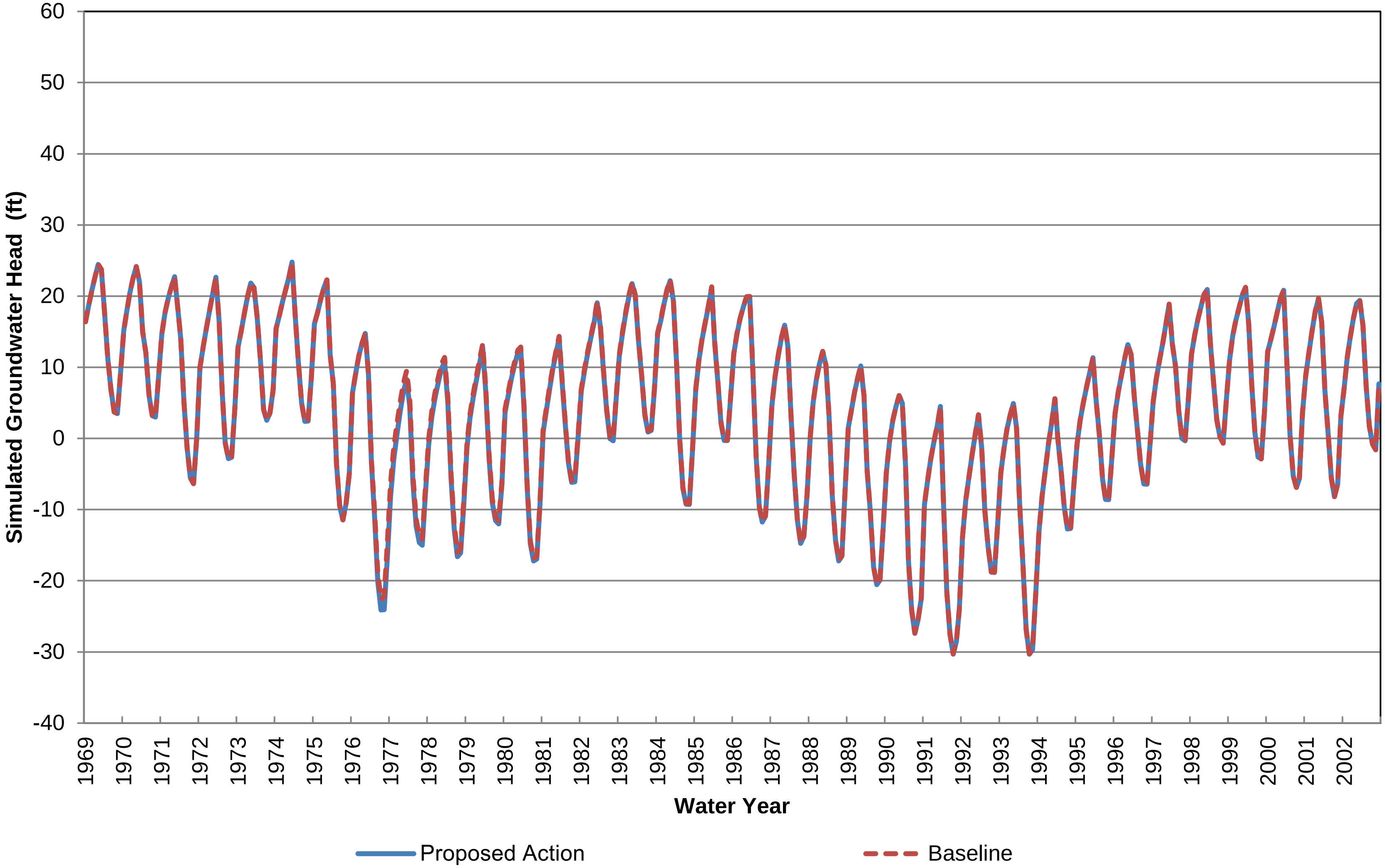
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 16 (Approximately 70-220 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

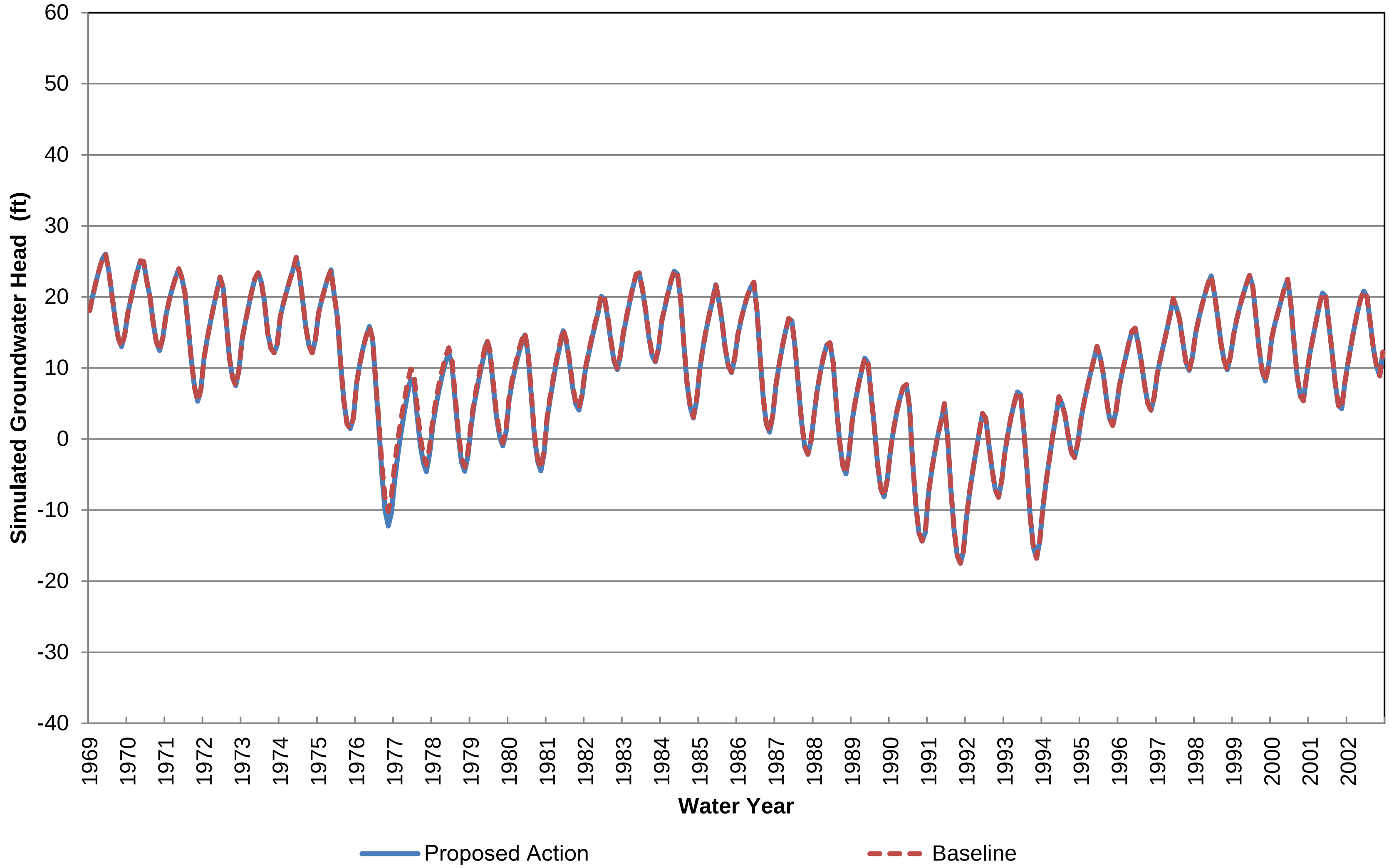
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 16 (Approximately 220-370 ft bgs)



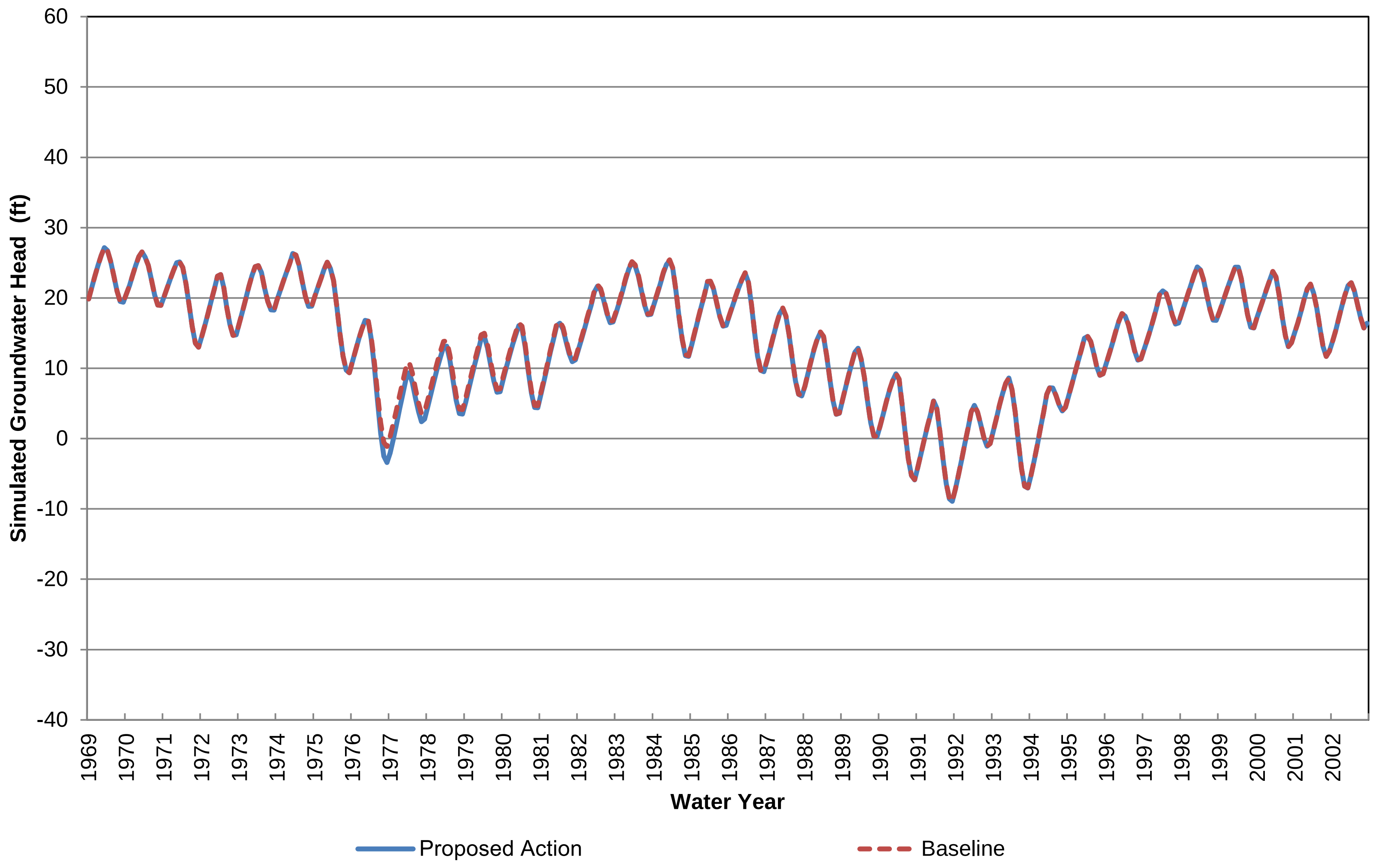
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 16 (Approximately 370-530 ft bgs)



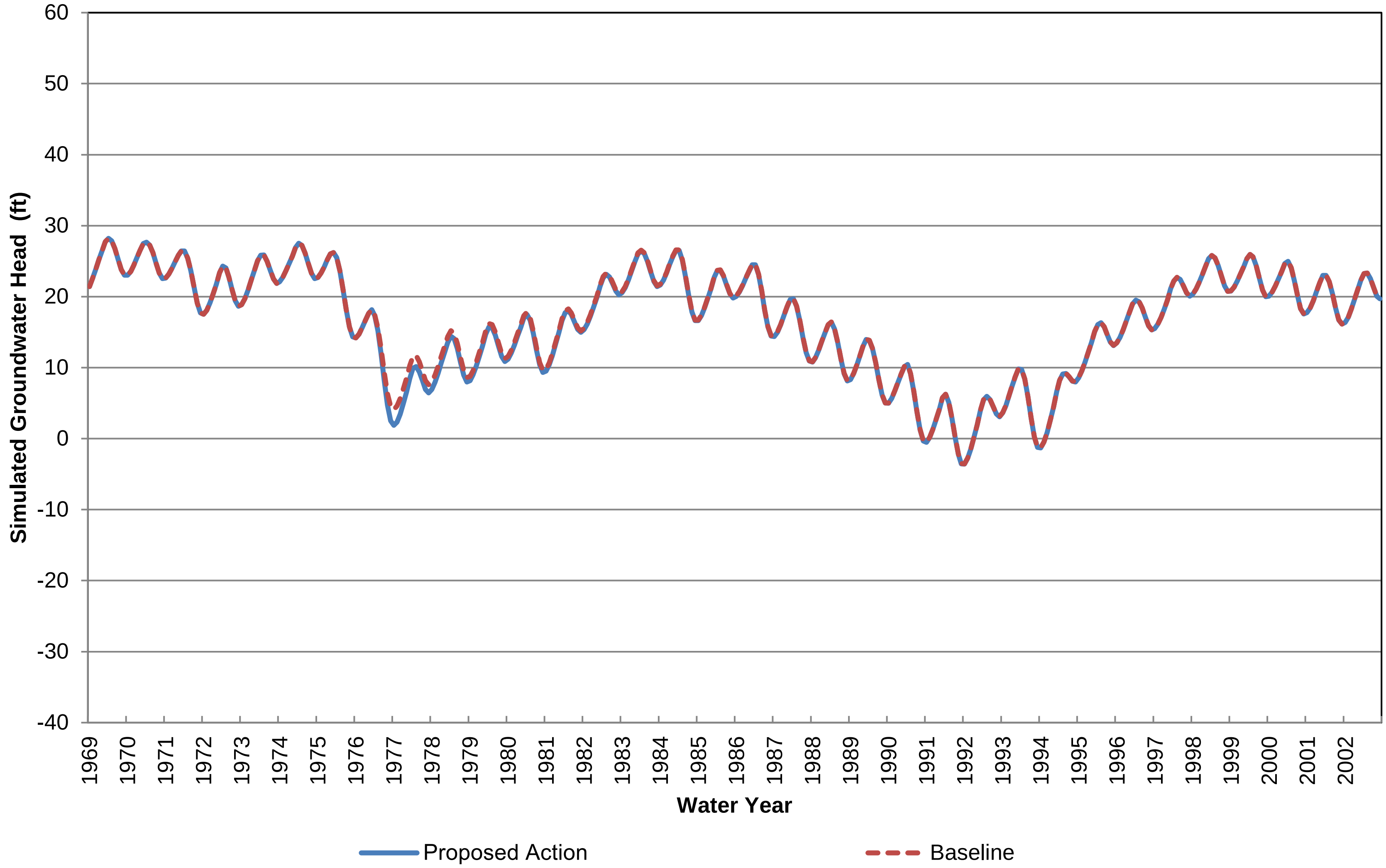
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 16 (Approximately 530-760 ft bgs)



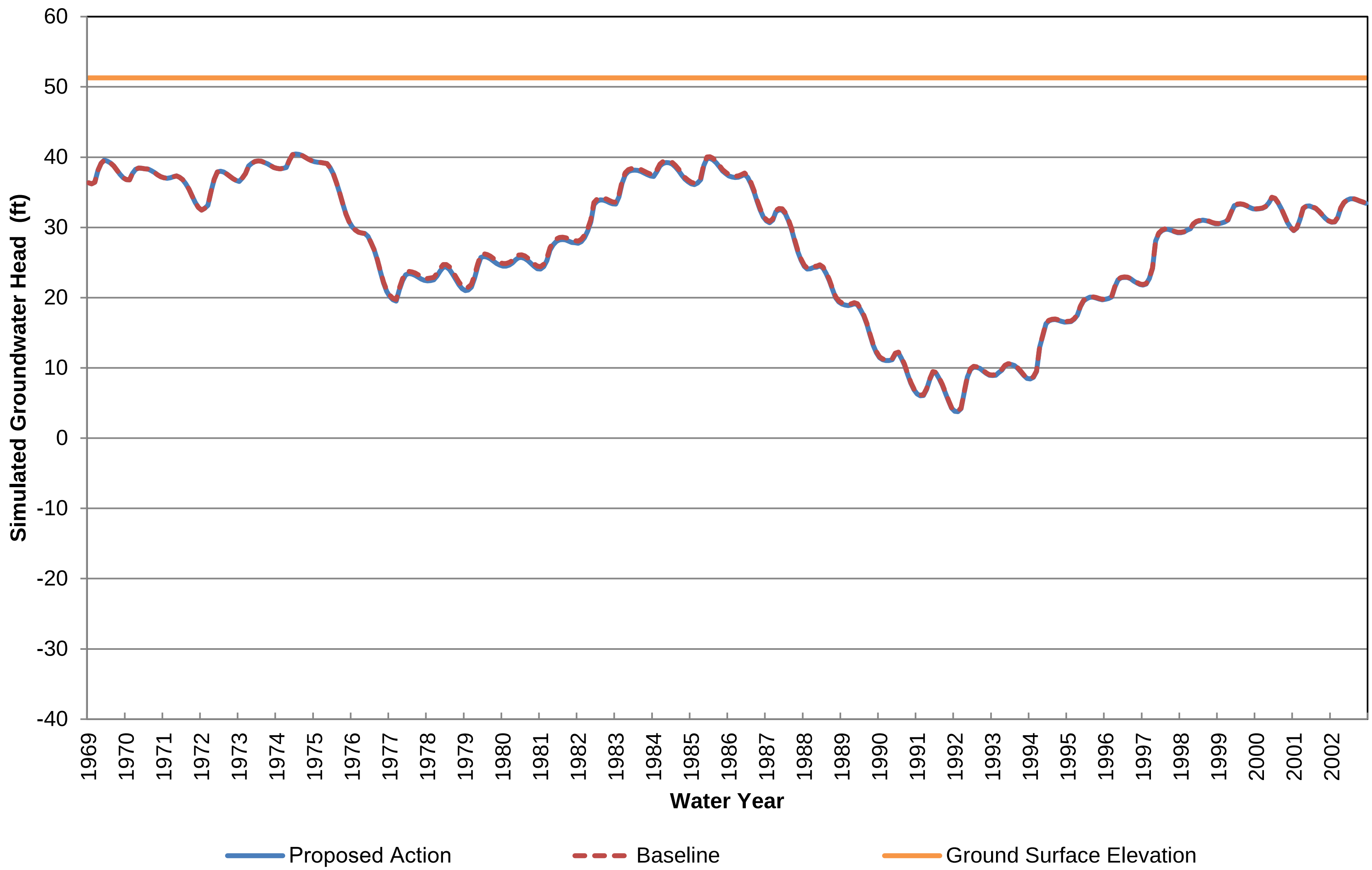
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 16 (Approximately 760-1020 ft bgs)

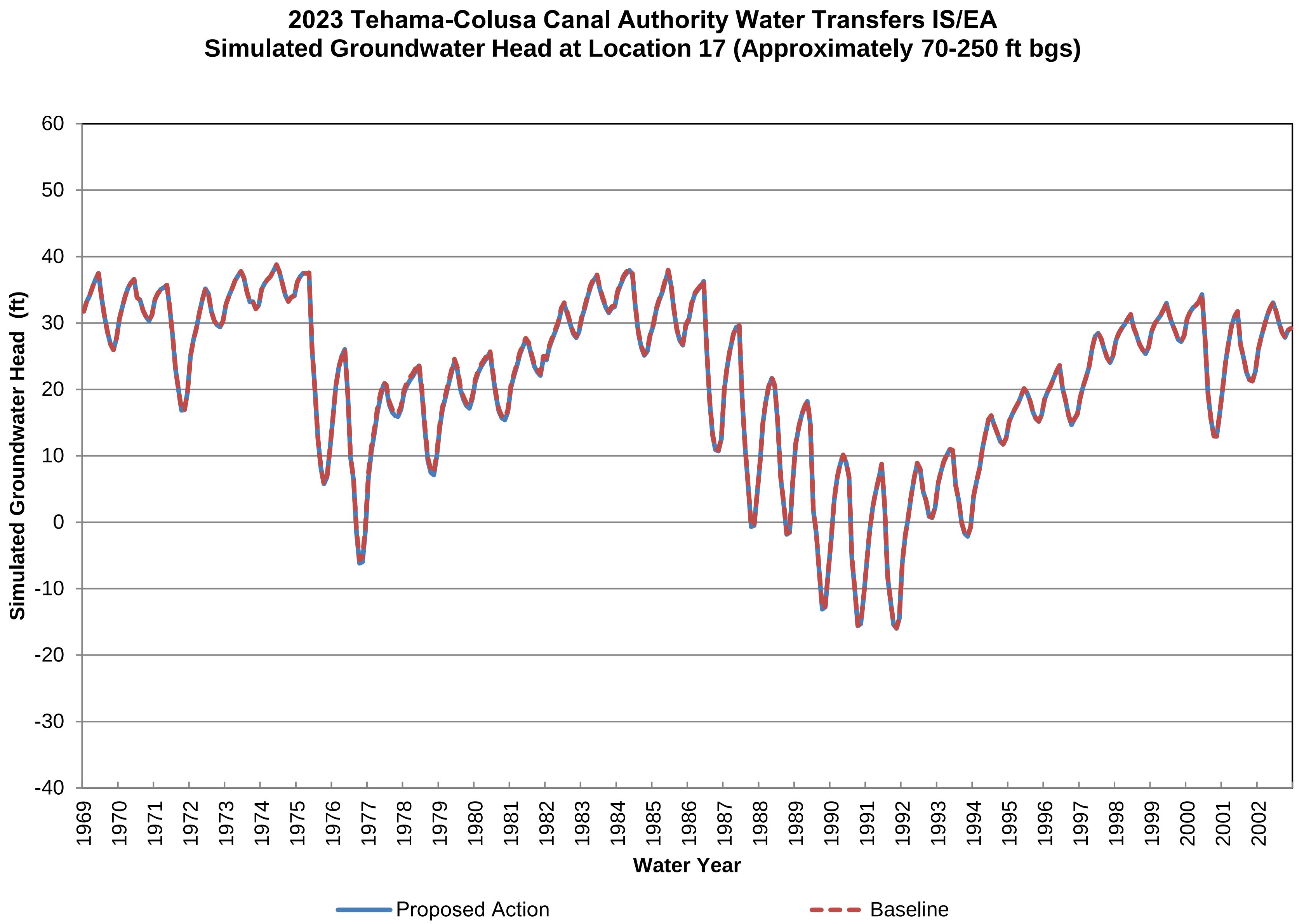


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 16 (Approximately 1020-1390 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 17 (Approximately 0-70 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 17 (Approximately 70-250 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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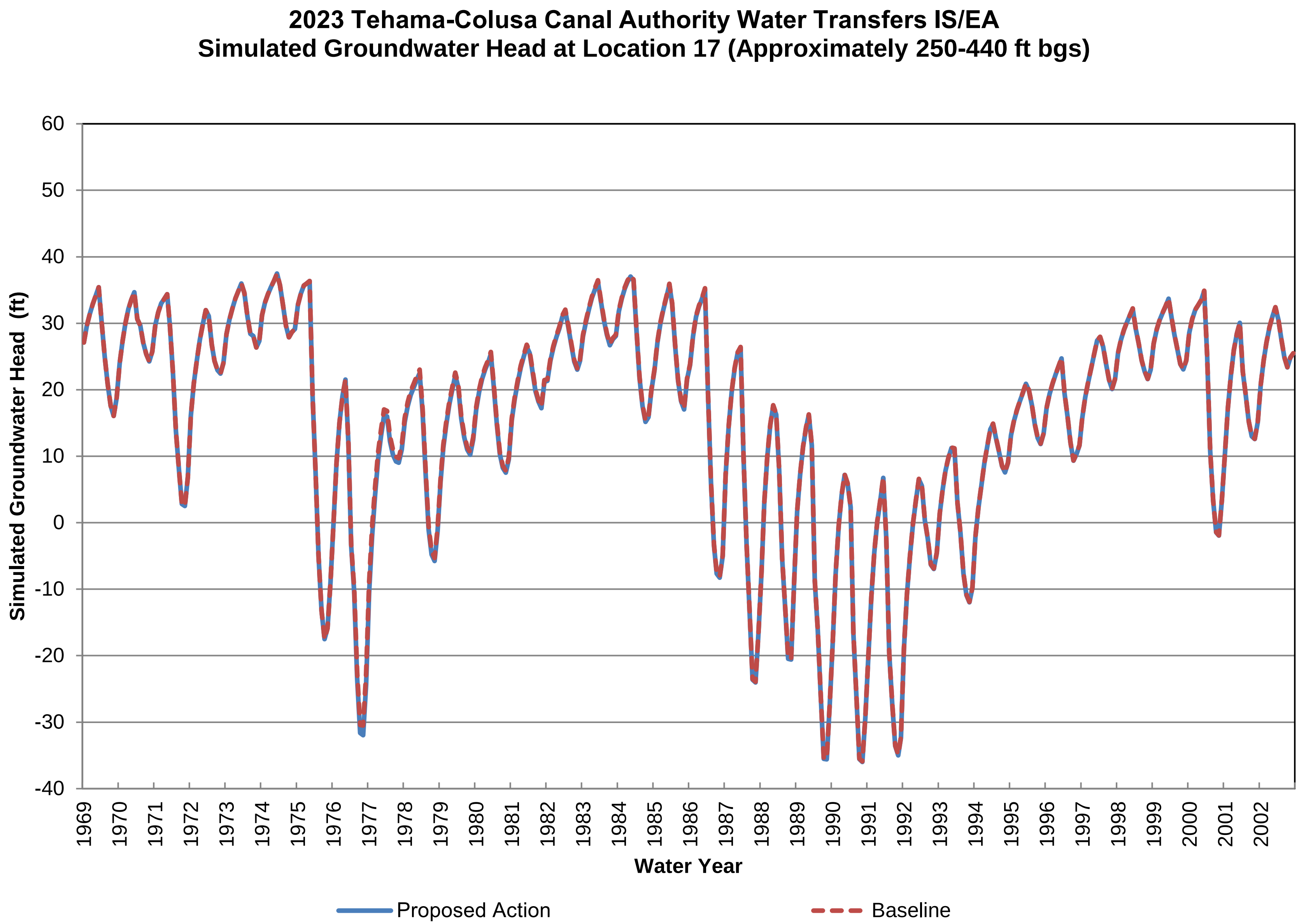
2001
2002
Water Year
Proposed Action
Baseline



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 17 (Approximately 250-440 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1998
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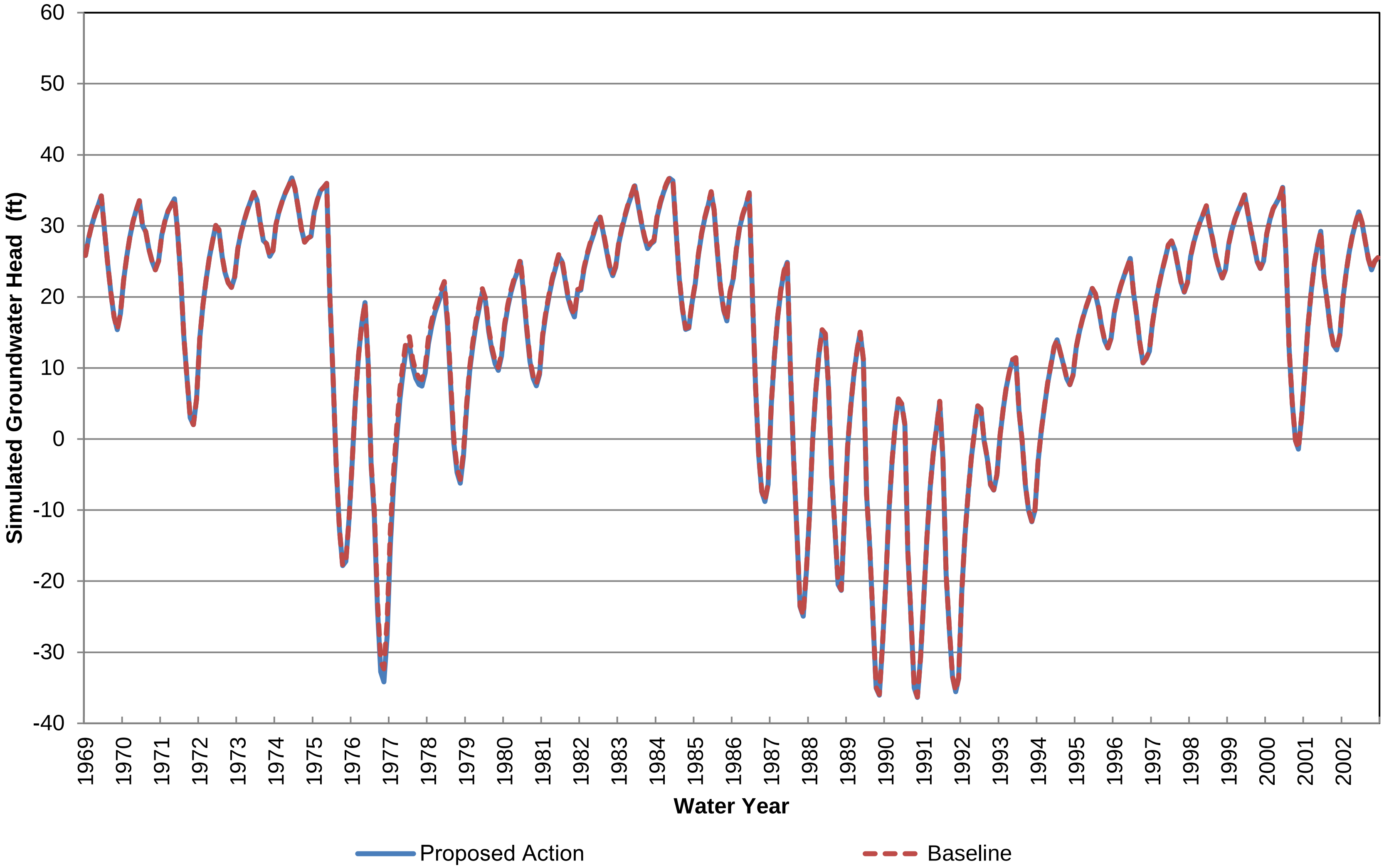
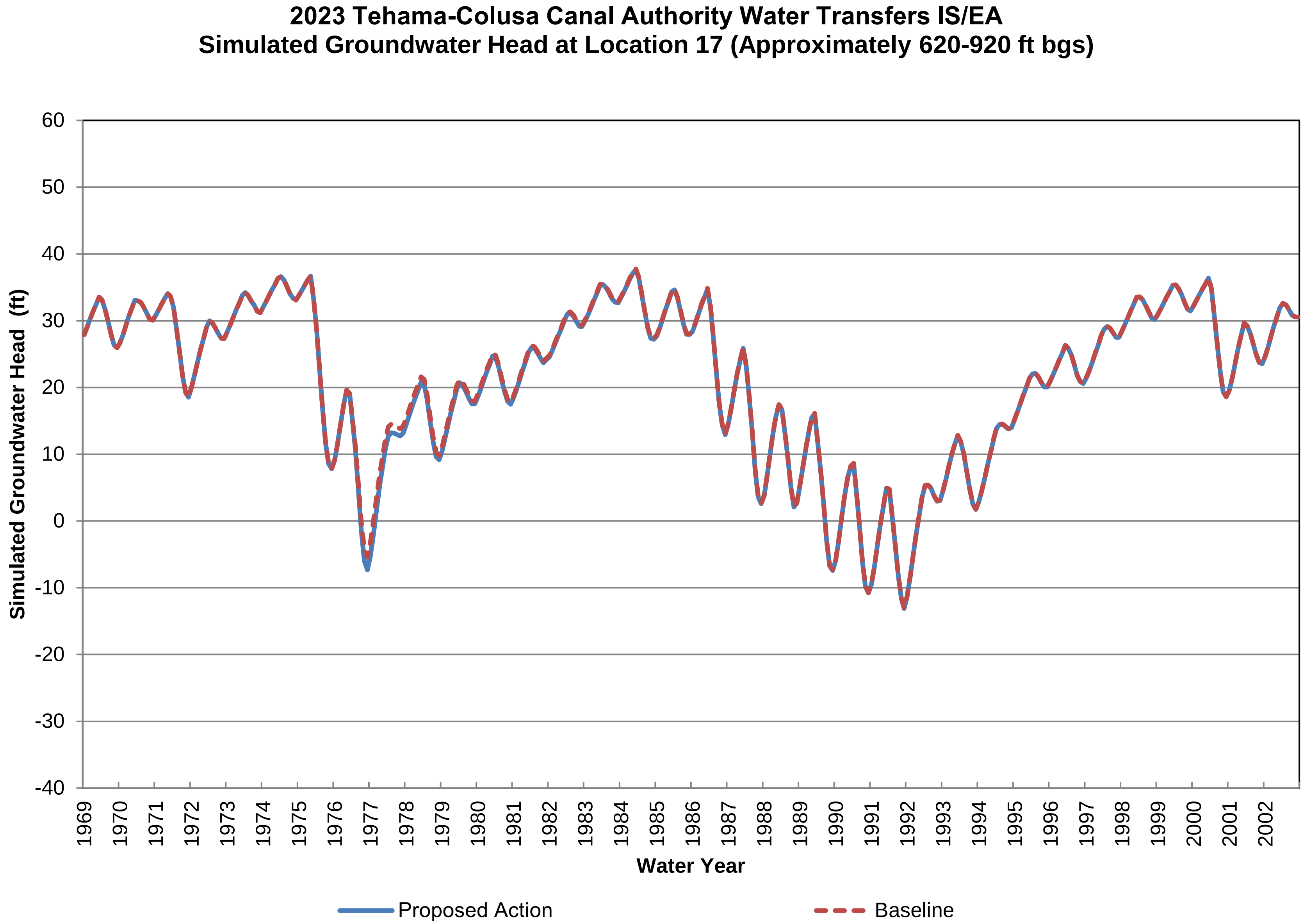
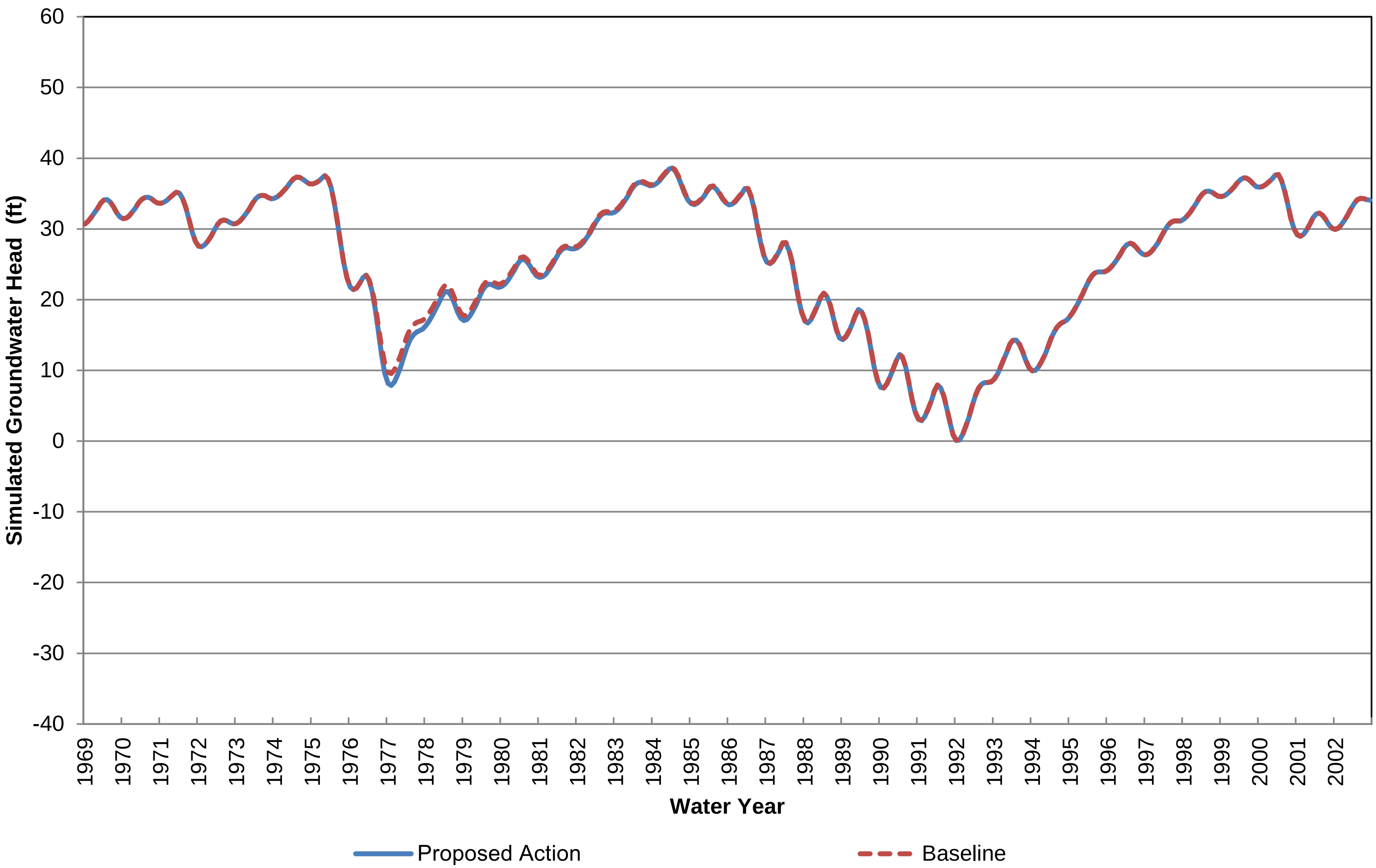
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 17 (Approximately 440-620 ft bgs)

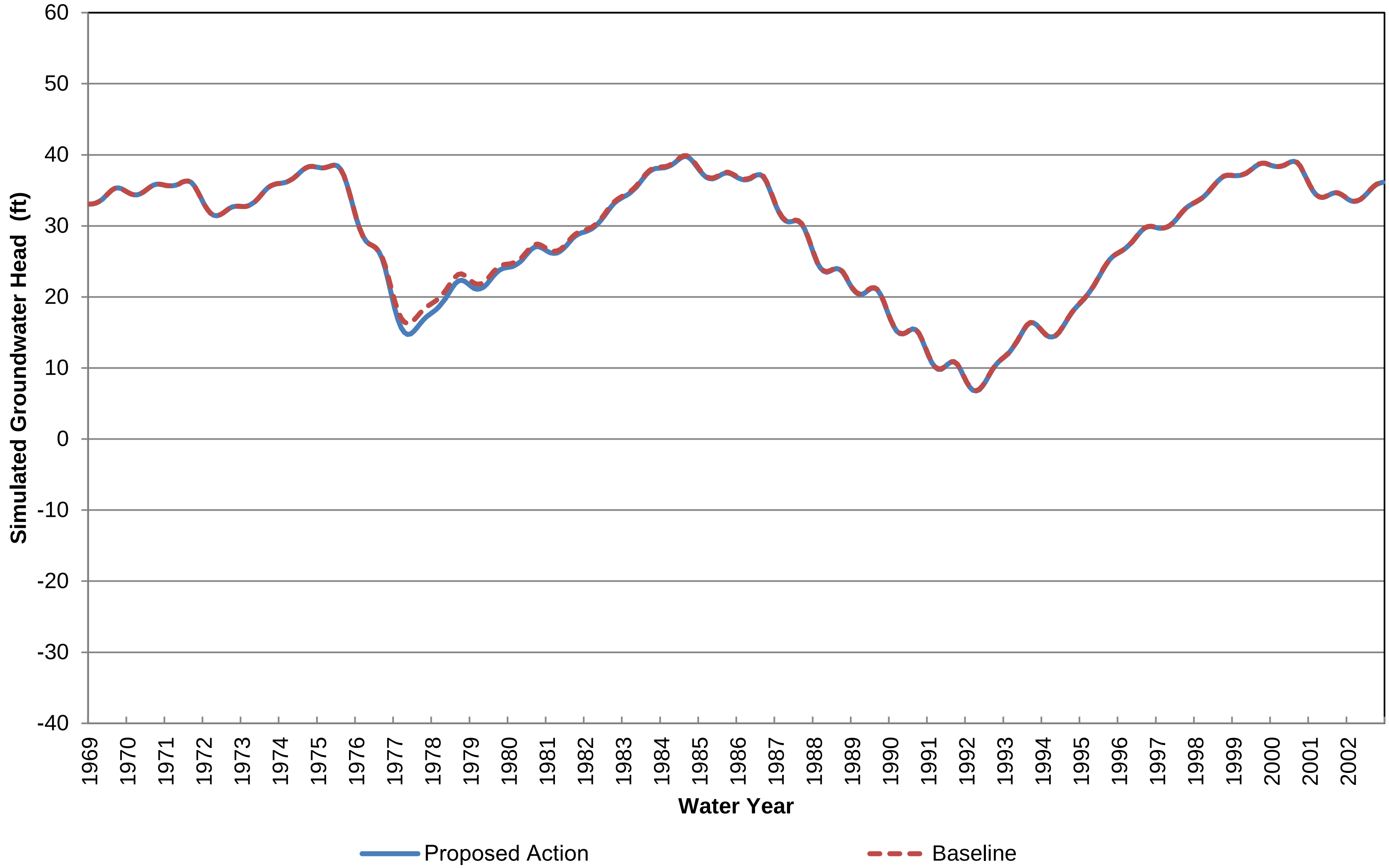



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 17 (Approximately 620-920 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

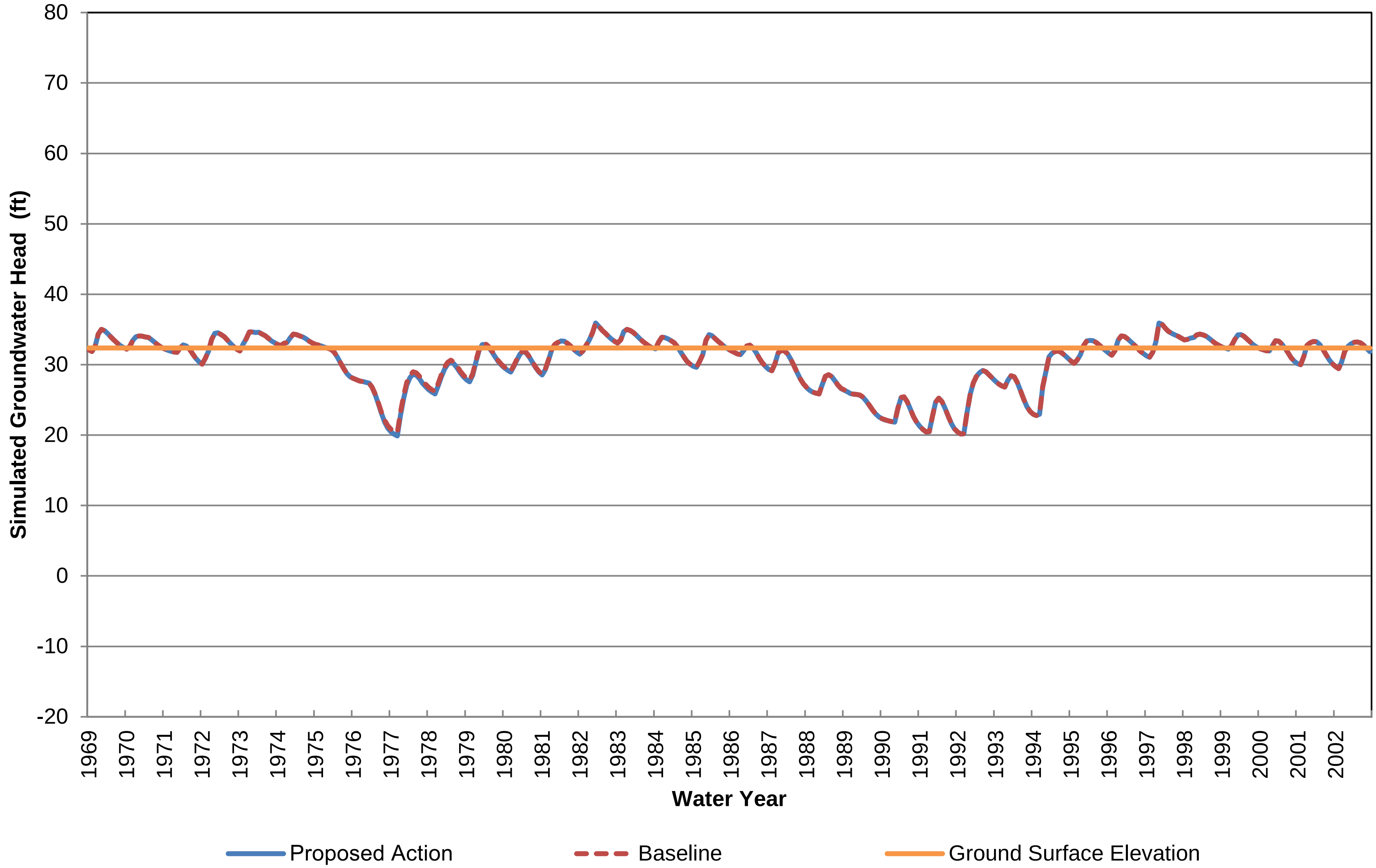
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 17 (Approximately 920-1220 ft bgs)

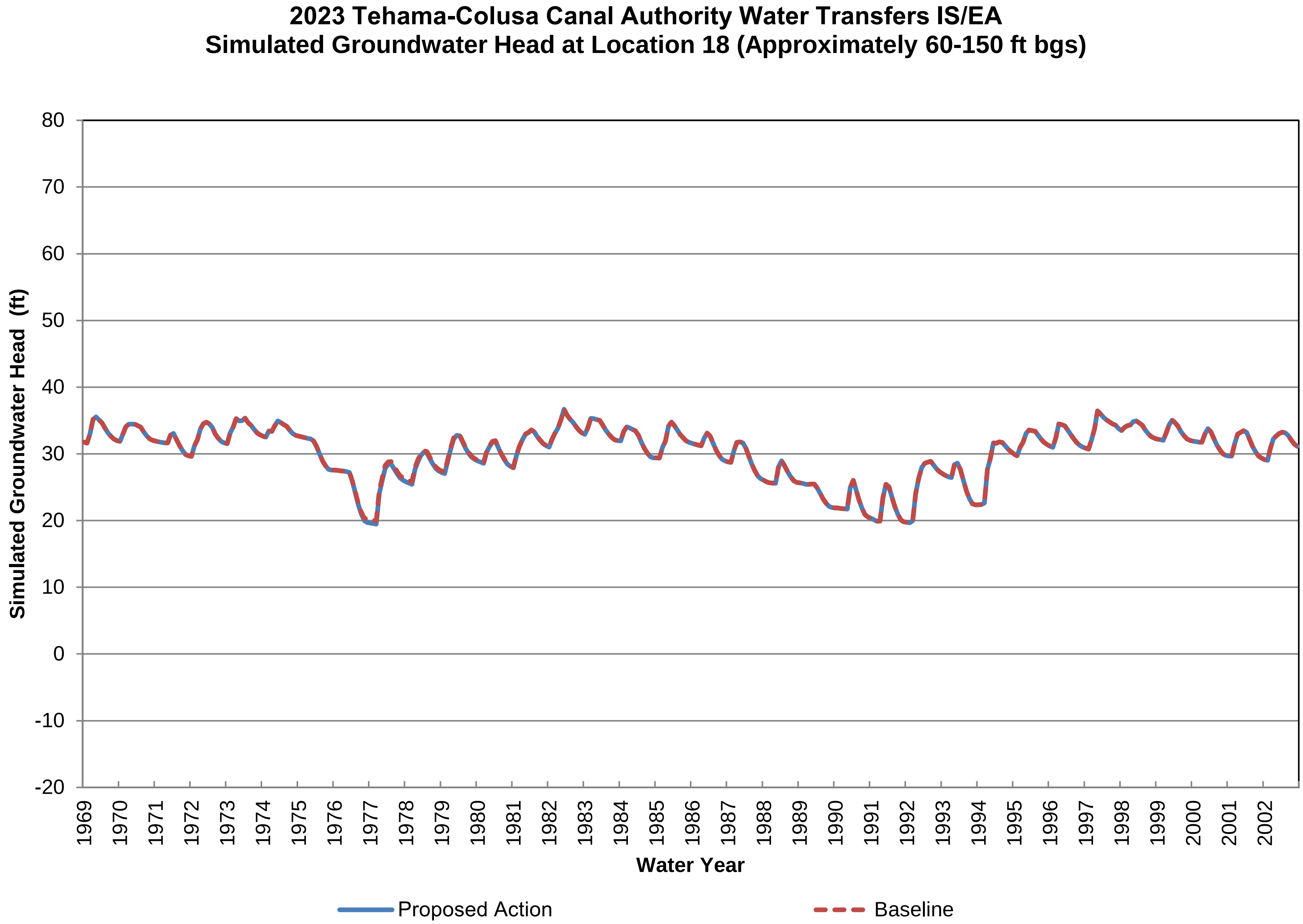


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 17 (Approximately 1220-1680 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 18 (Approximately 0-60 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 18 (Approximately 60-150 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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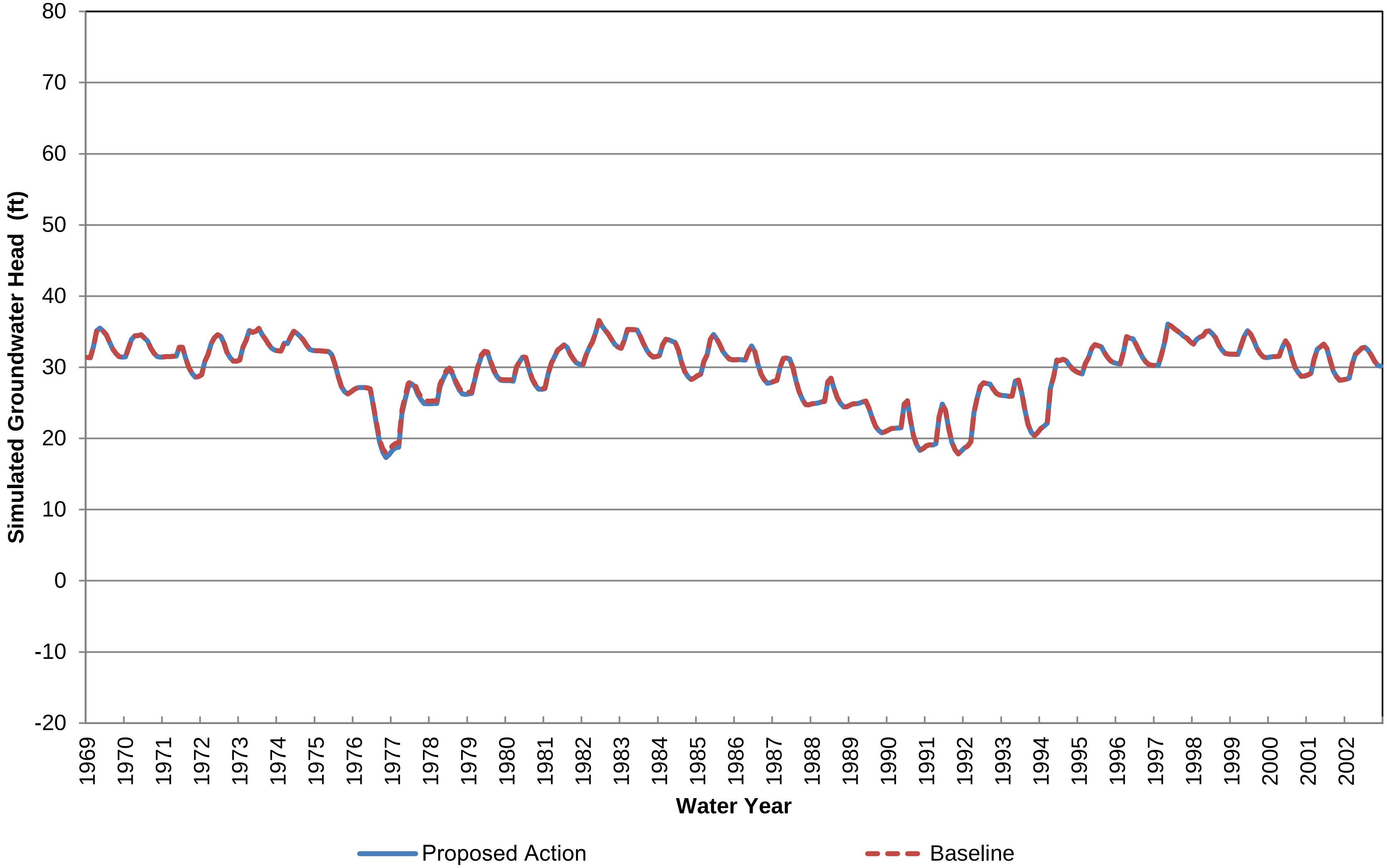
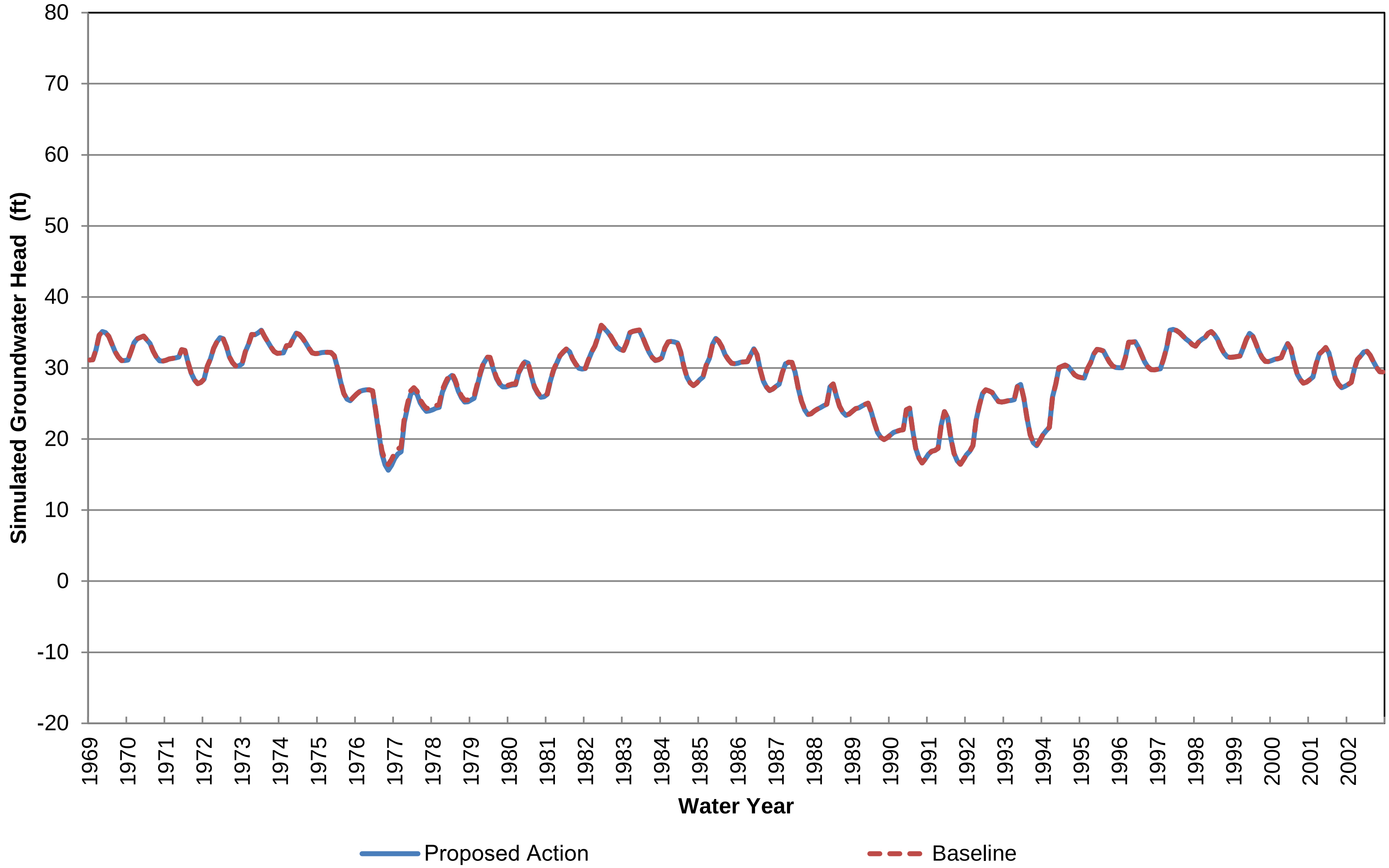
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

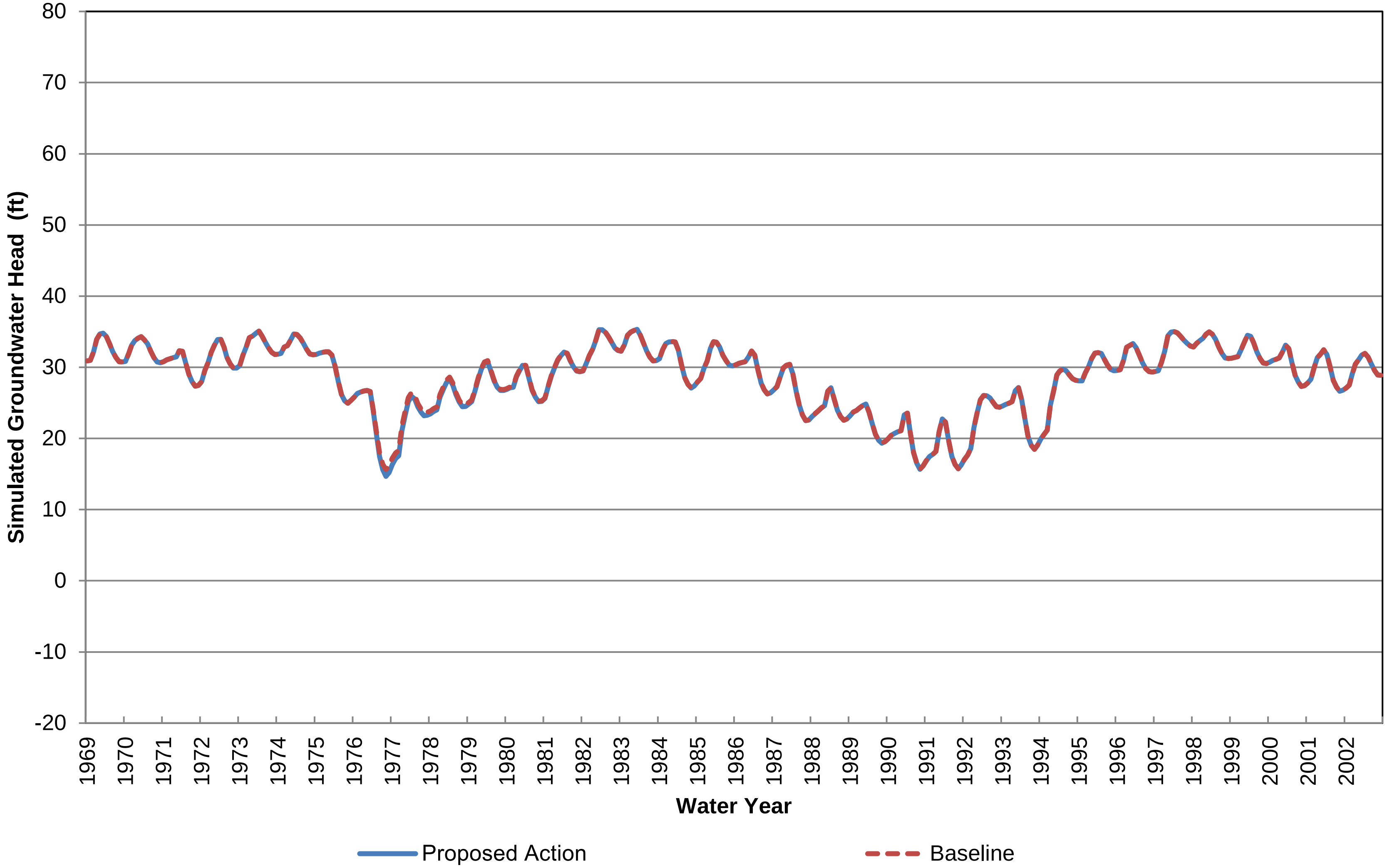
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 18 (Approximately 150-240 ft bgs)



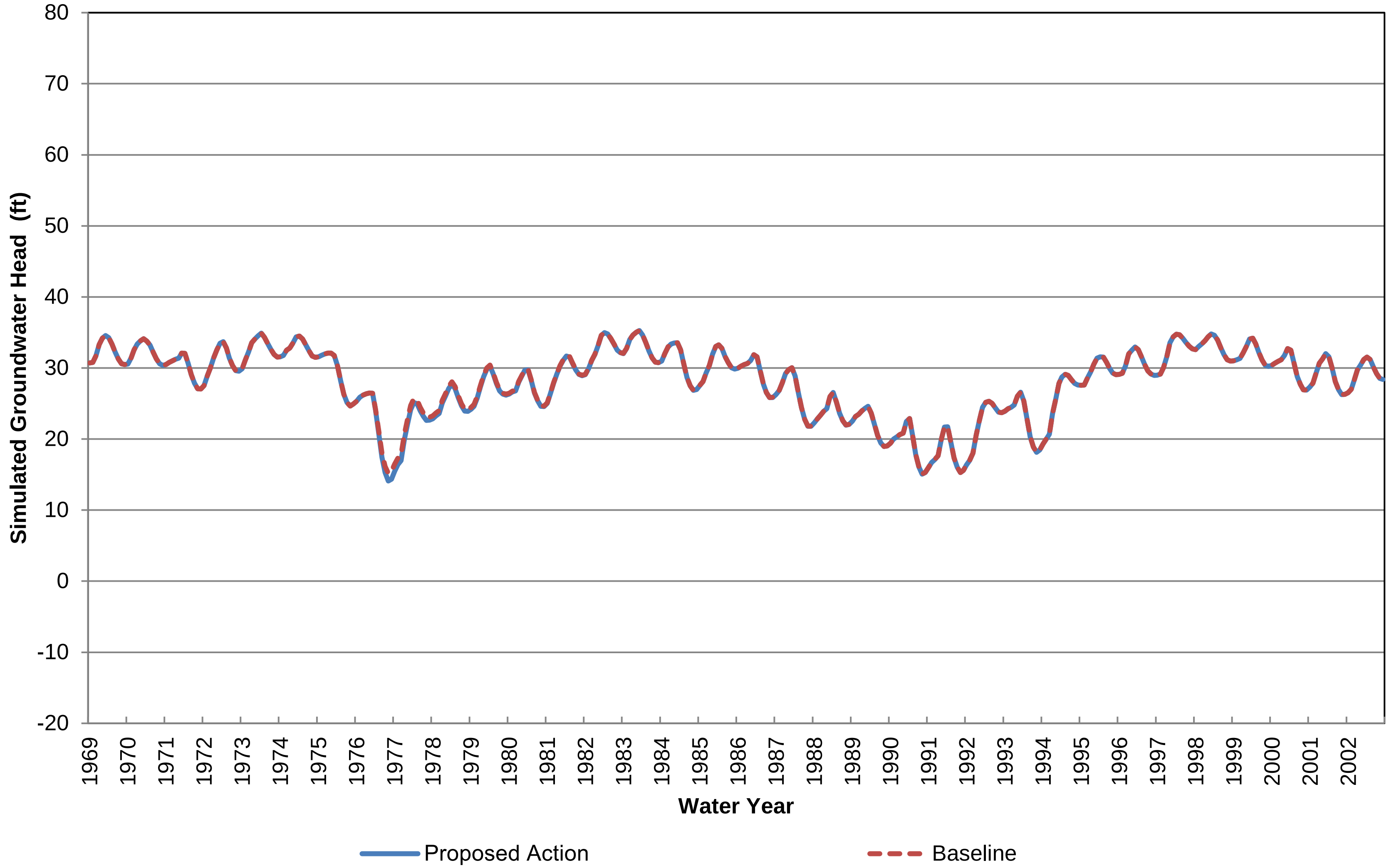
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 18 (Approximately 240-330 ft bgs)



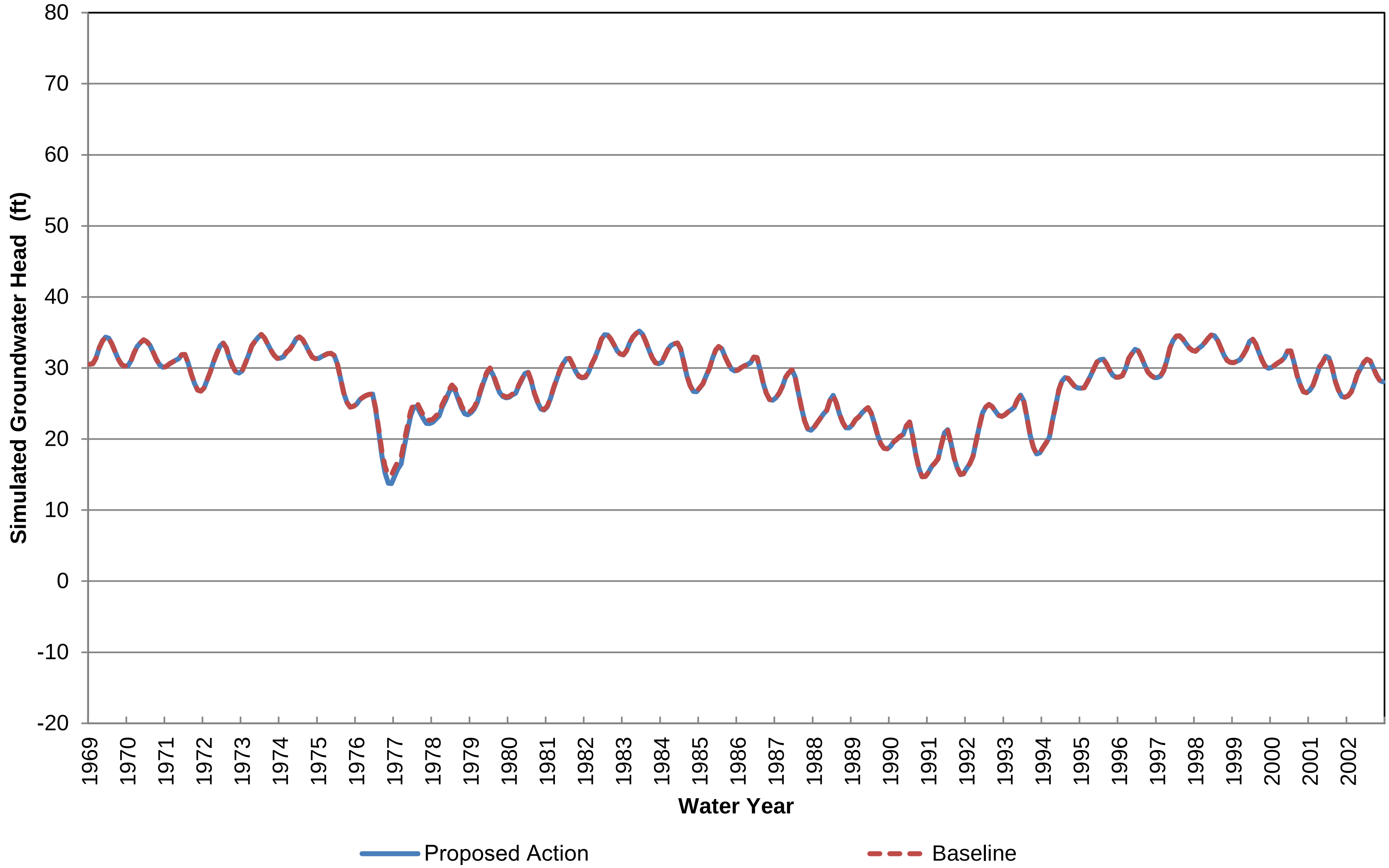
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 18 (Approximately 330-450 ft bgs)

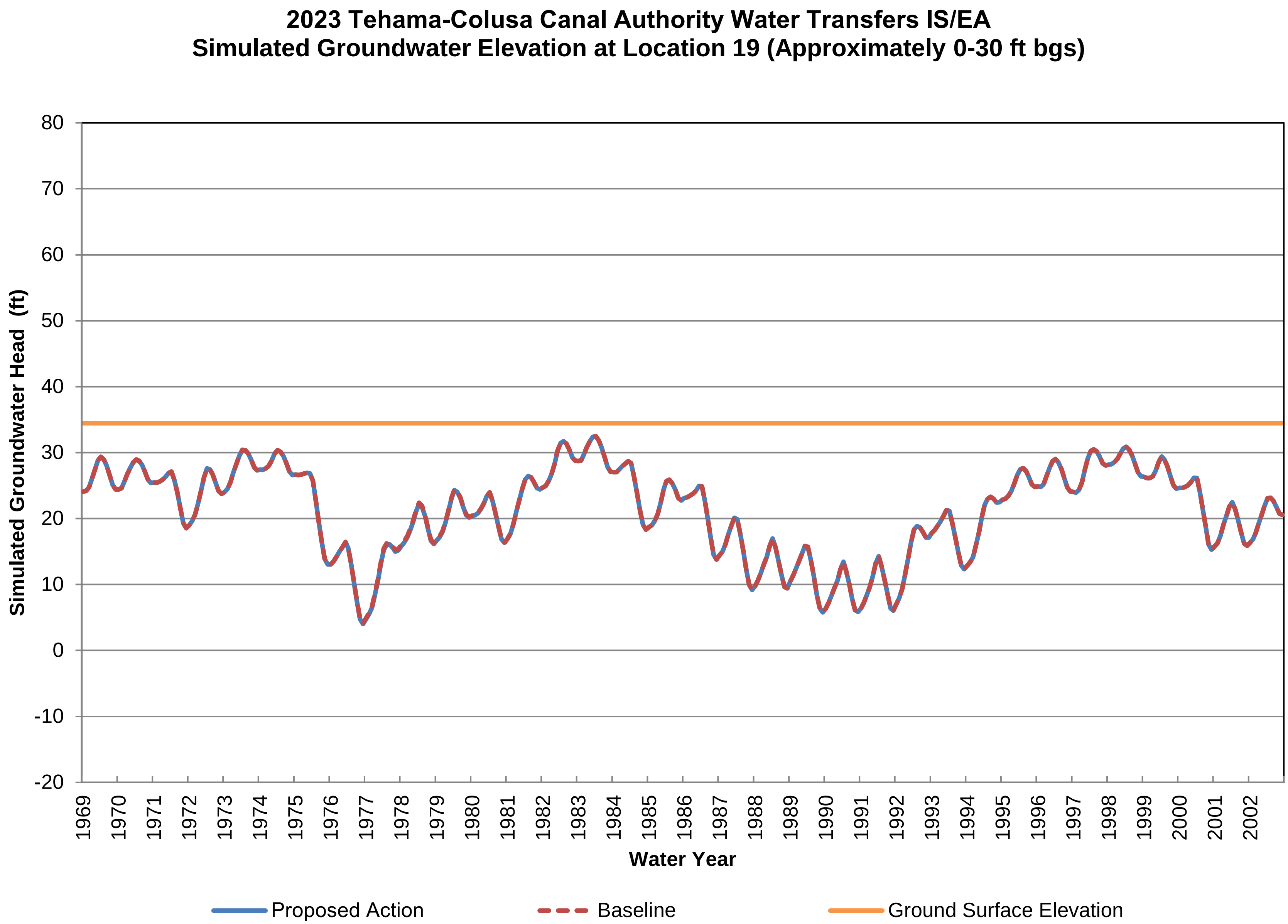


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 18 (Approximately 450-600 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 18 (Approximately 600-820 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 19 (Approximately 0-30 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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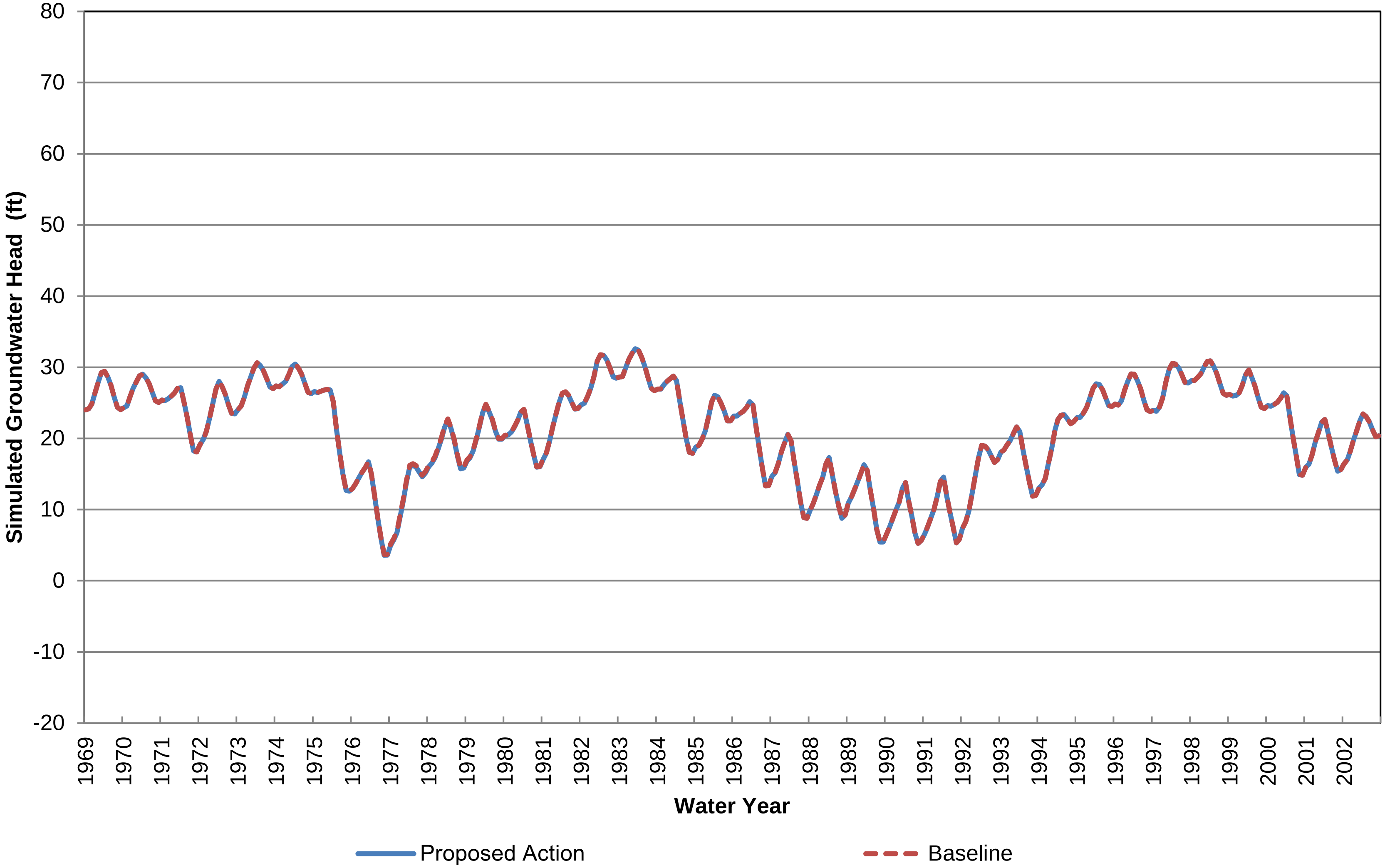
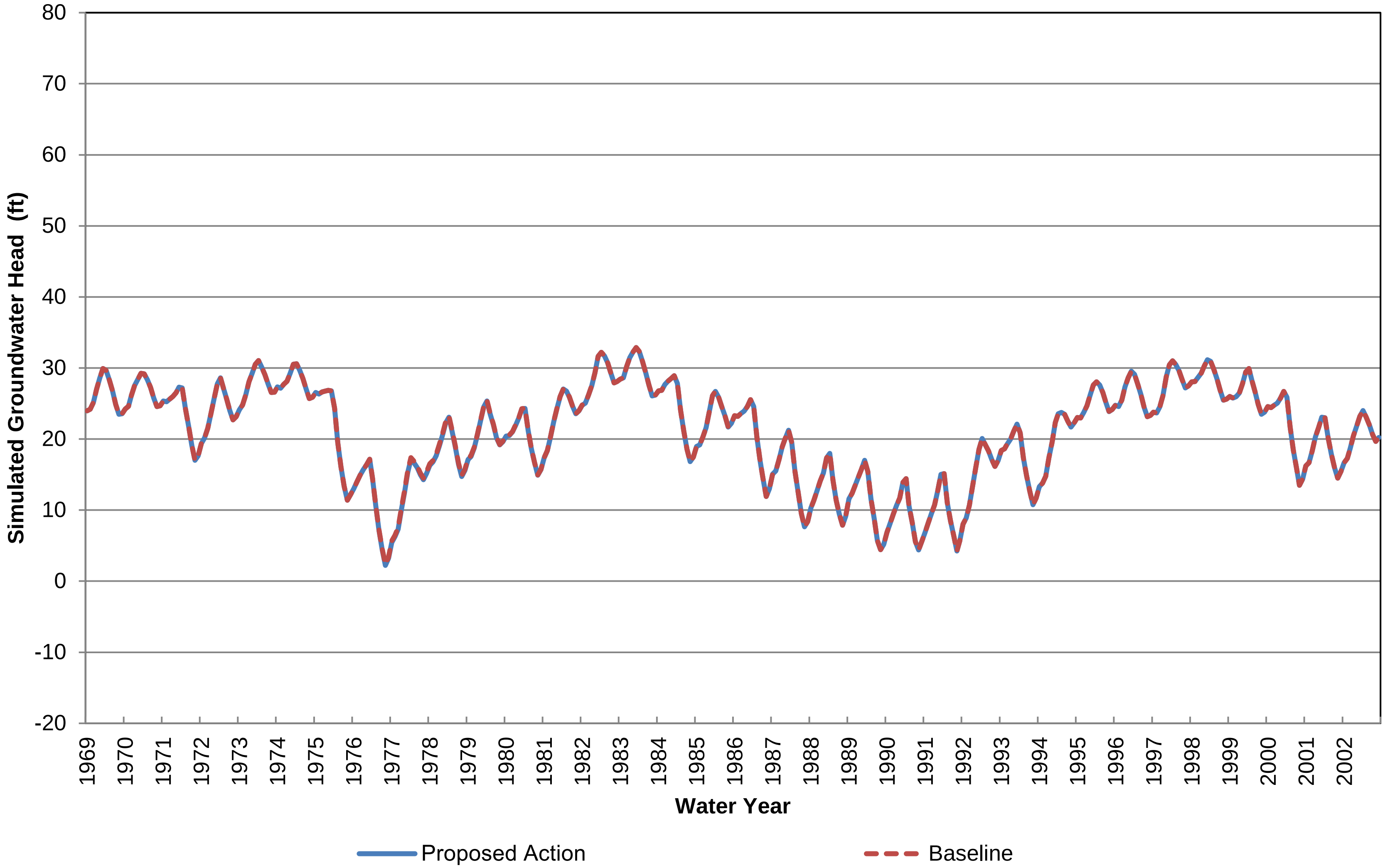
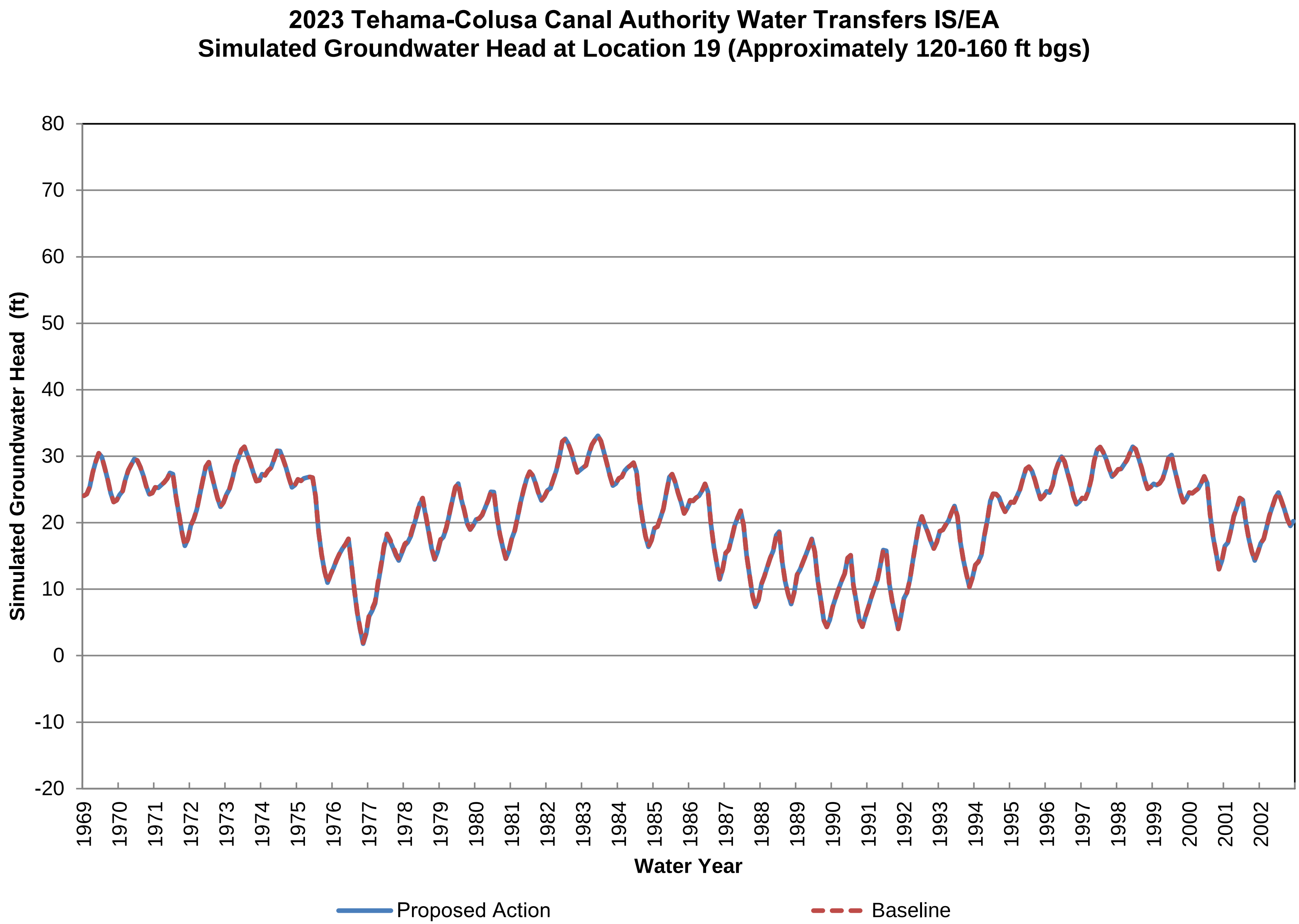
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 19 (Approximately 30-70 ft bgs)



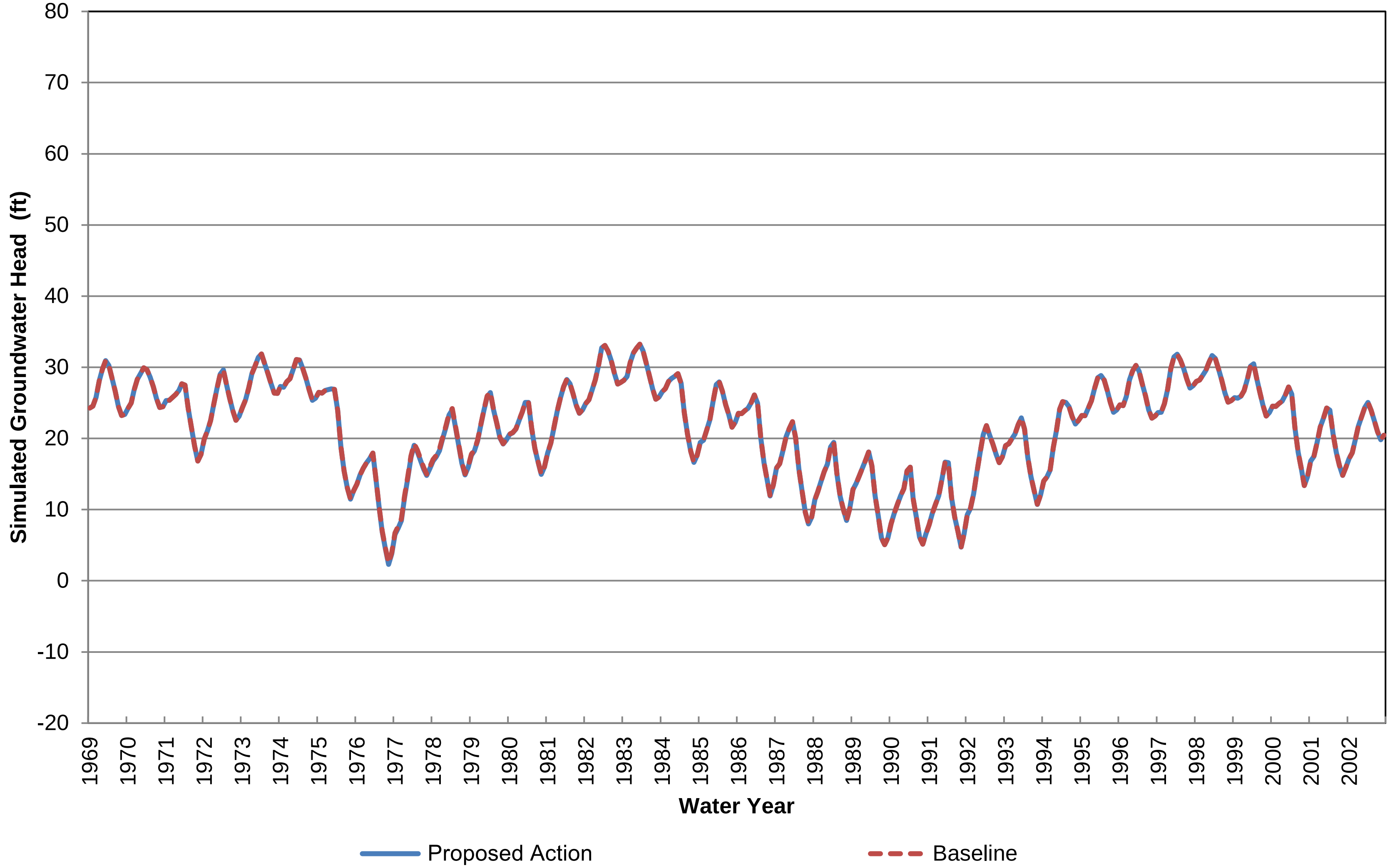
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 19 (Approximately 70-120 ft bgs)

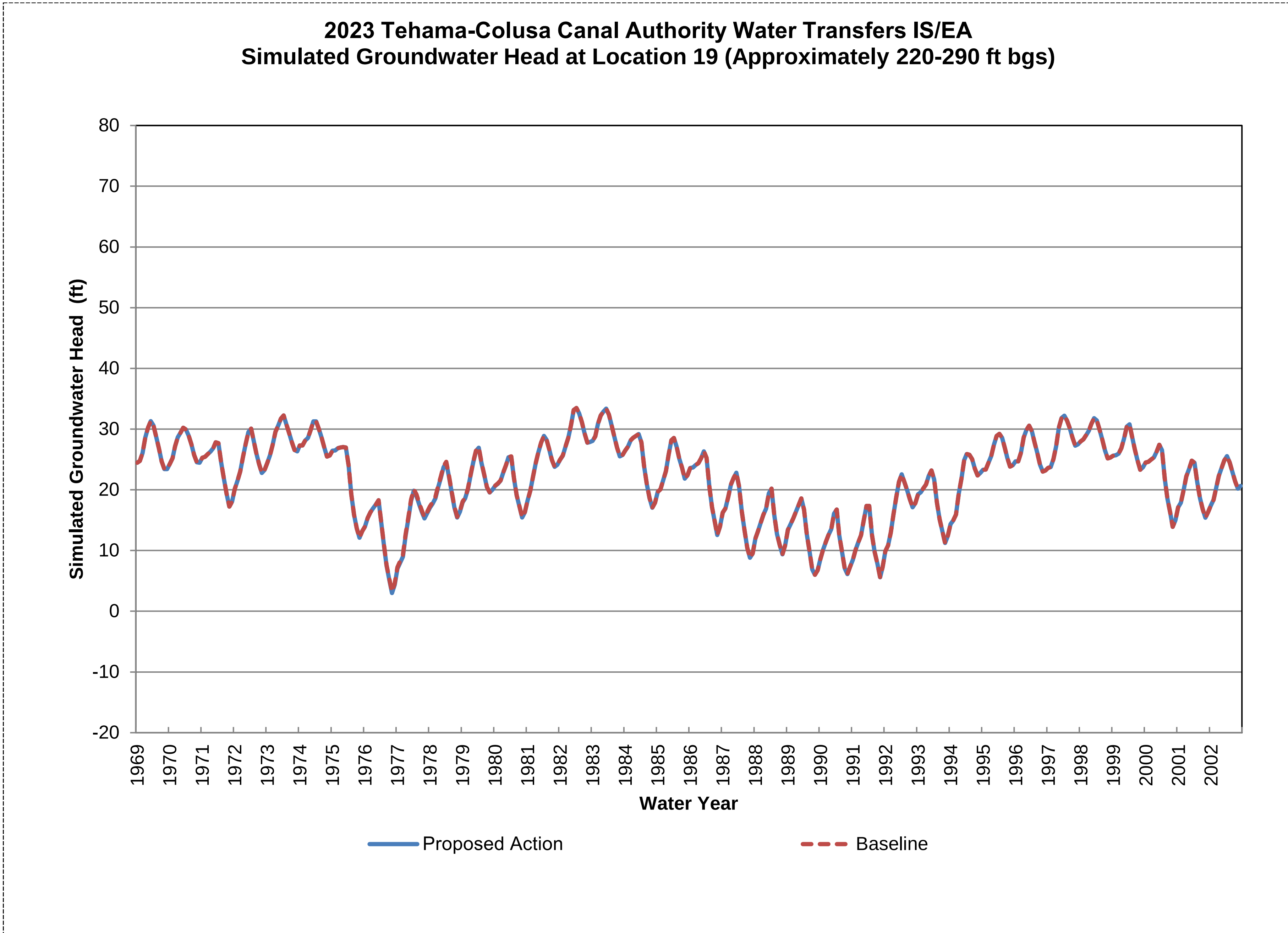




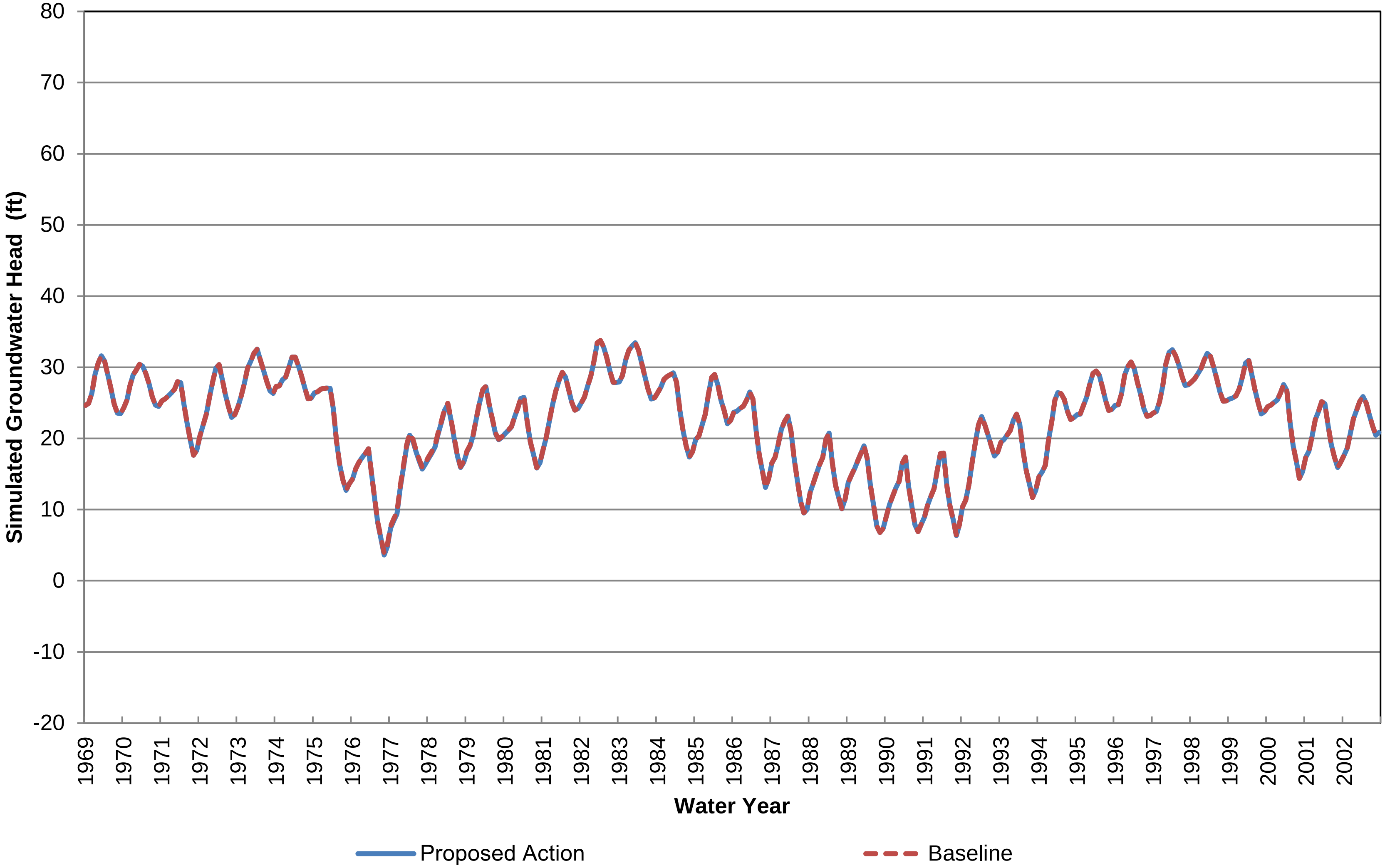
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 19 (Approximately 120-160 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 19 (Approximately 160-220 ft bgs)

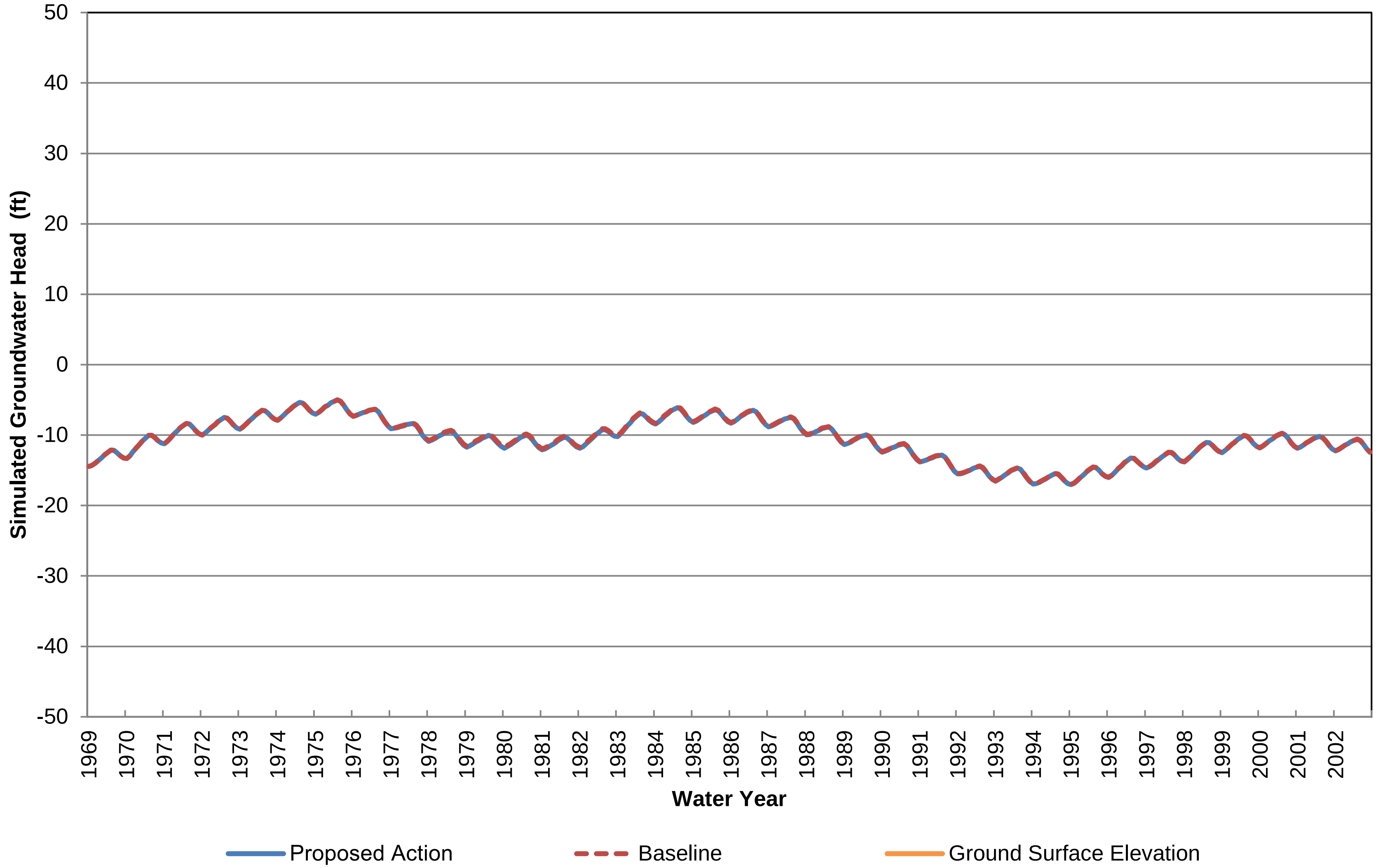



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 19 (Approximately 220-290 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

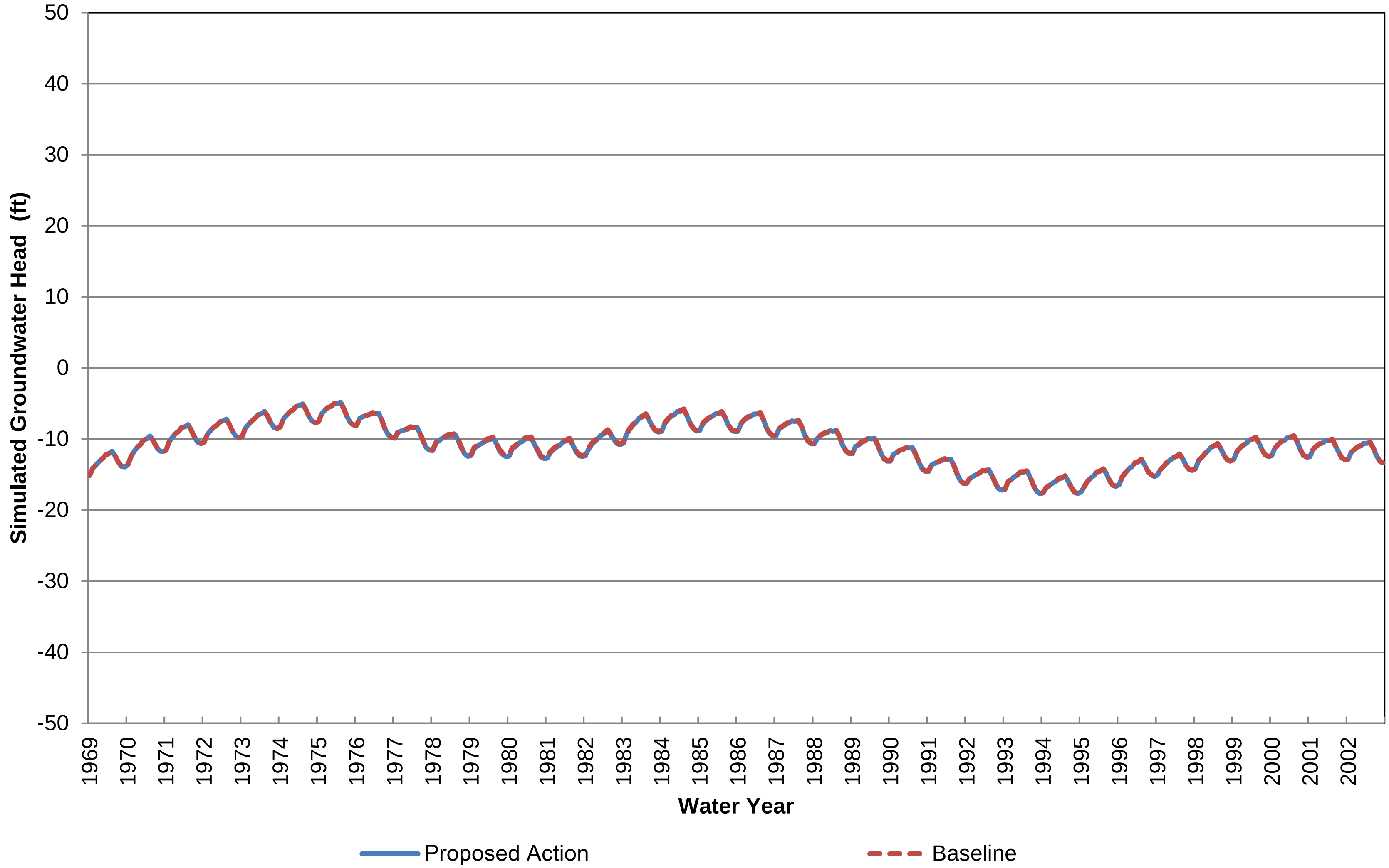
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 19 (Approximately 290-400 ft bgs)

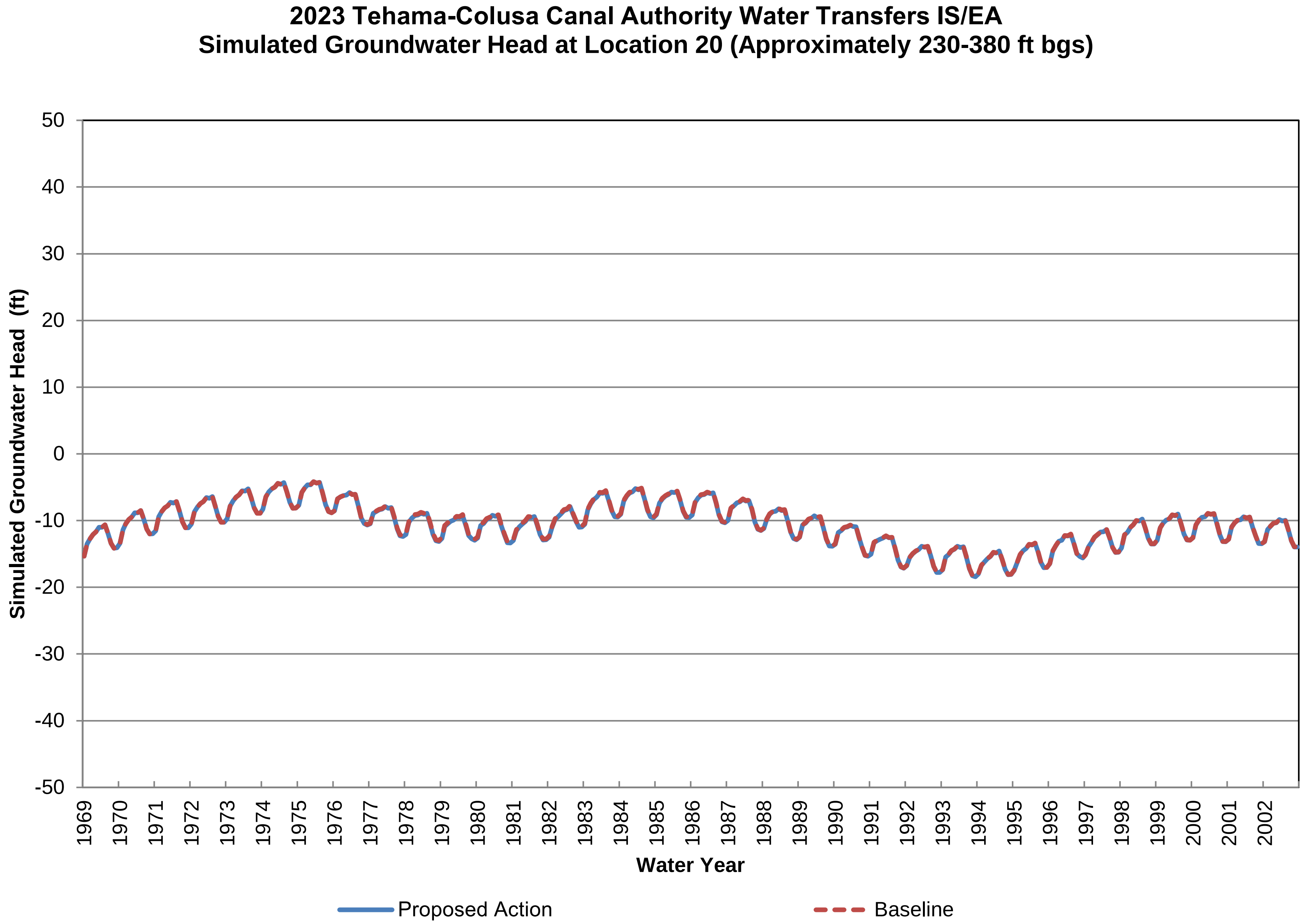


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 20 (Approximately 0-70 ft bgs)



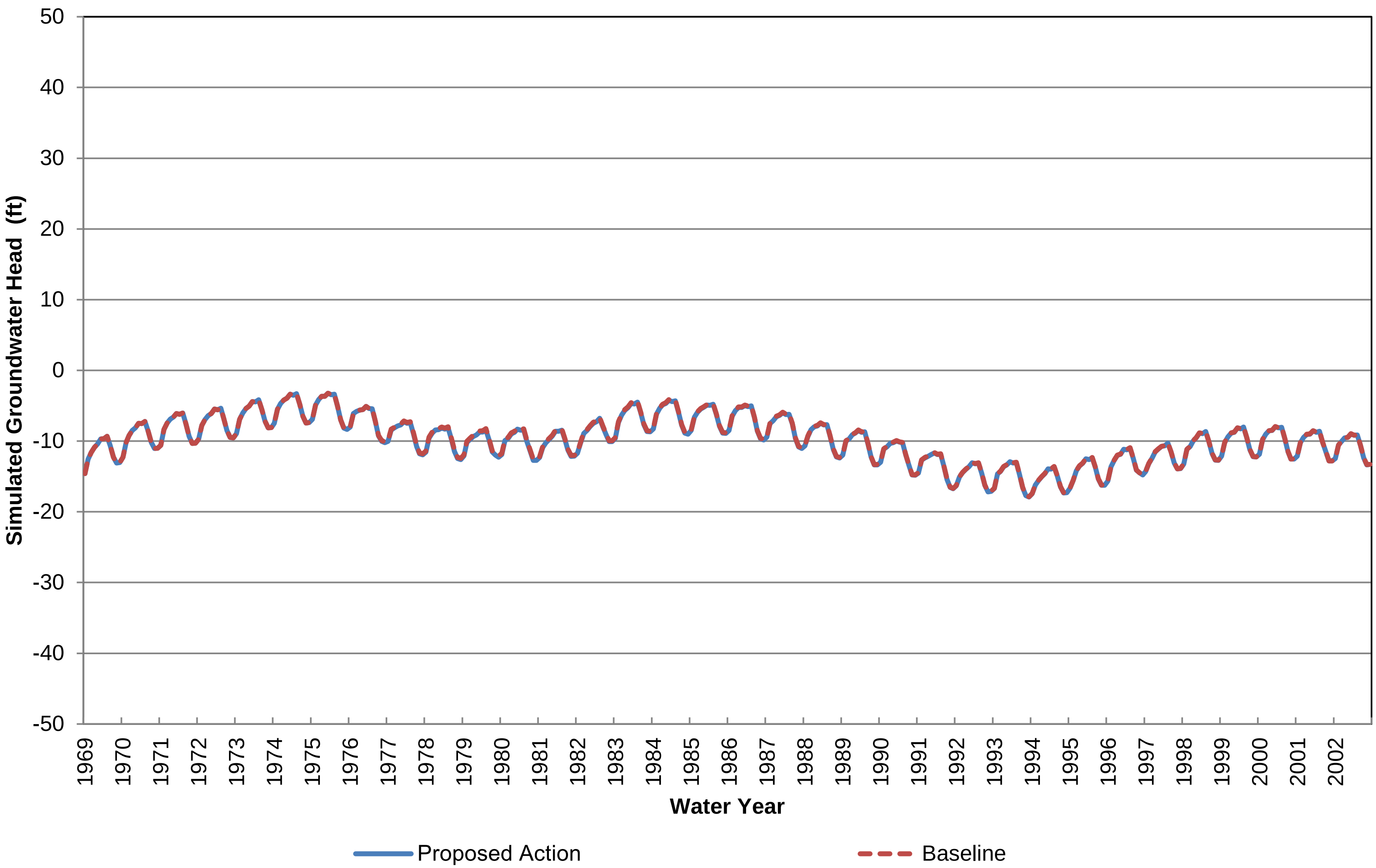
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 20 (Approximately 70-230 ft bgs)



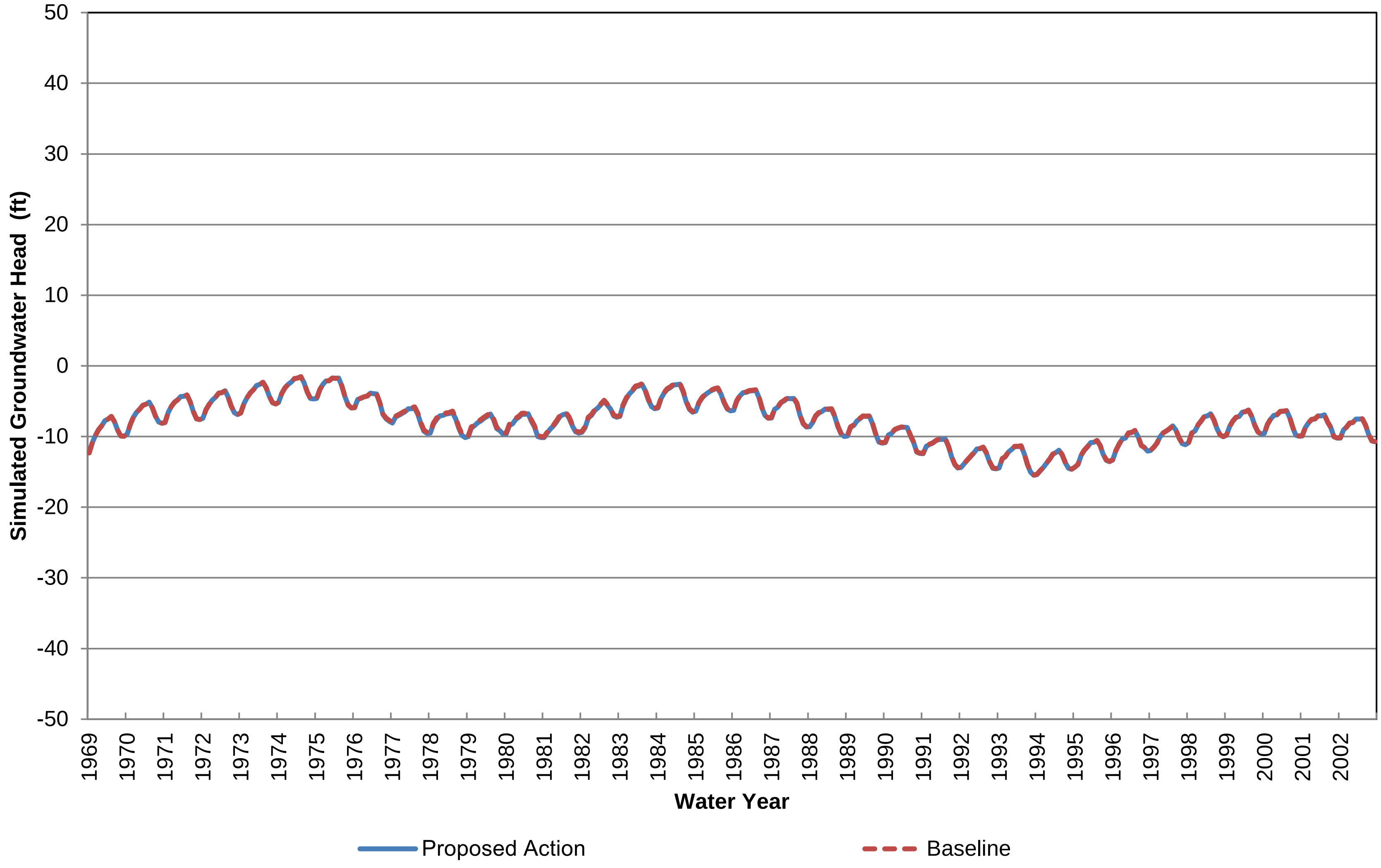


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 20 (Approximately 230-380 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

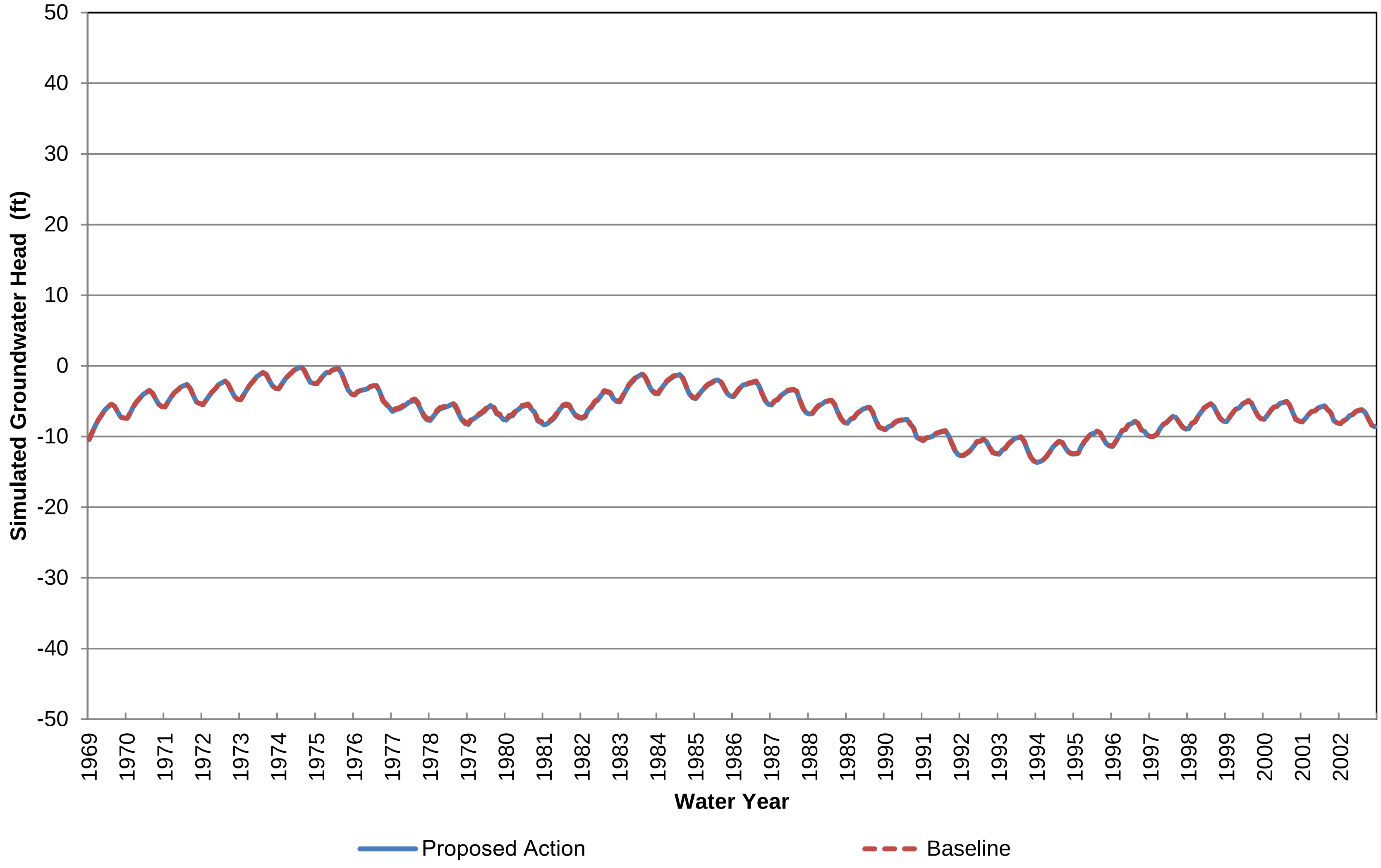
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 20 (Approximately 380-530 ft bgs)



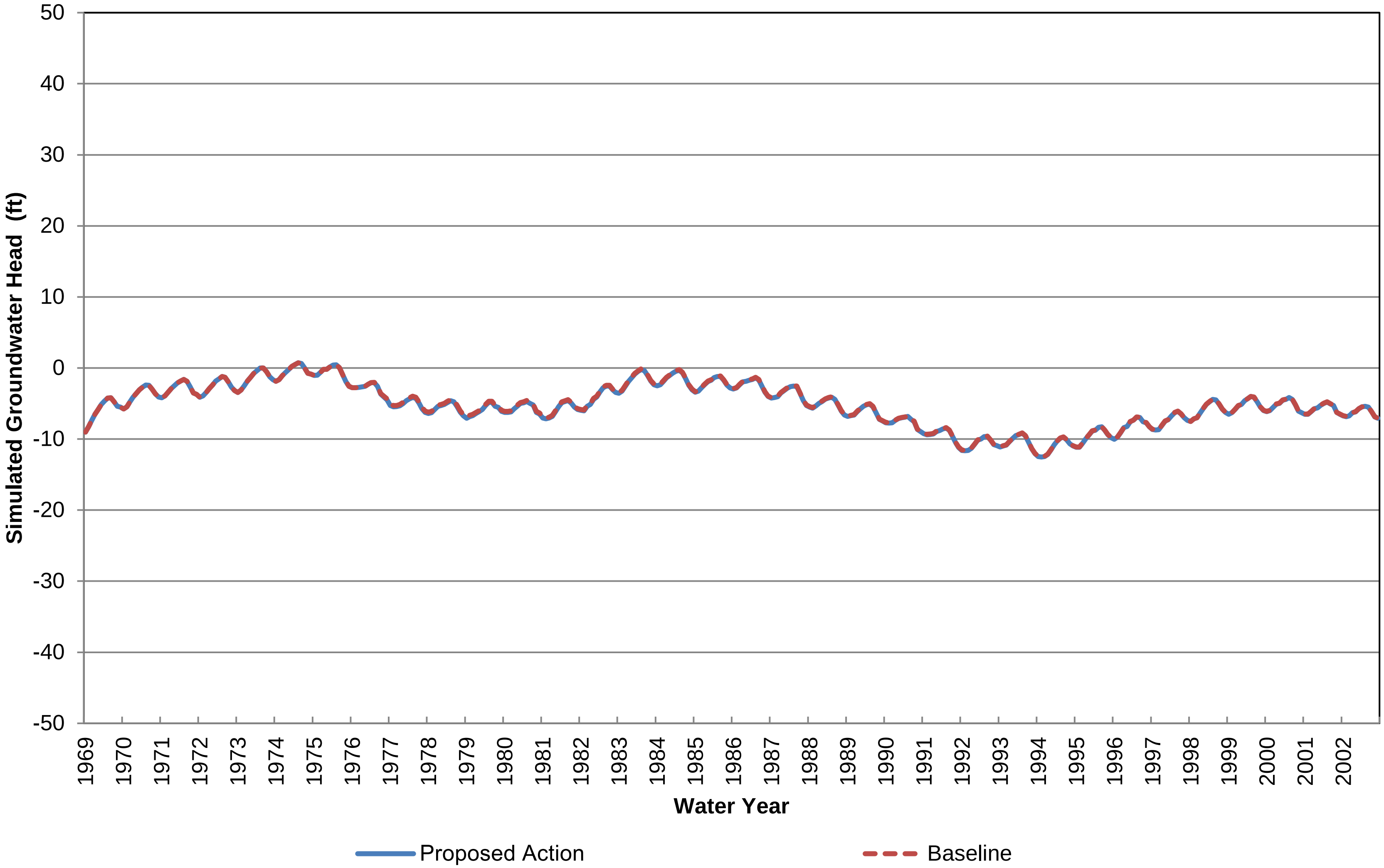
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 20 (Approximately 530-780 ft bgs)



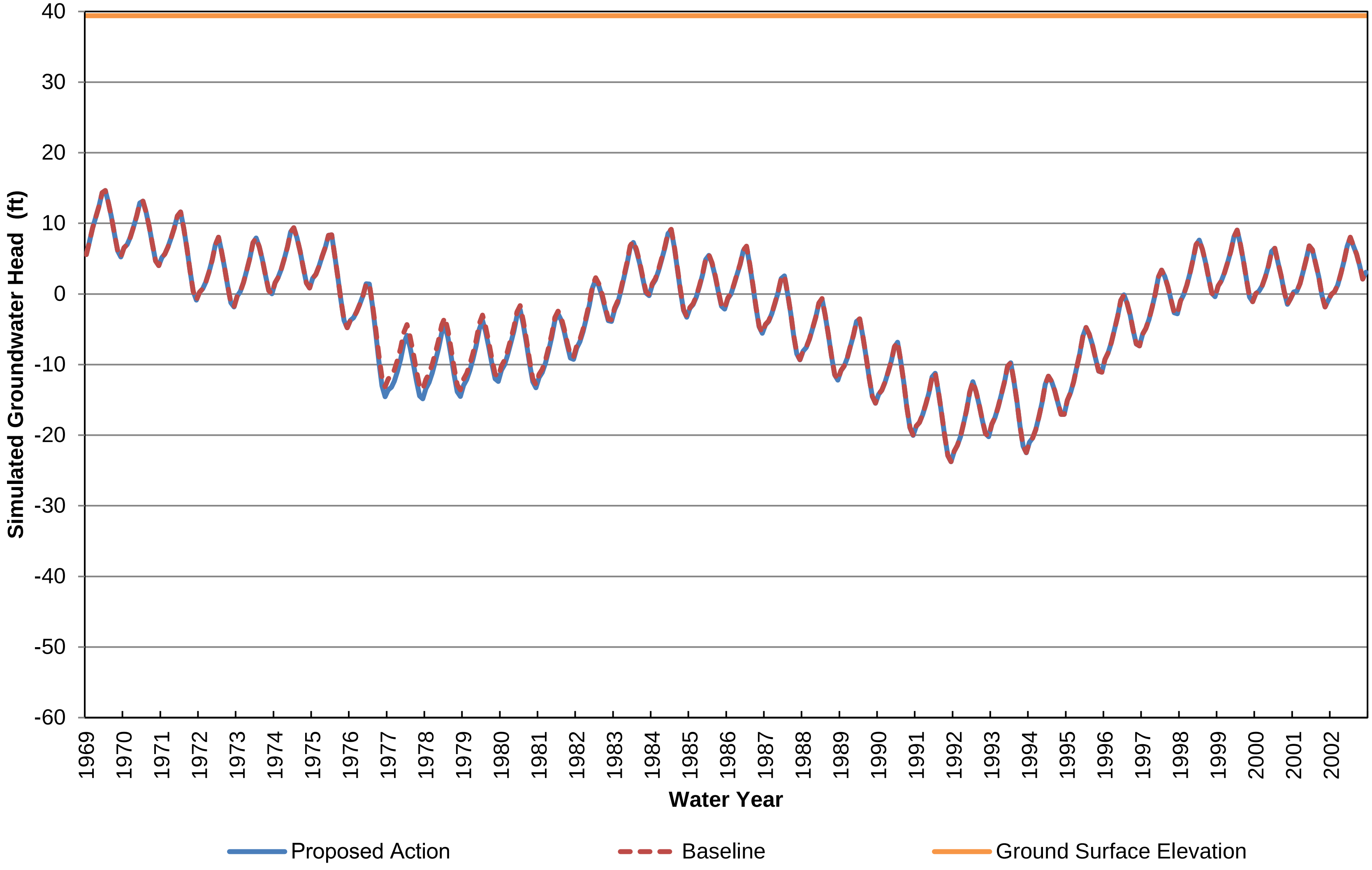
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 20 (Approximately 780-1030 ft bgs)

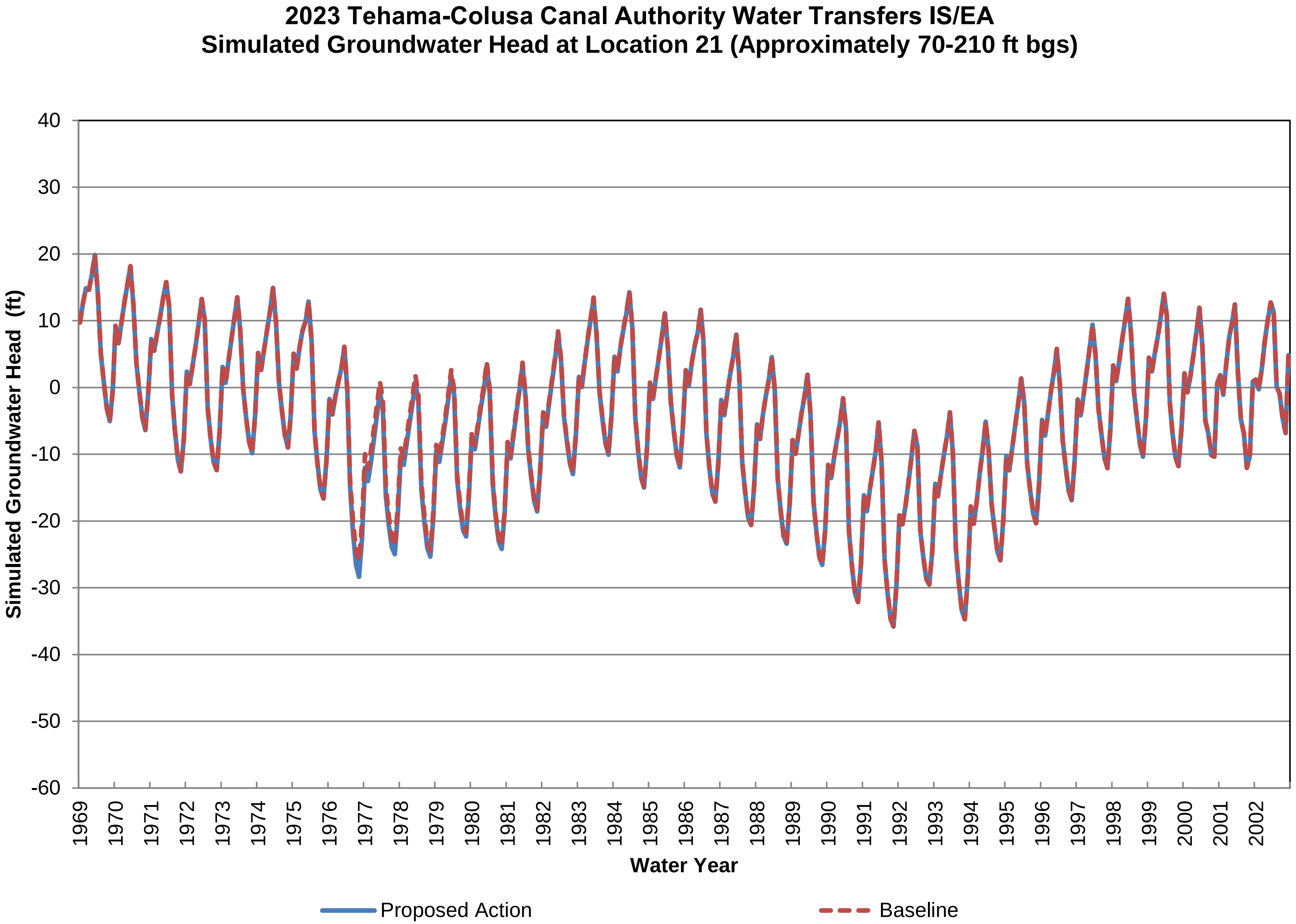


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 20 (Approximately 1030-1420 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 21 (Approximately 0-70 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 21 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
1987
1988
1989
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1993
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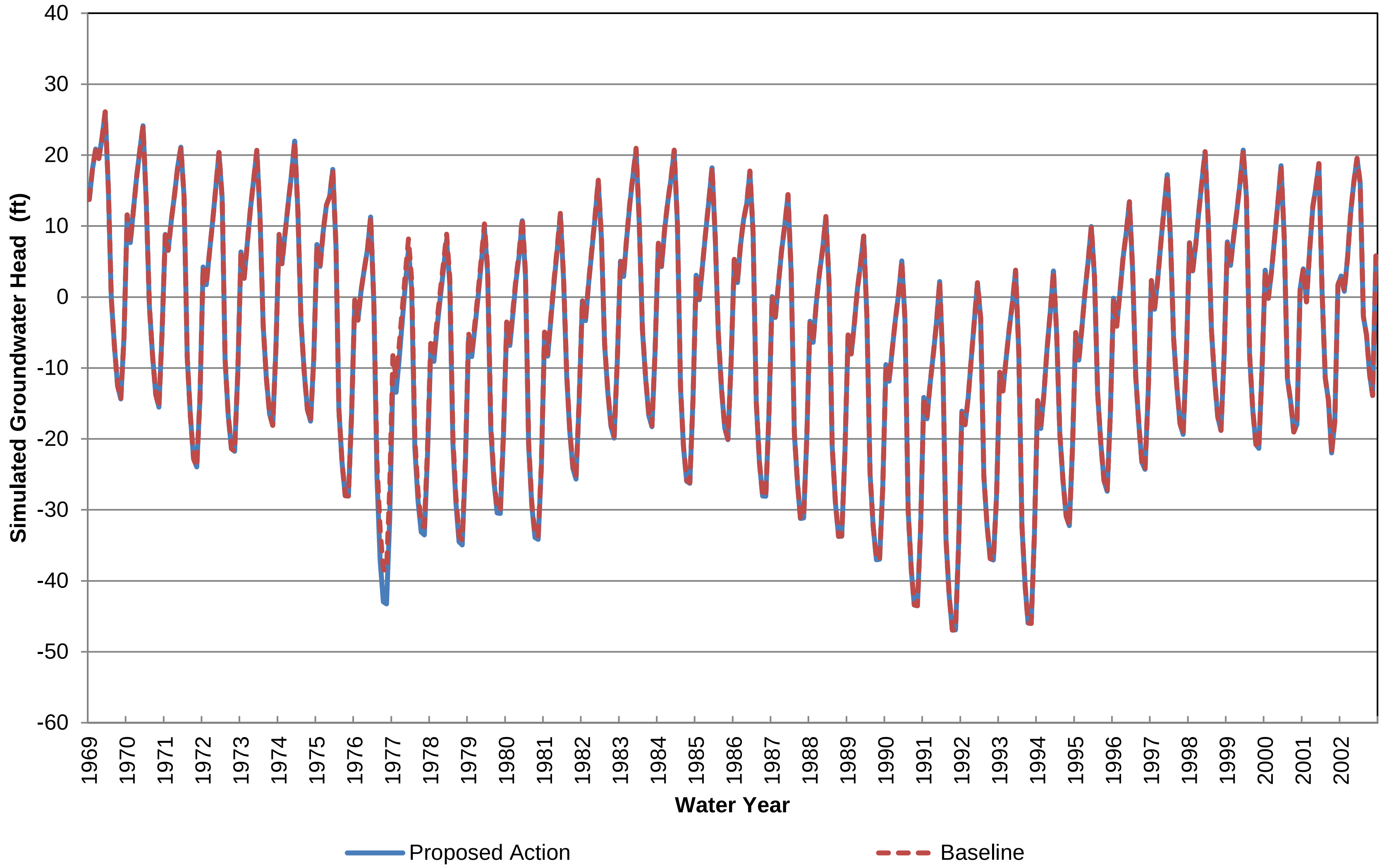
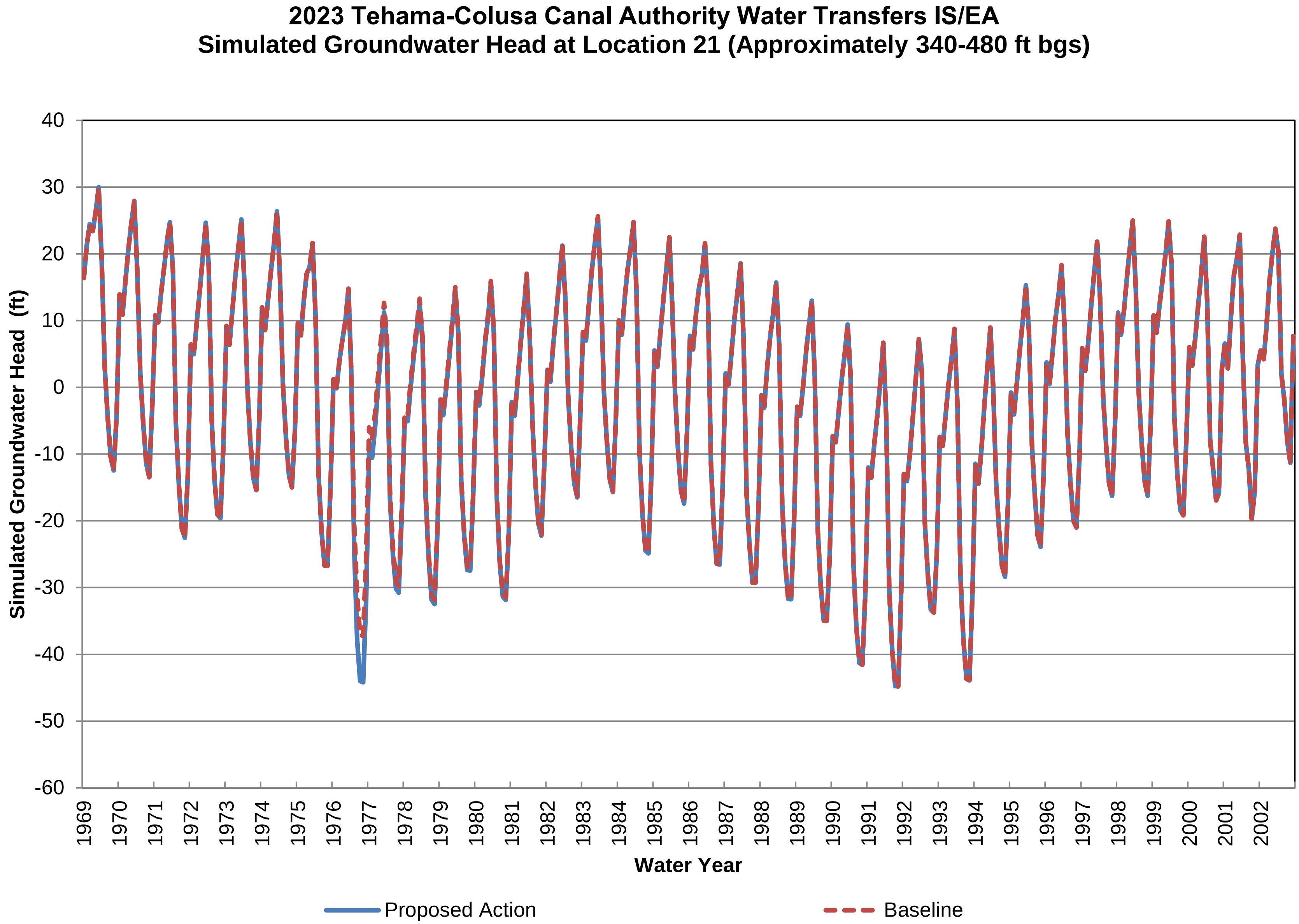
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 21 (Approximately 210-340 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 21 (Approximately 340-480 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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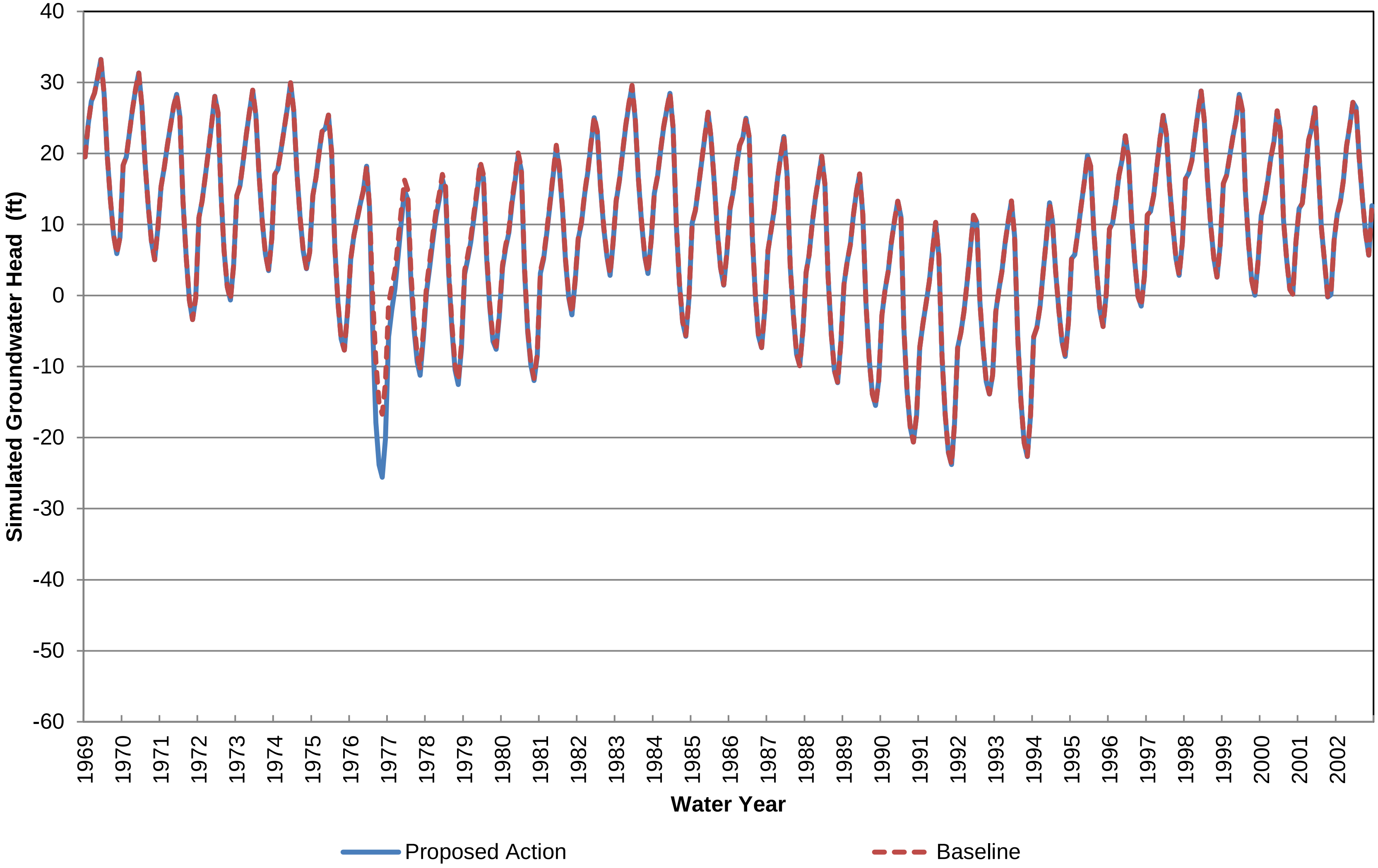
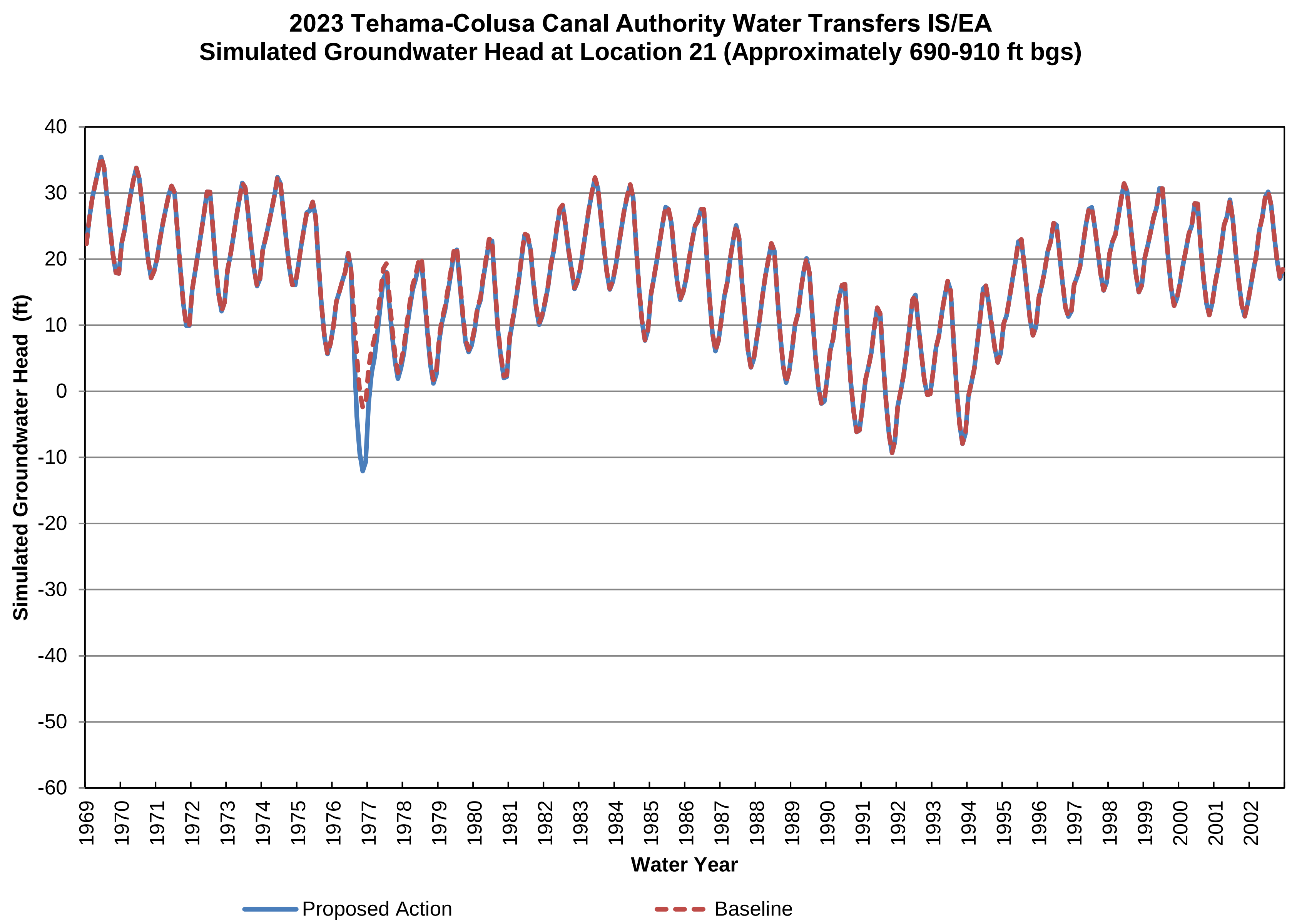
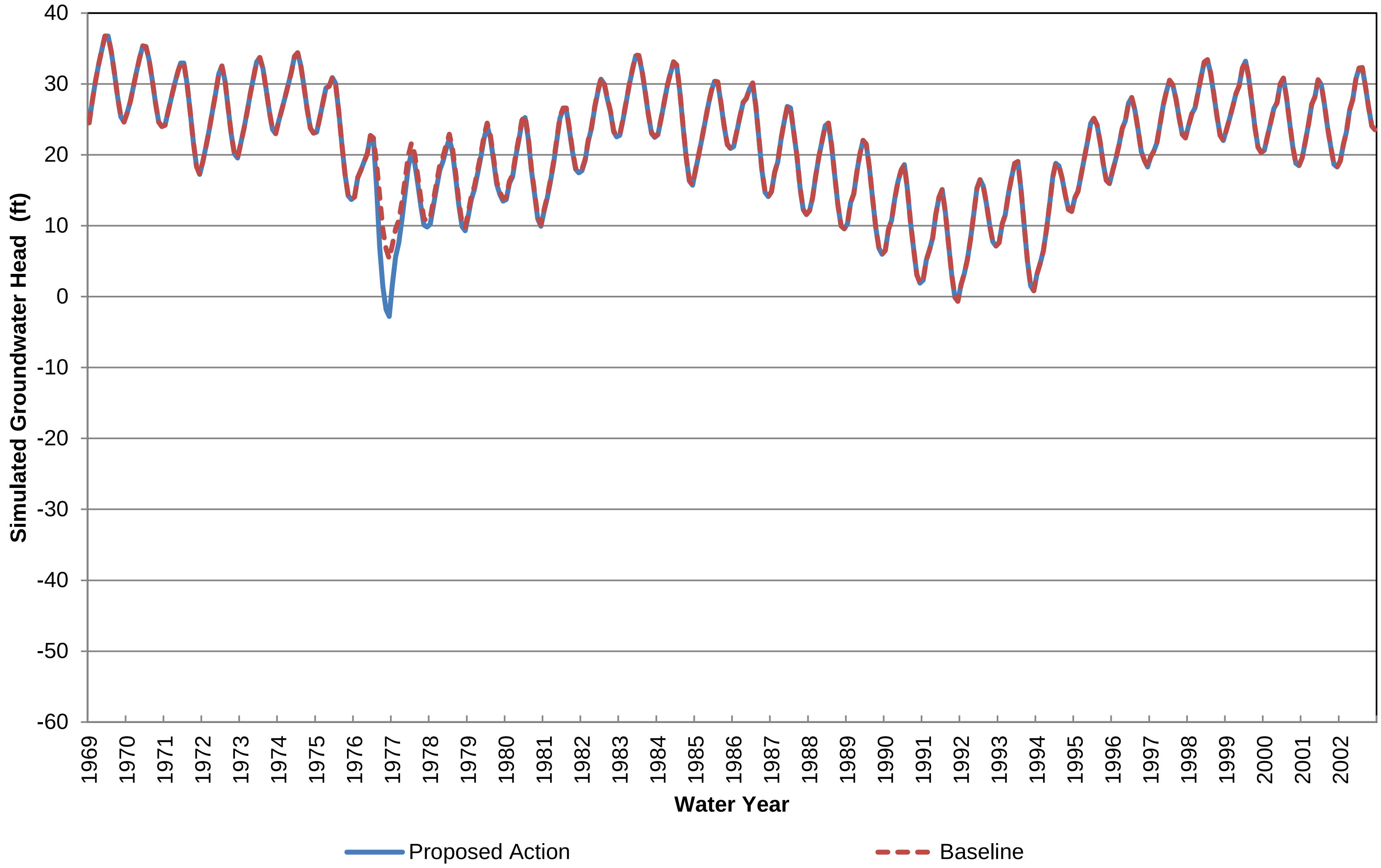
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

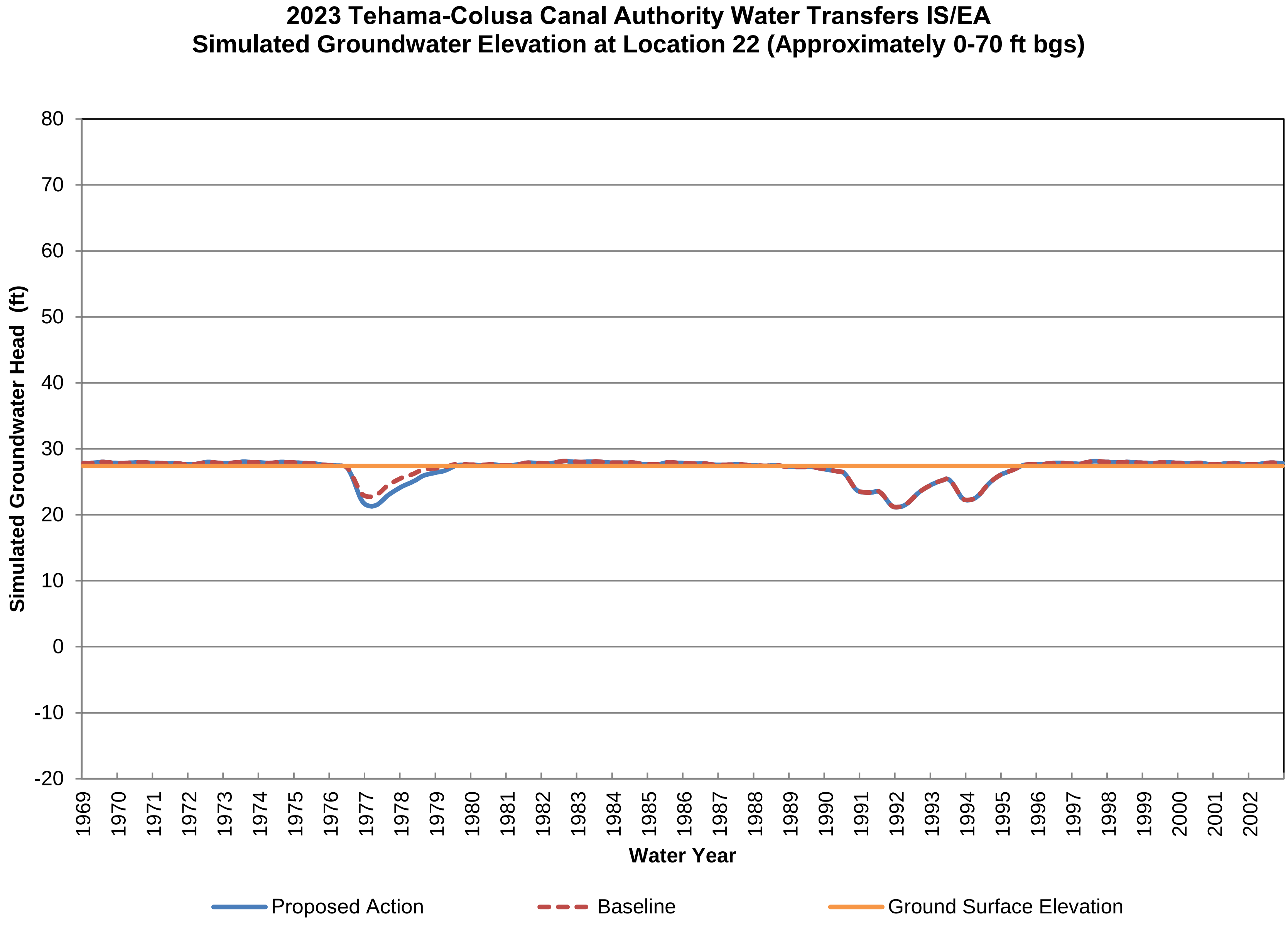
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 21 (Approximately 480-690 ft bgs)

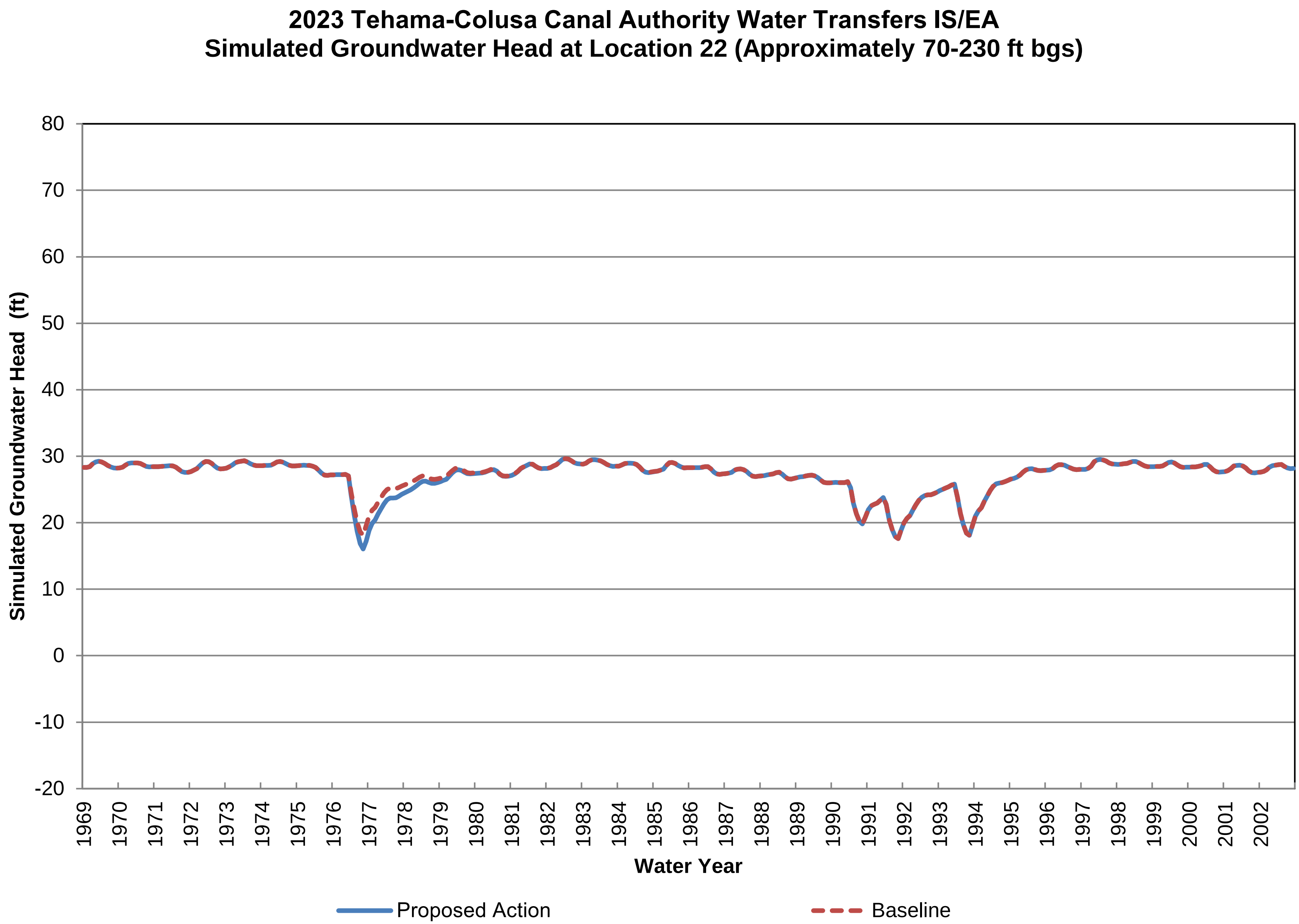



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 21 (Approximately 690-910 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

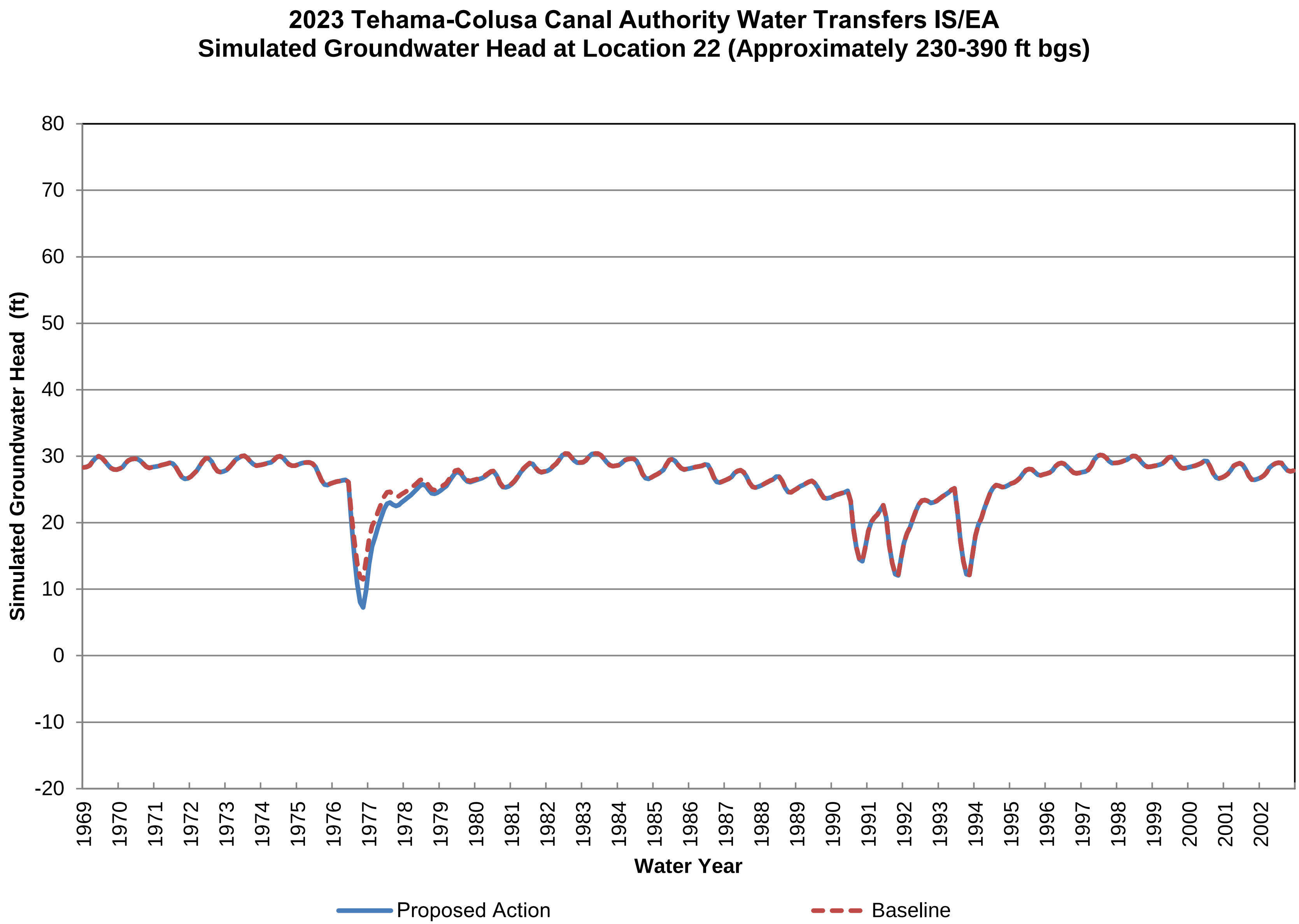
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 21 (Approximately 910-1250 ft bgs)



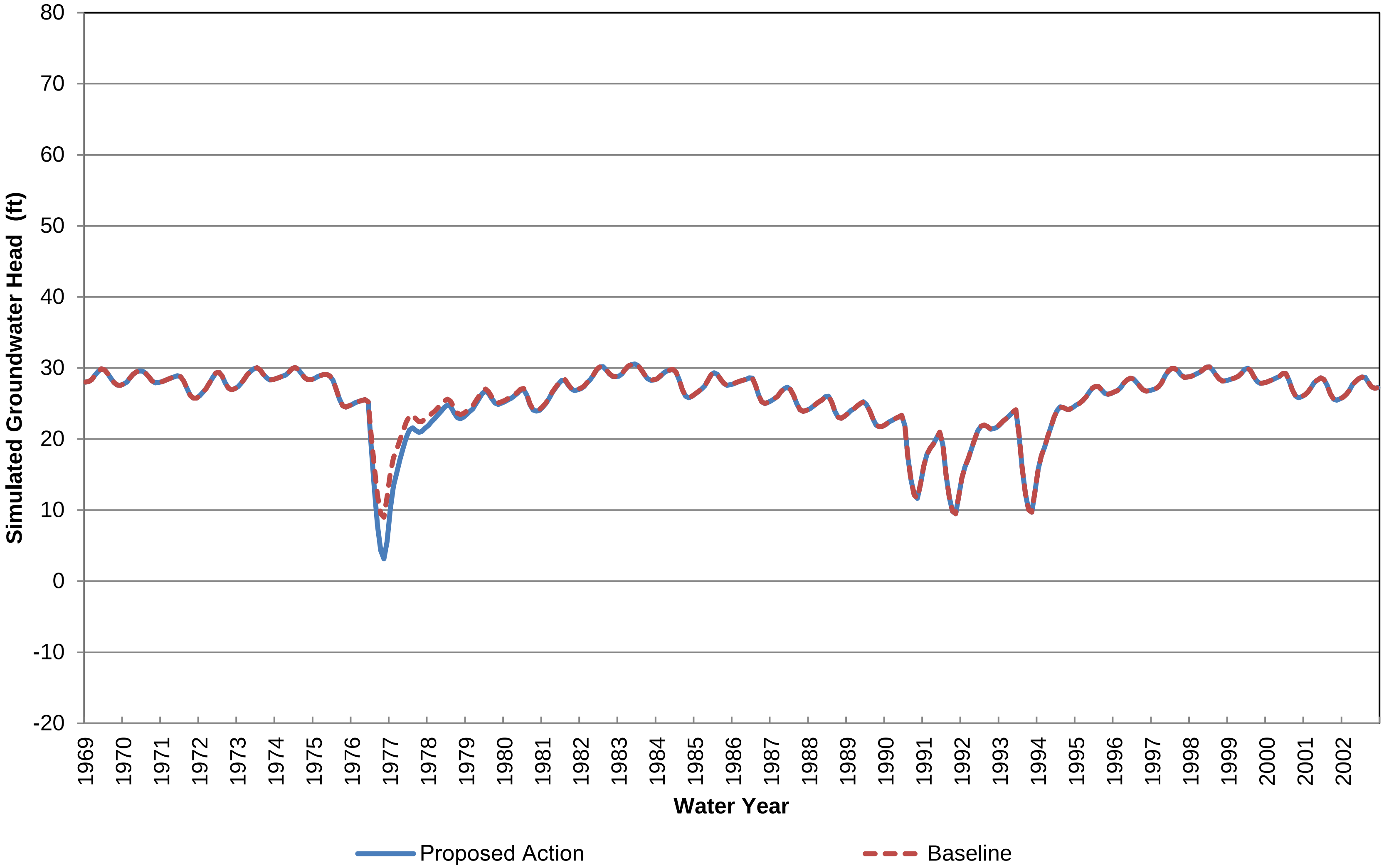

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 22 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation

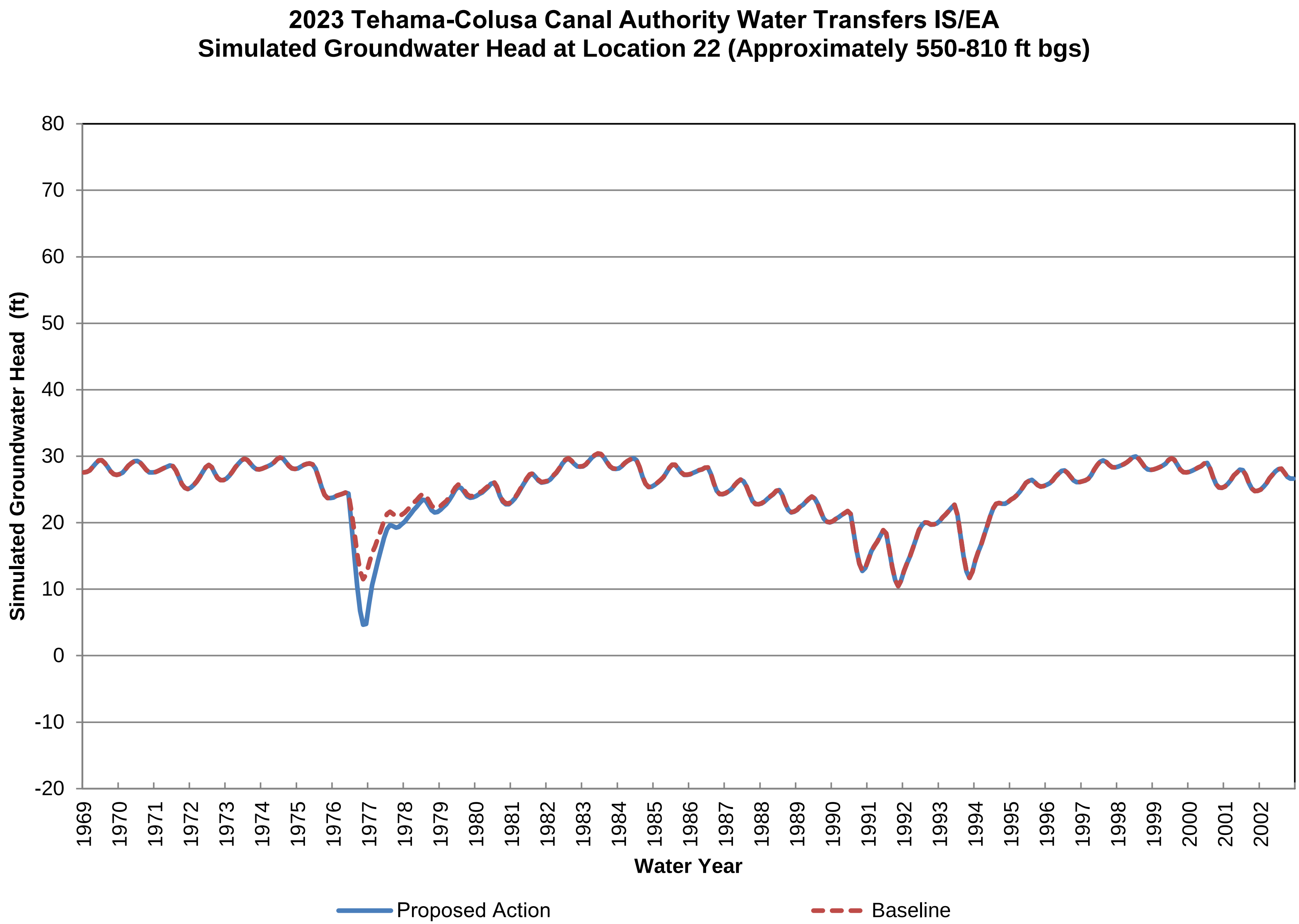


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 22 (Approximately 70-230 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

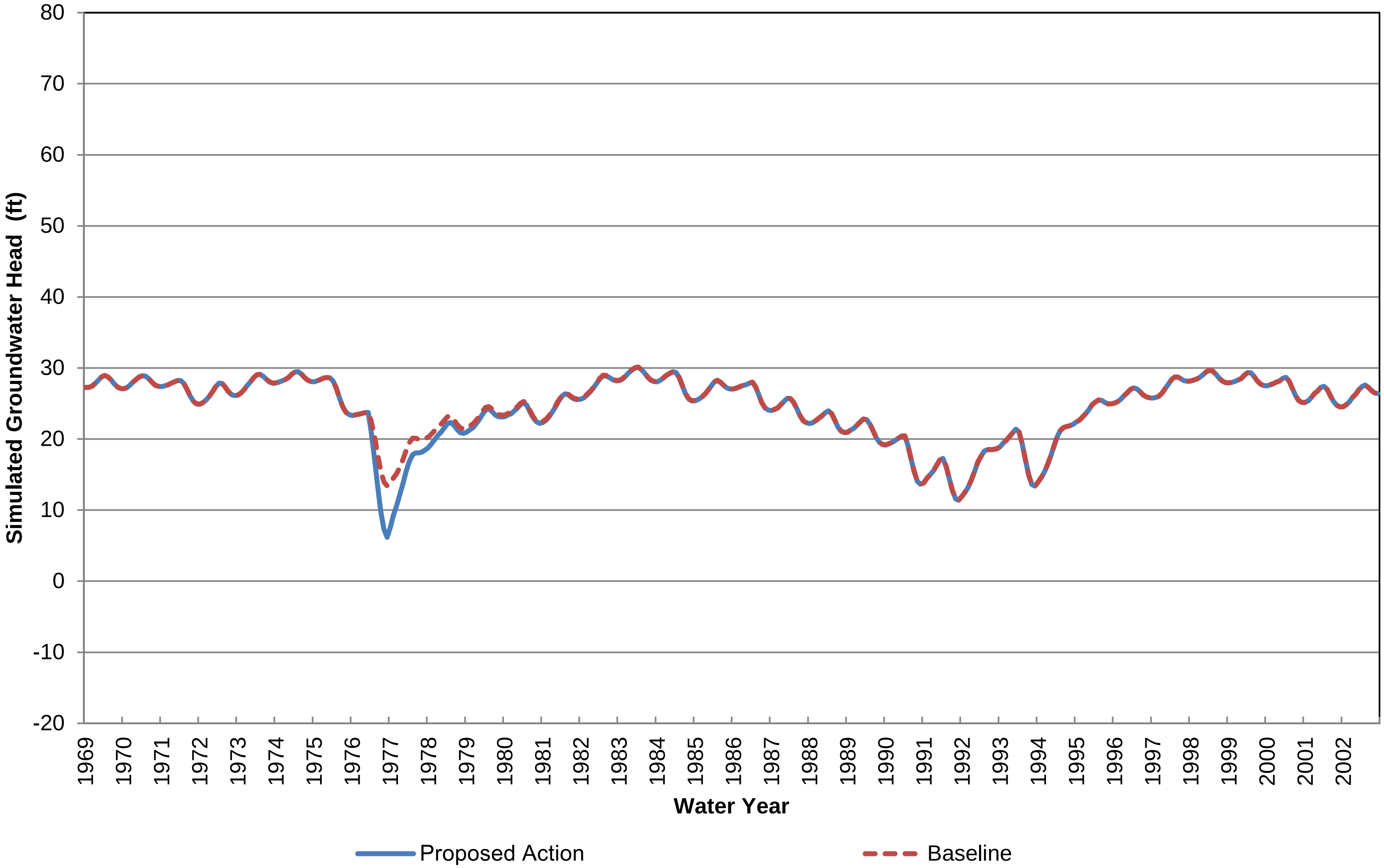

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 22 (Approximately 230-390 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

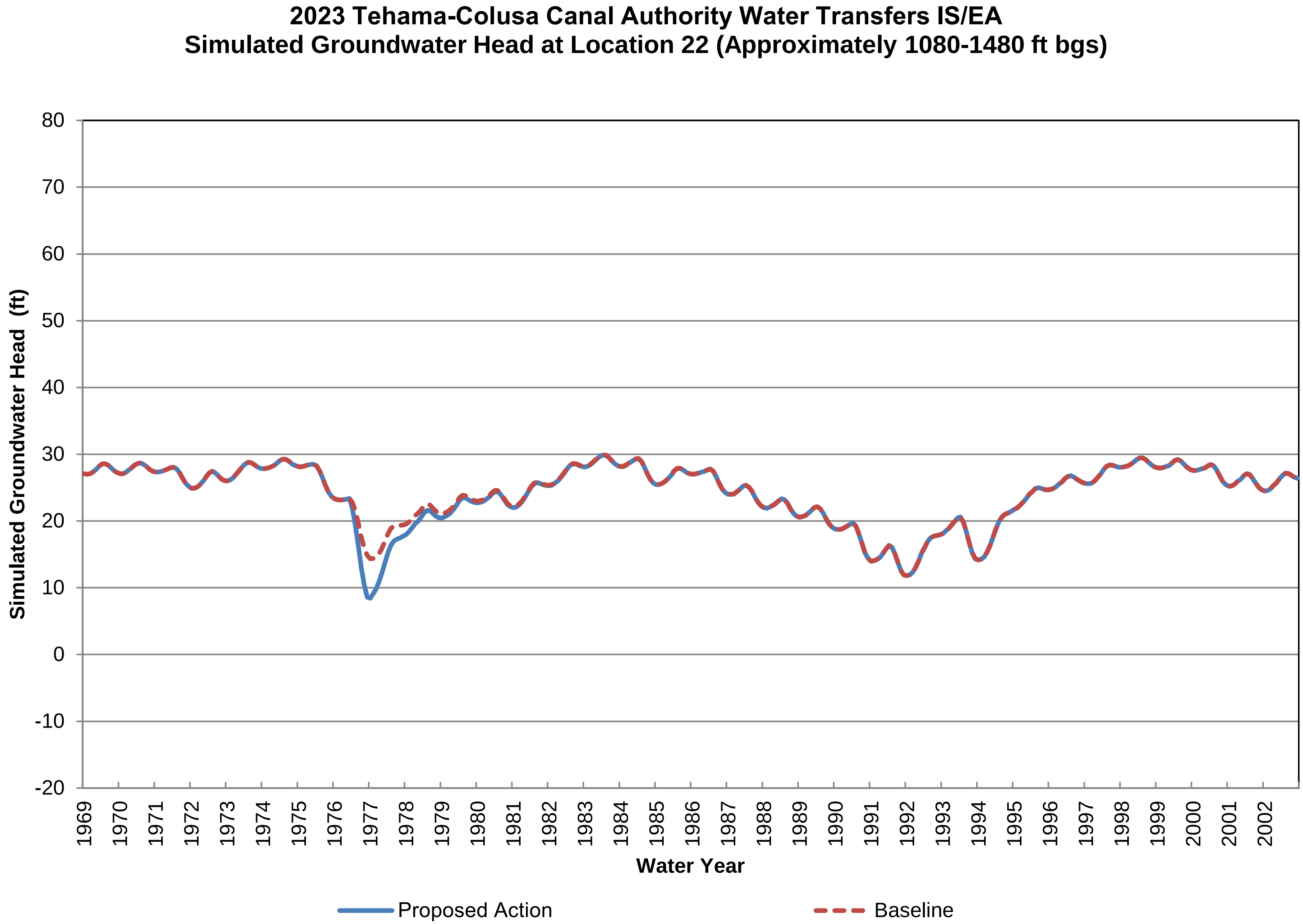
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 22 (Approximately 390-550 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 22 (Approximately 550-810 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 22 (Approximately 810-1080 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 22 (Approximately 1080-1480 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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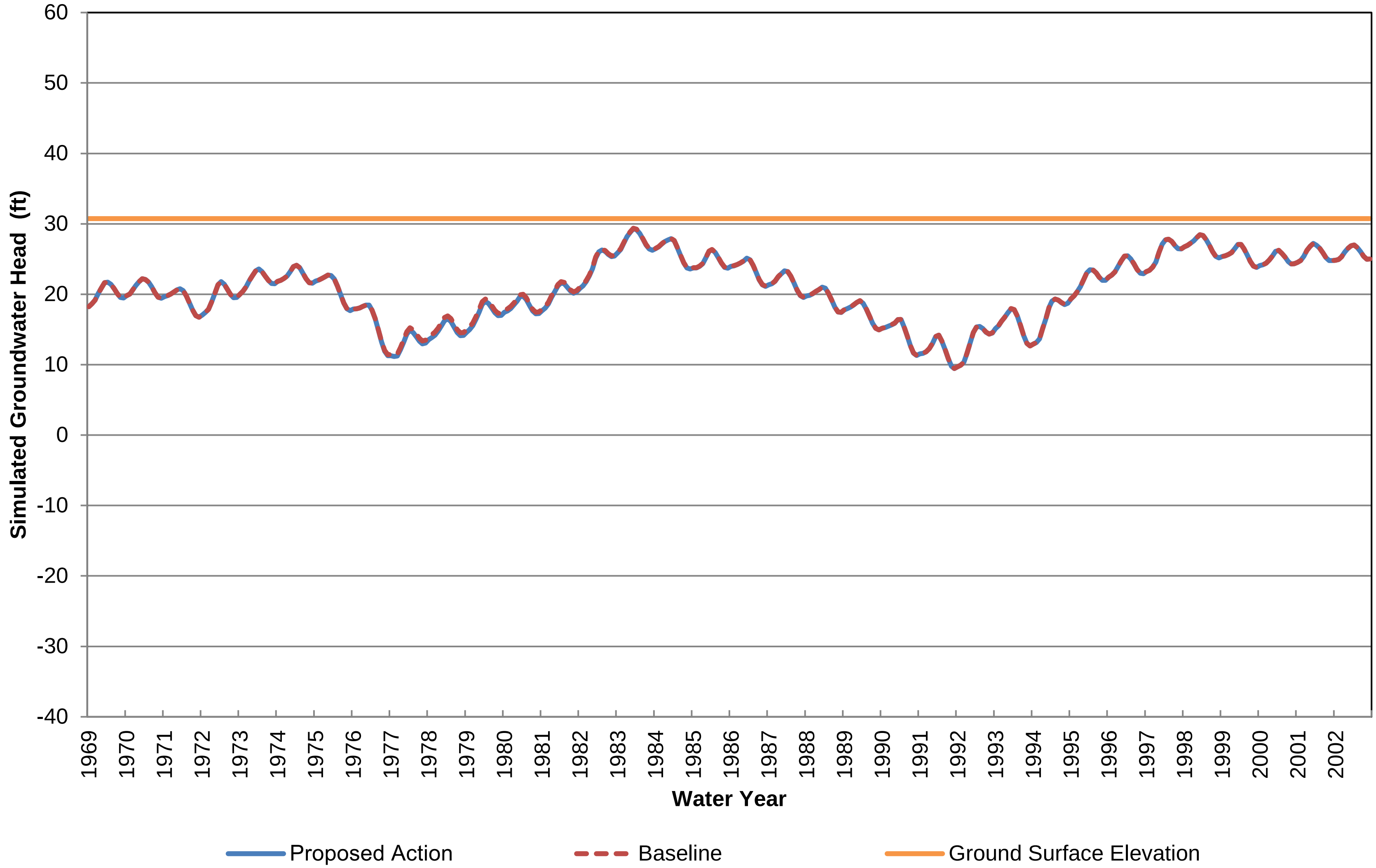
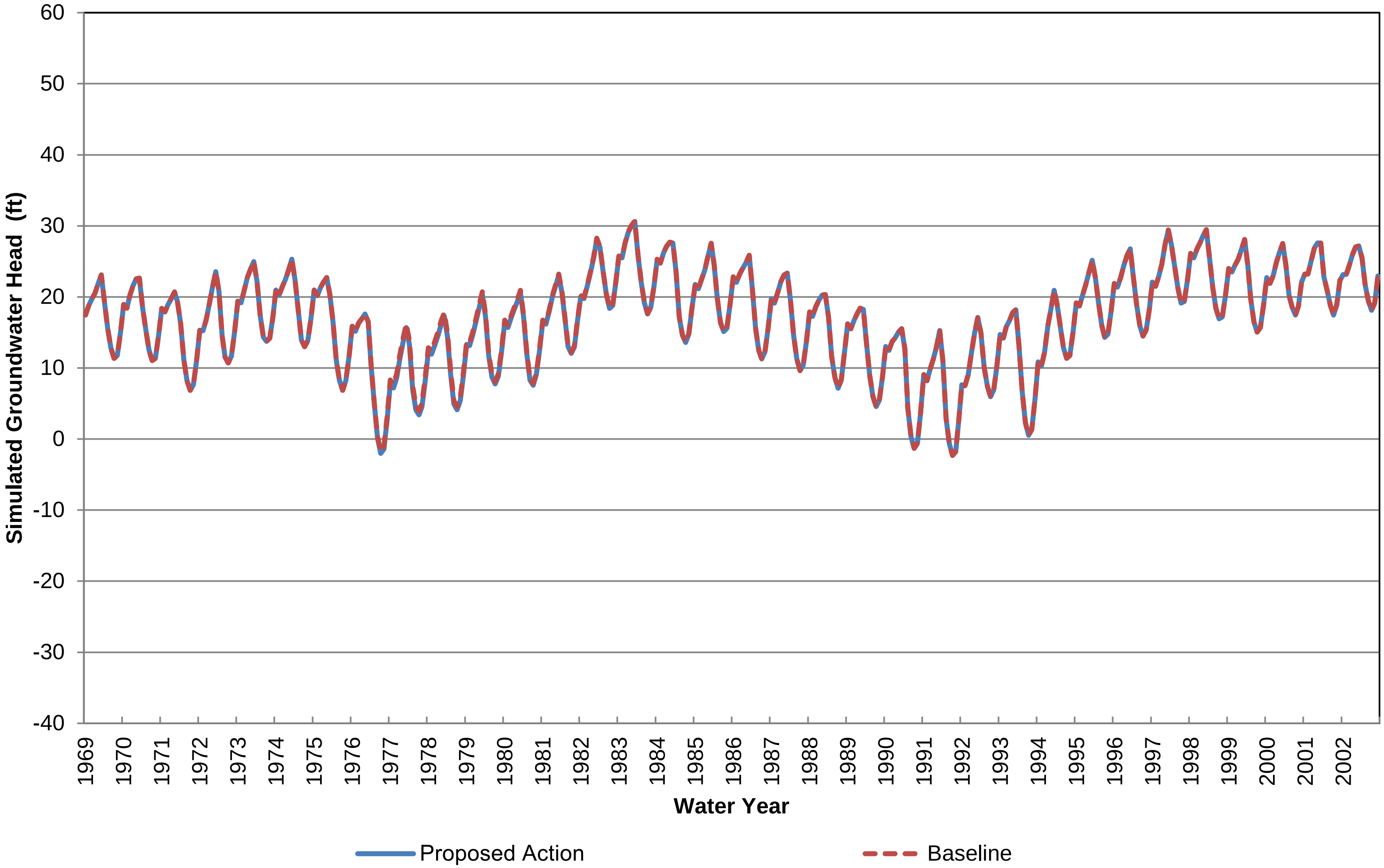
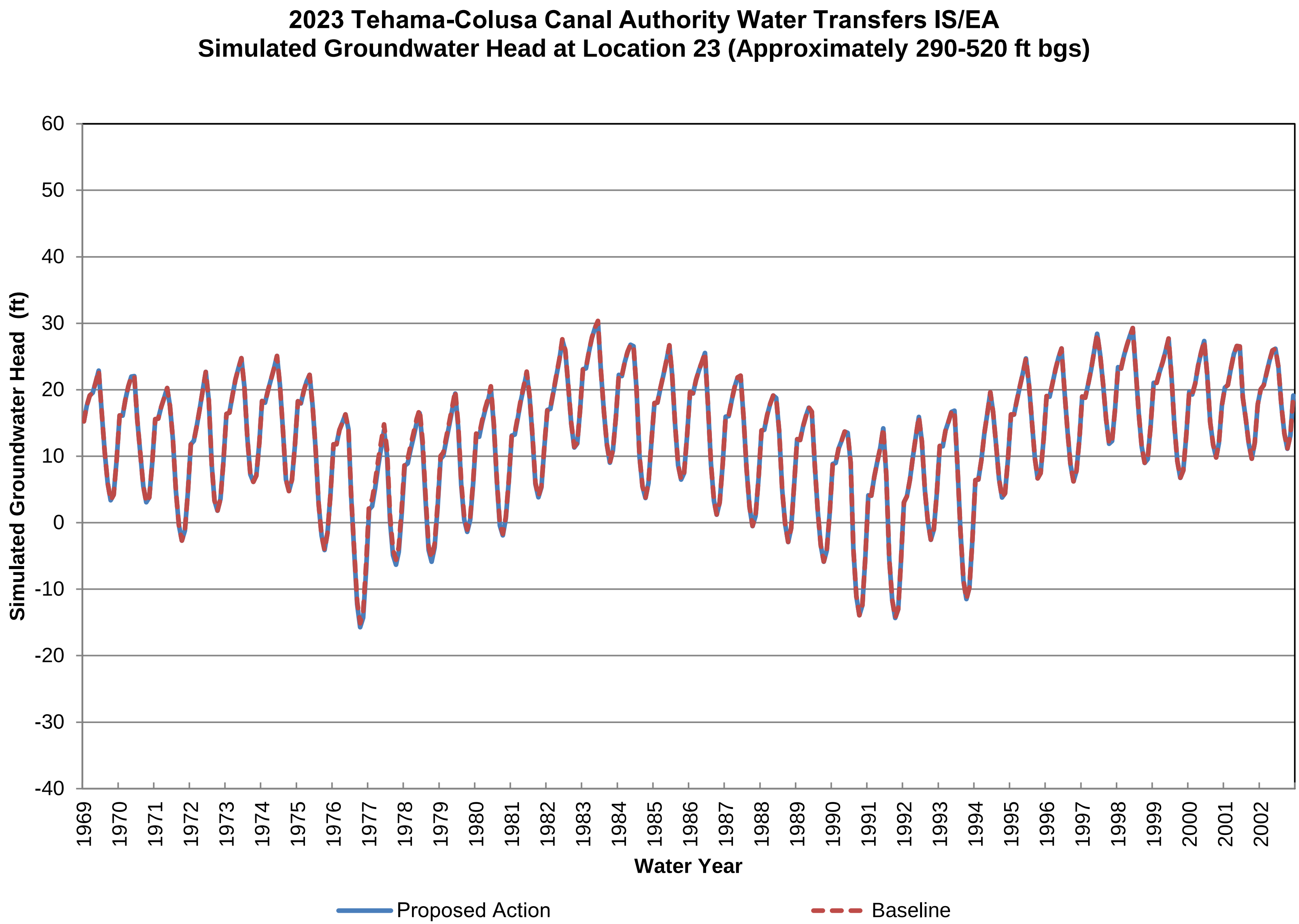
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 23 (Approximately 0-70 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 23 (Approximately 70-290 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 23 (Approximately 290-520 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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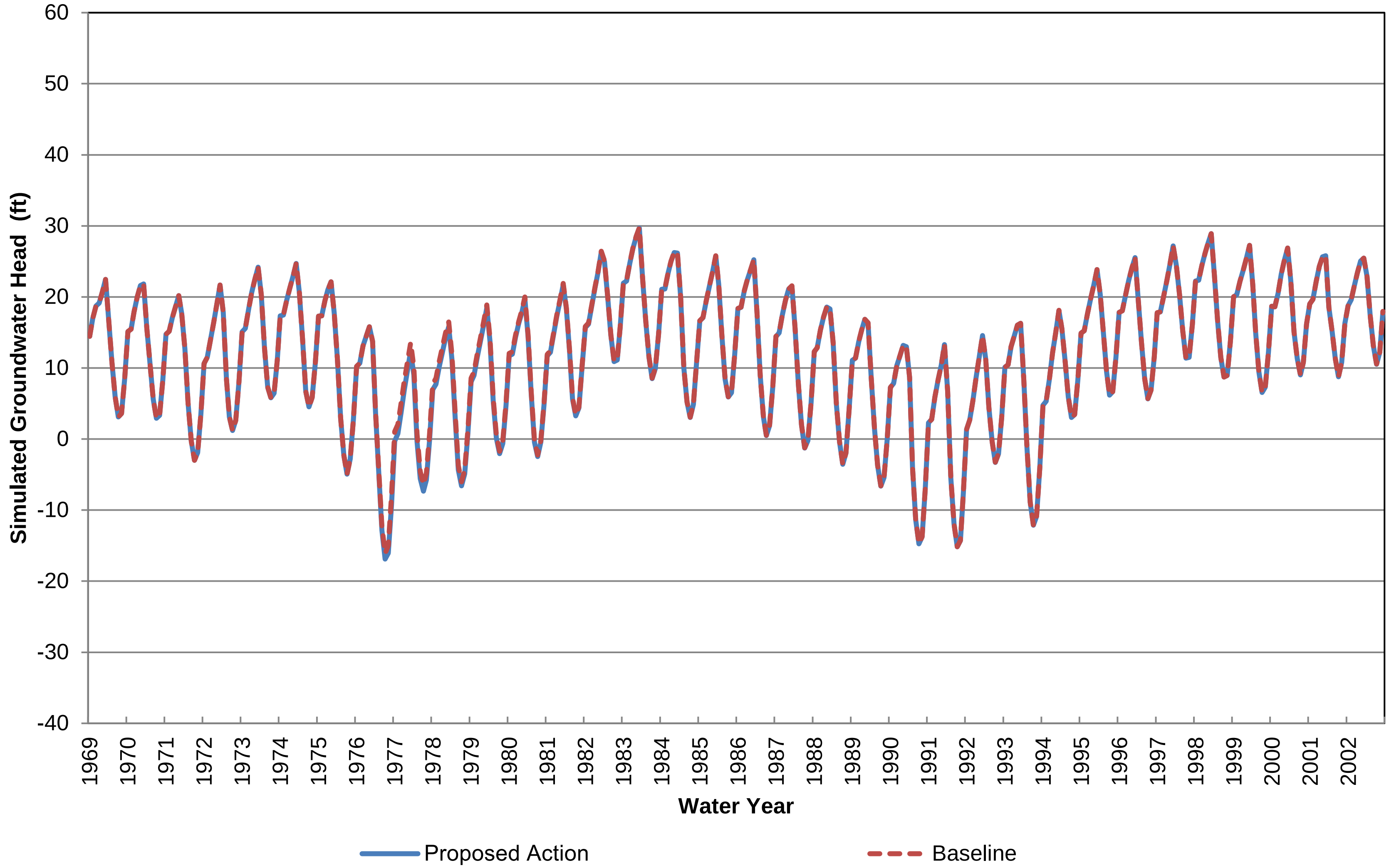
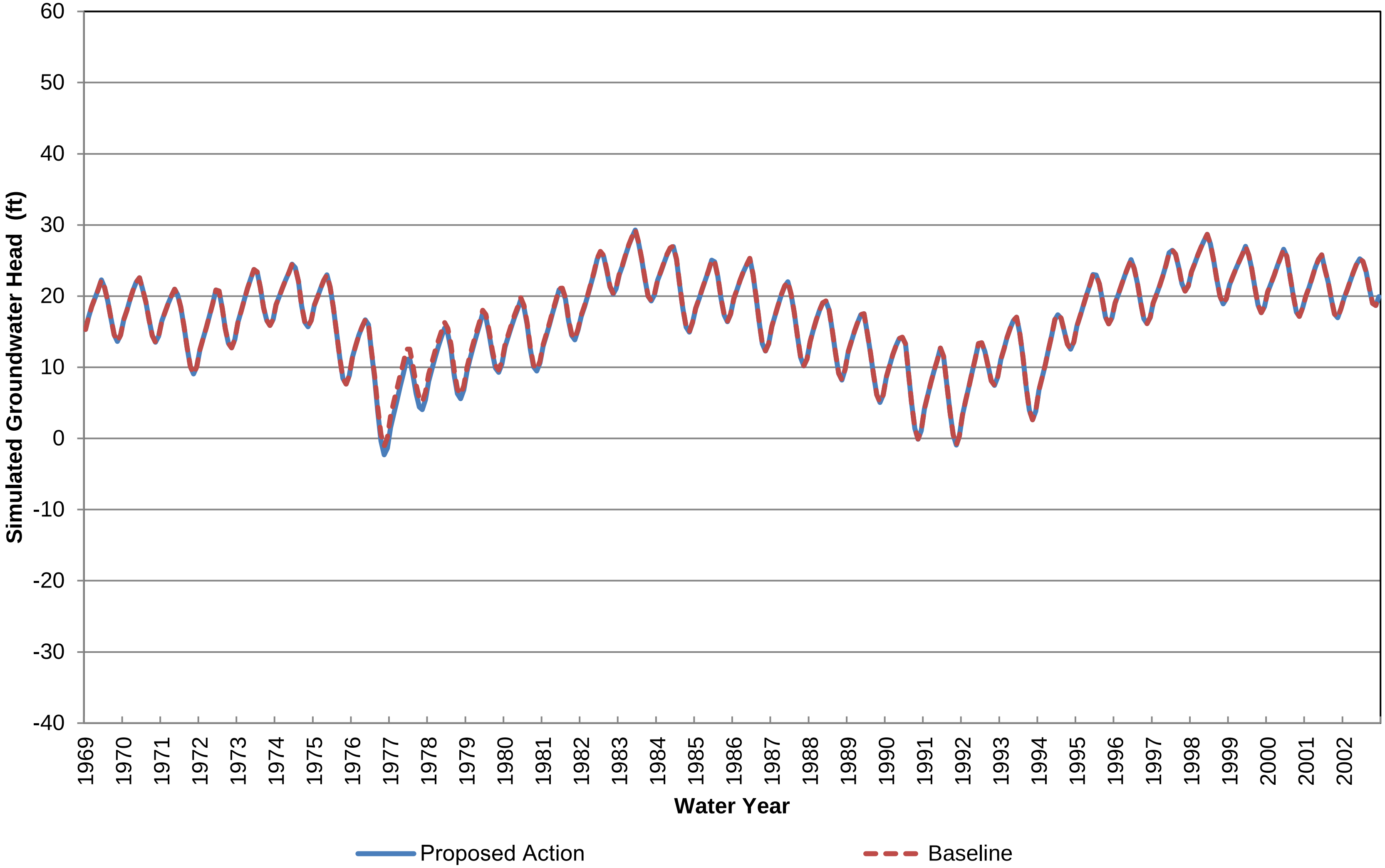
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

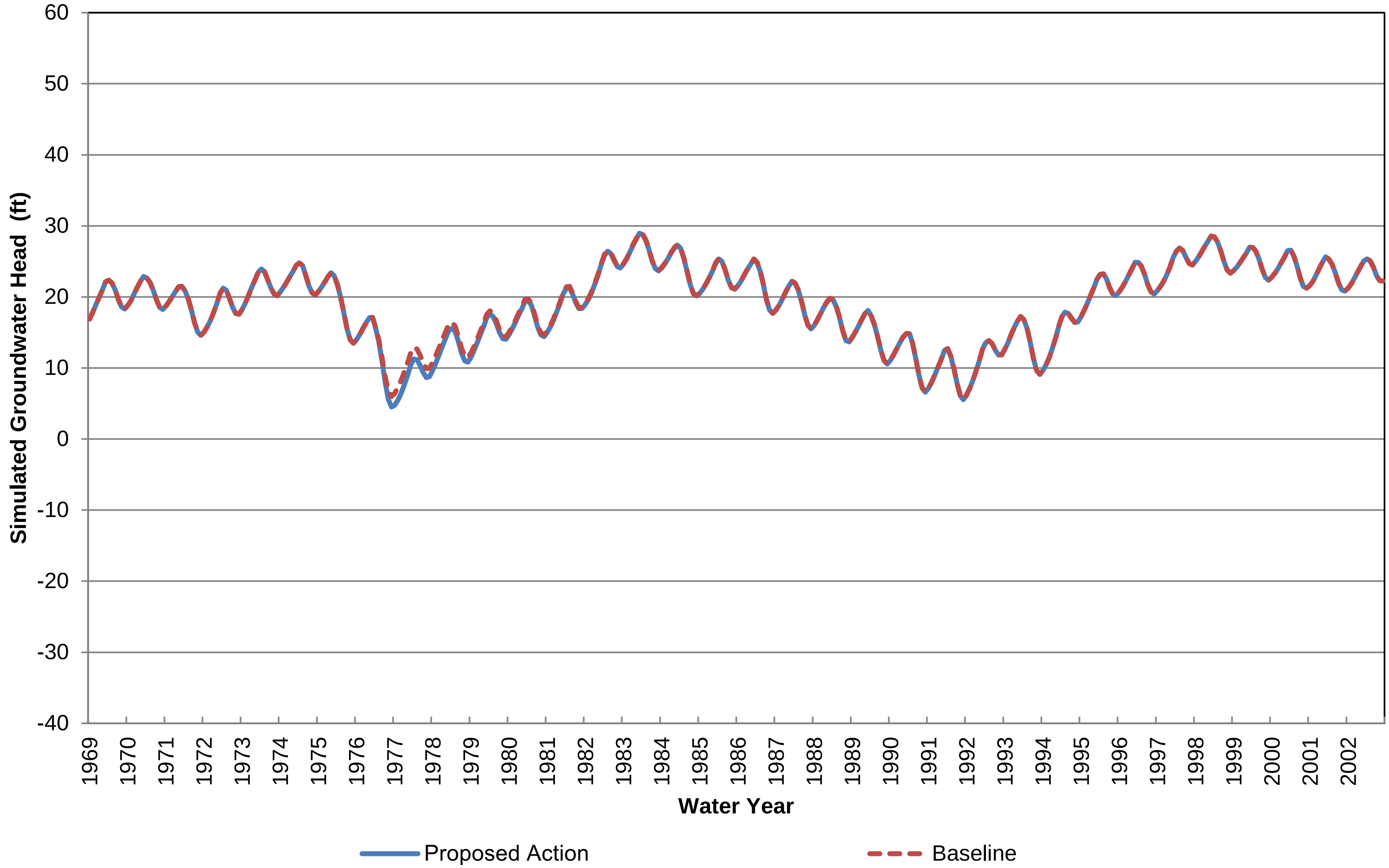
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 23 (Approximately 520-740 ft bgs)

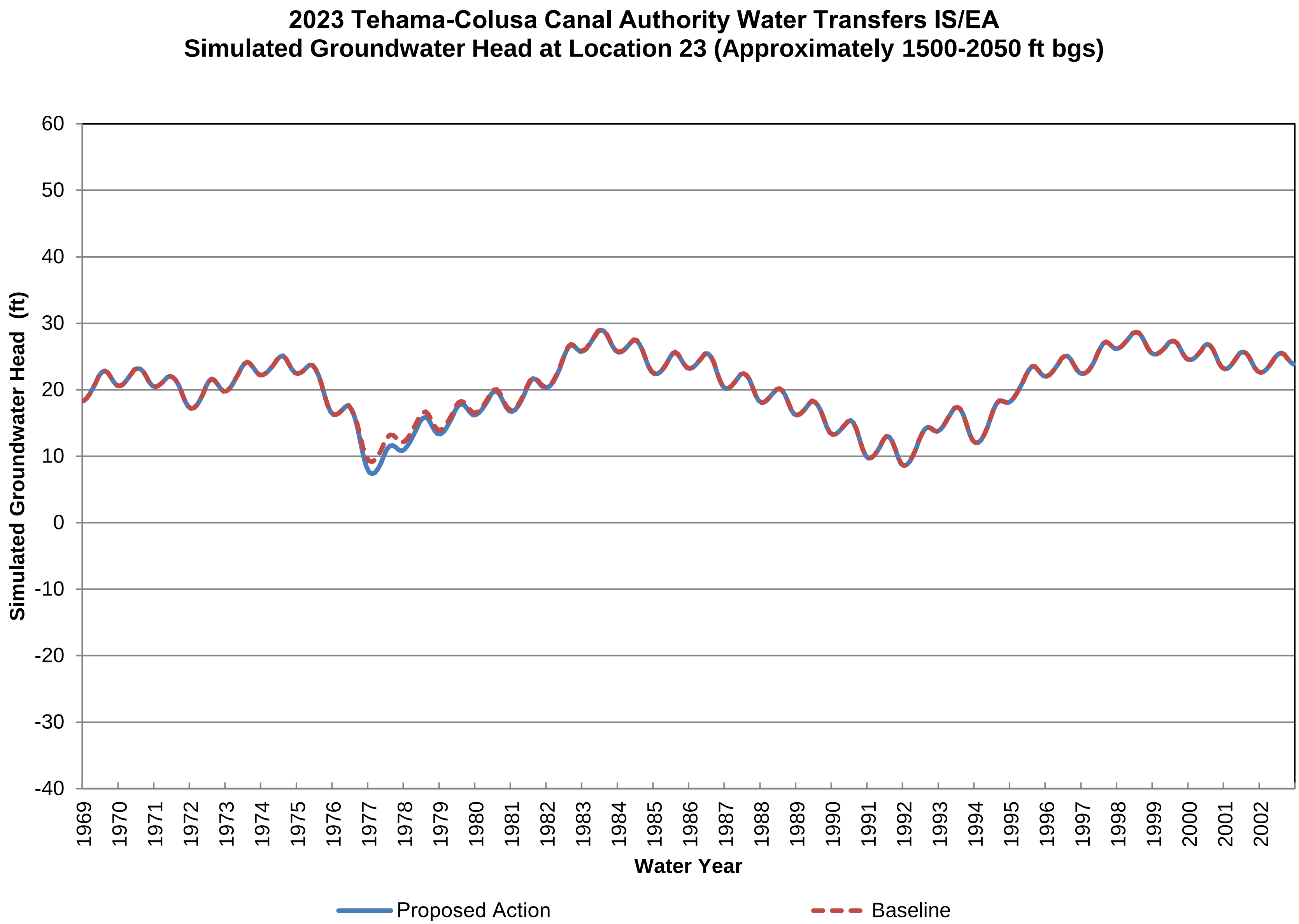


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 23 (Approximately 740-1120 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 23 (Approximately 1120-1500 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 23 (Approximately 1500-2050 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
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1976
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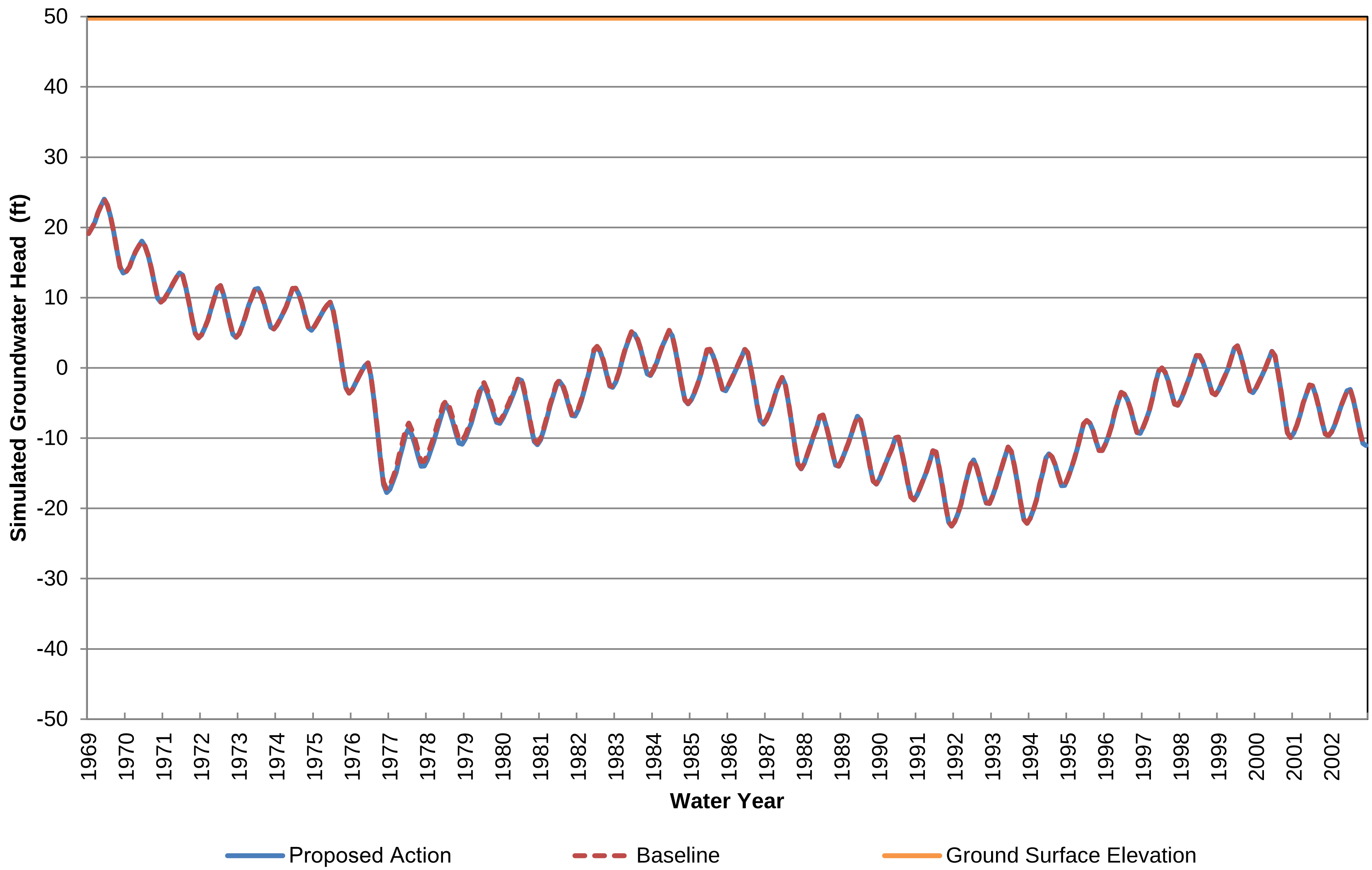
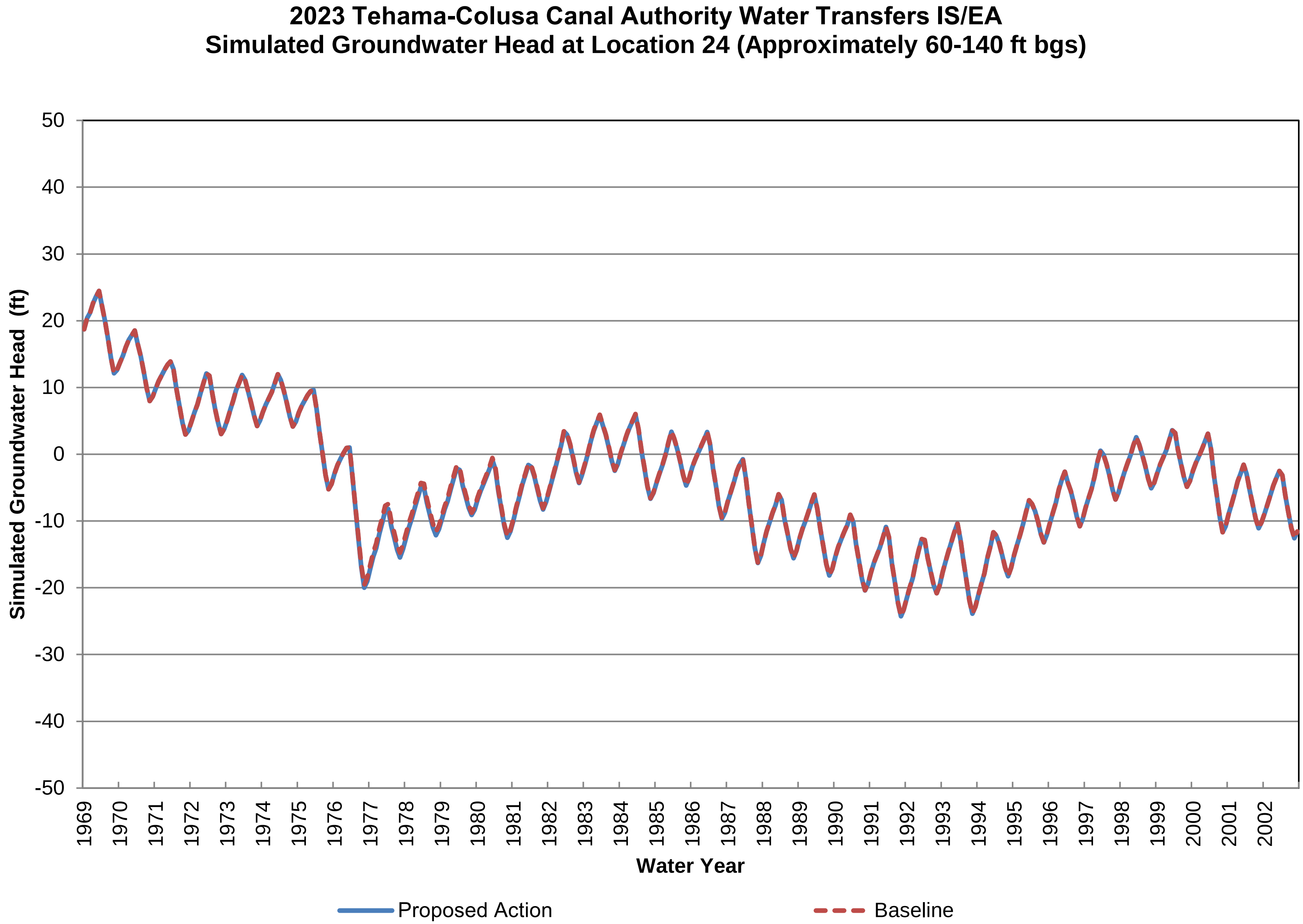
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 24 (Approximately 0-60 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 24 (Approximately 60-140 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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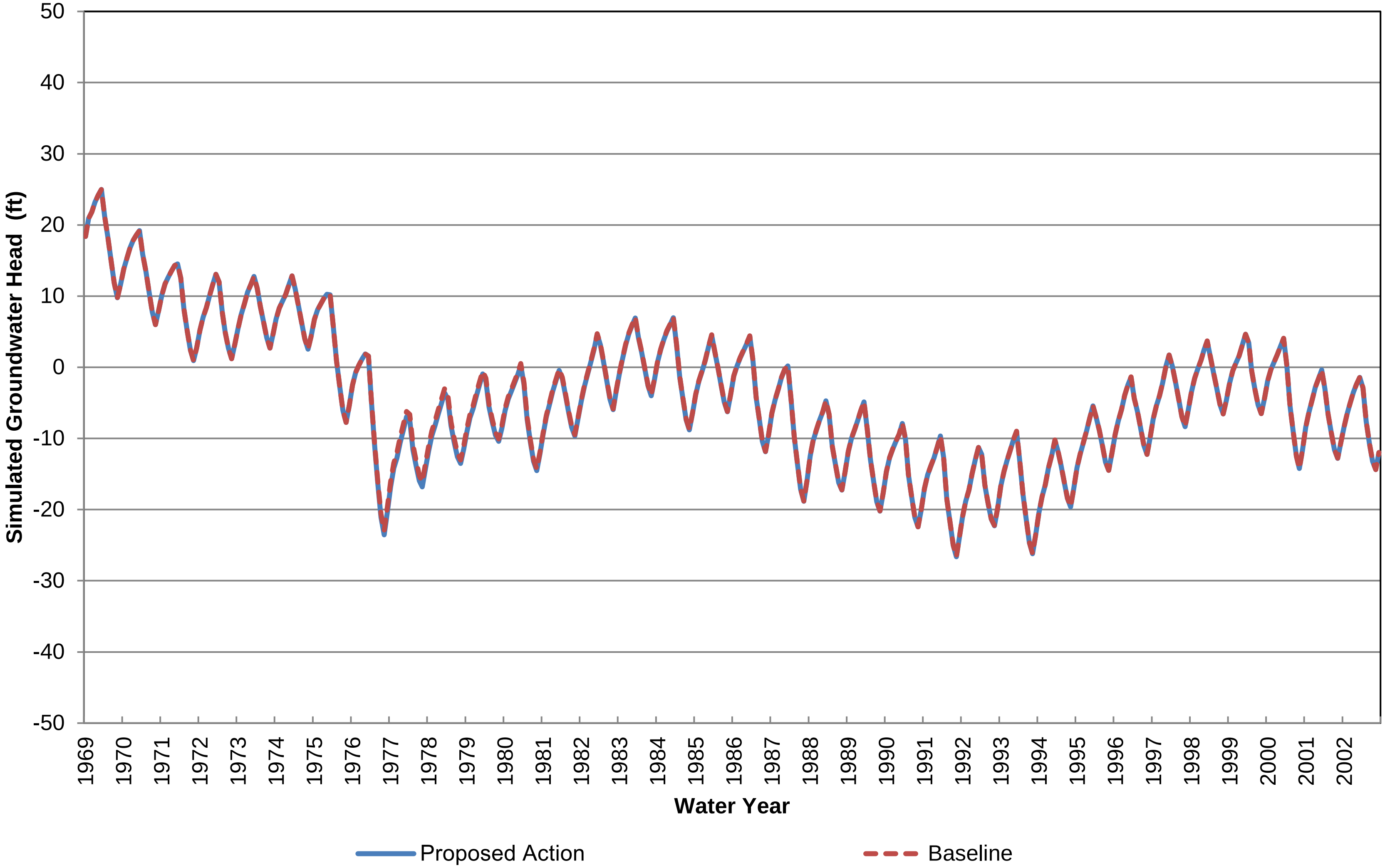
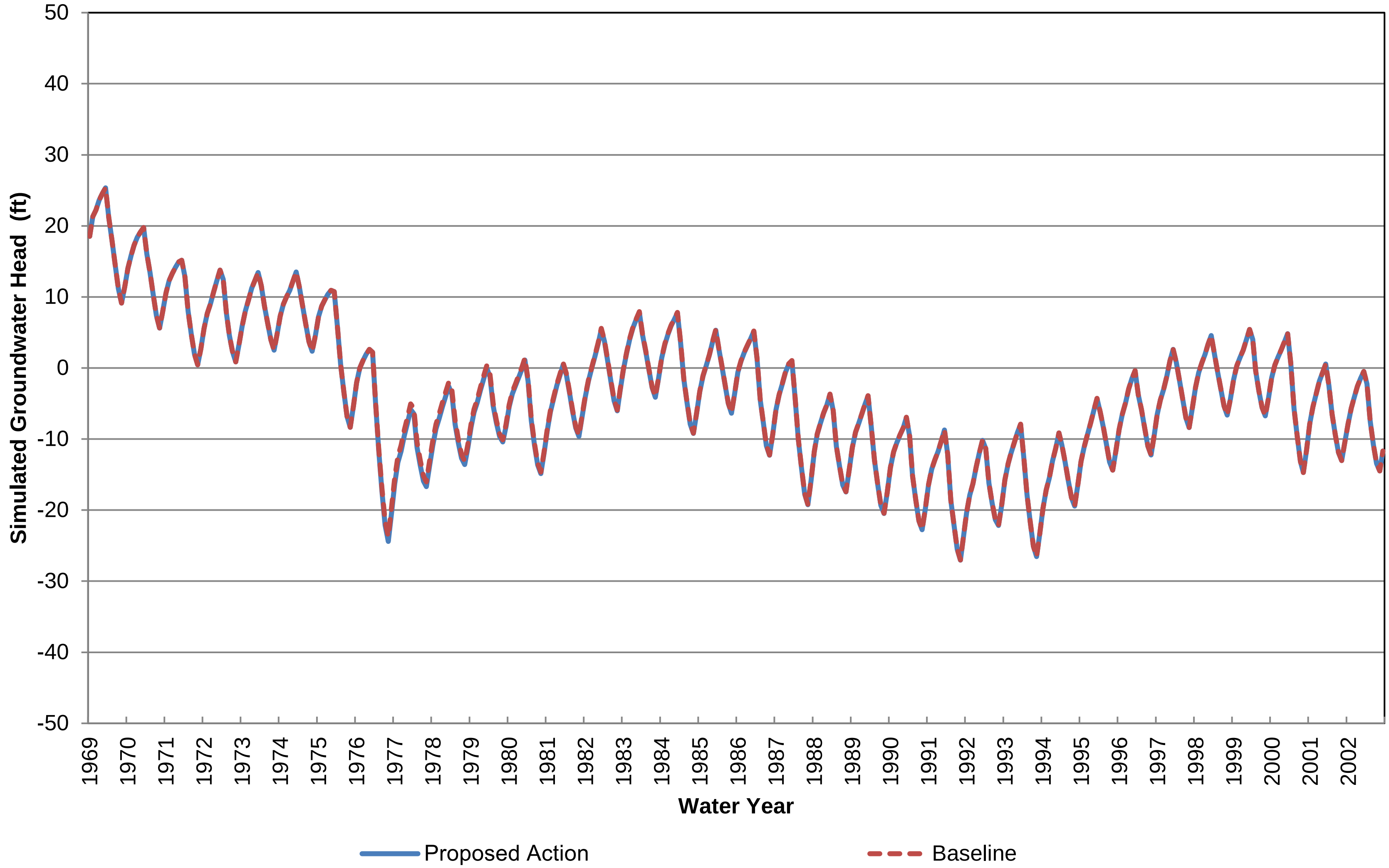
2001
2002
Water Year
Proposed Action
Baseline

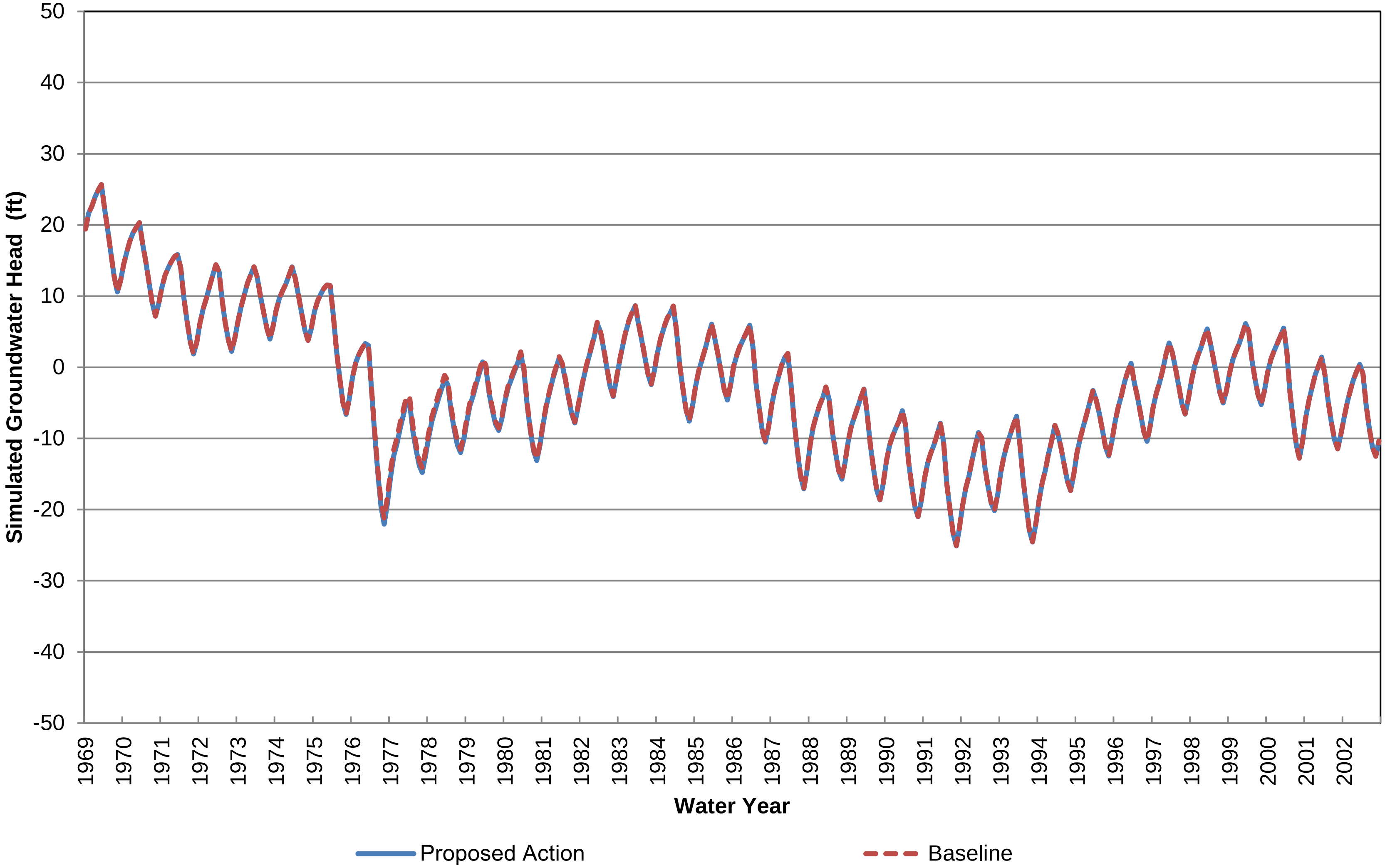
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 24 (Approximately 140-220 ft bgs)

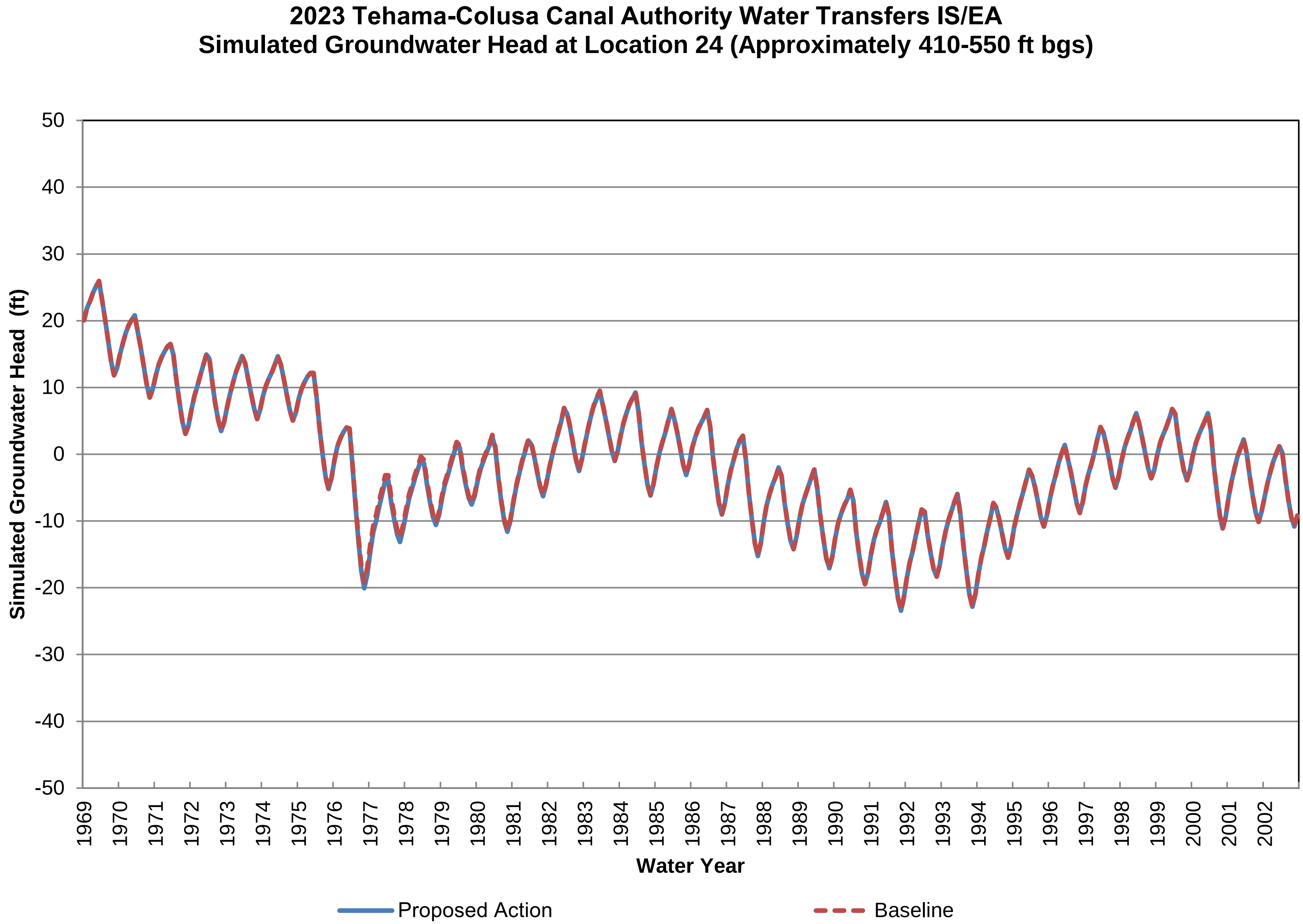


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 24 (Approximately 220-300 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 24 (Approximately 300-410 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 24 (Approximately 410-550 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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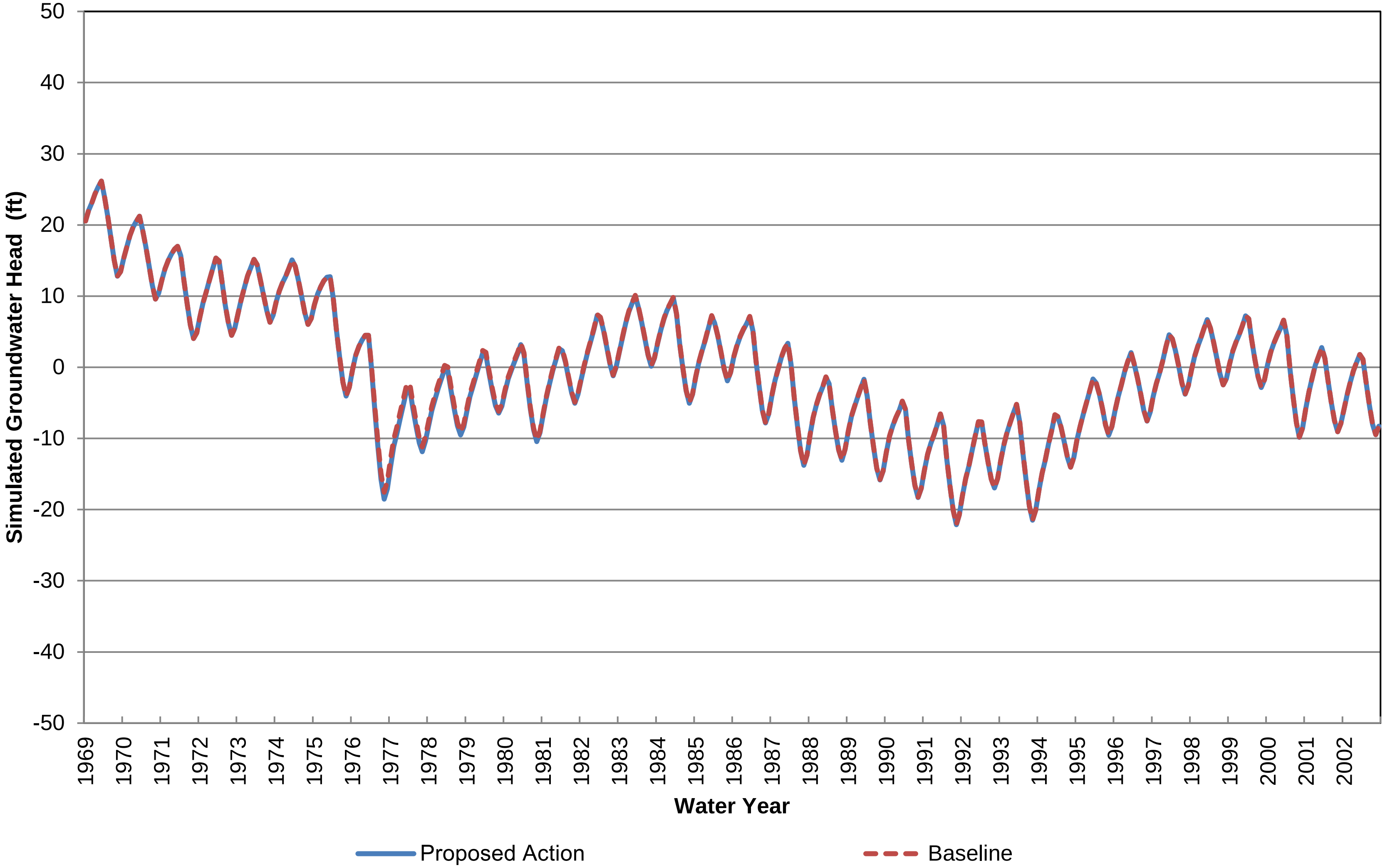
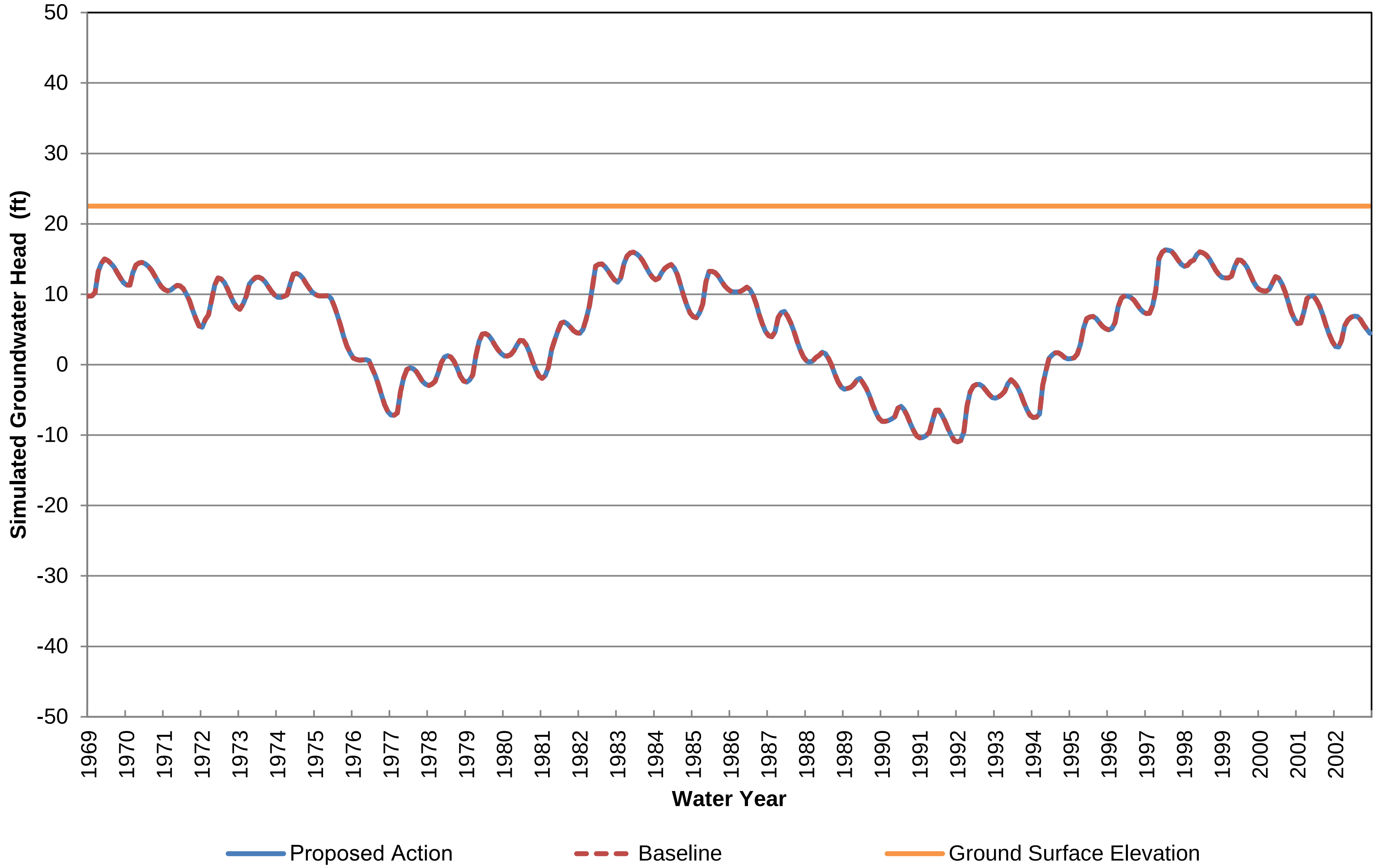
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

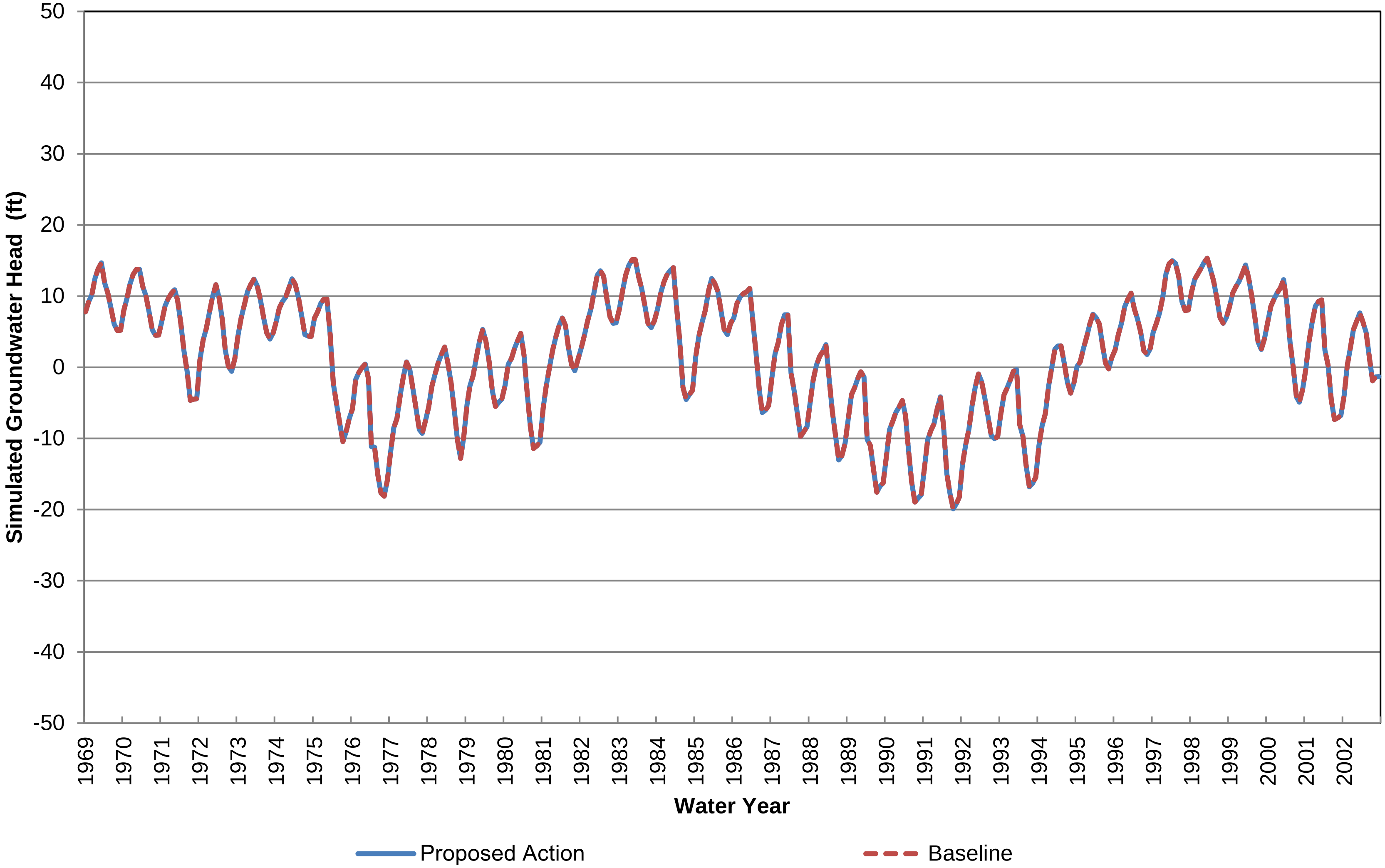
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 24 (Approximately 550-750 ft bgs)



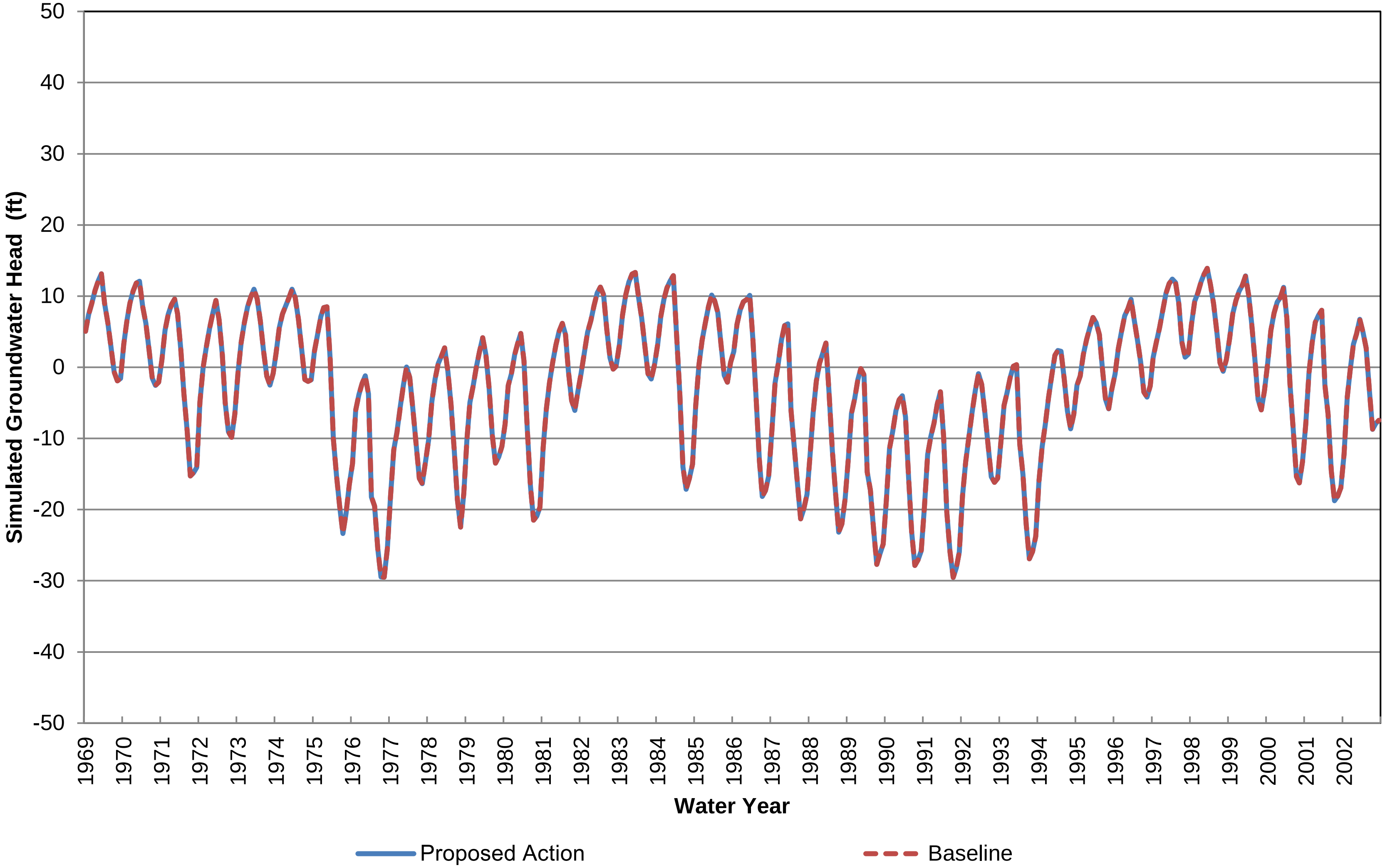
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 25 (Approximately 0-70 ft bgs)



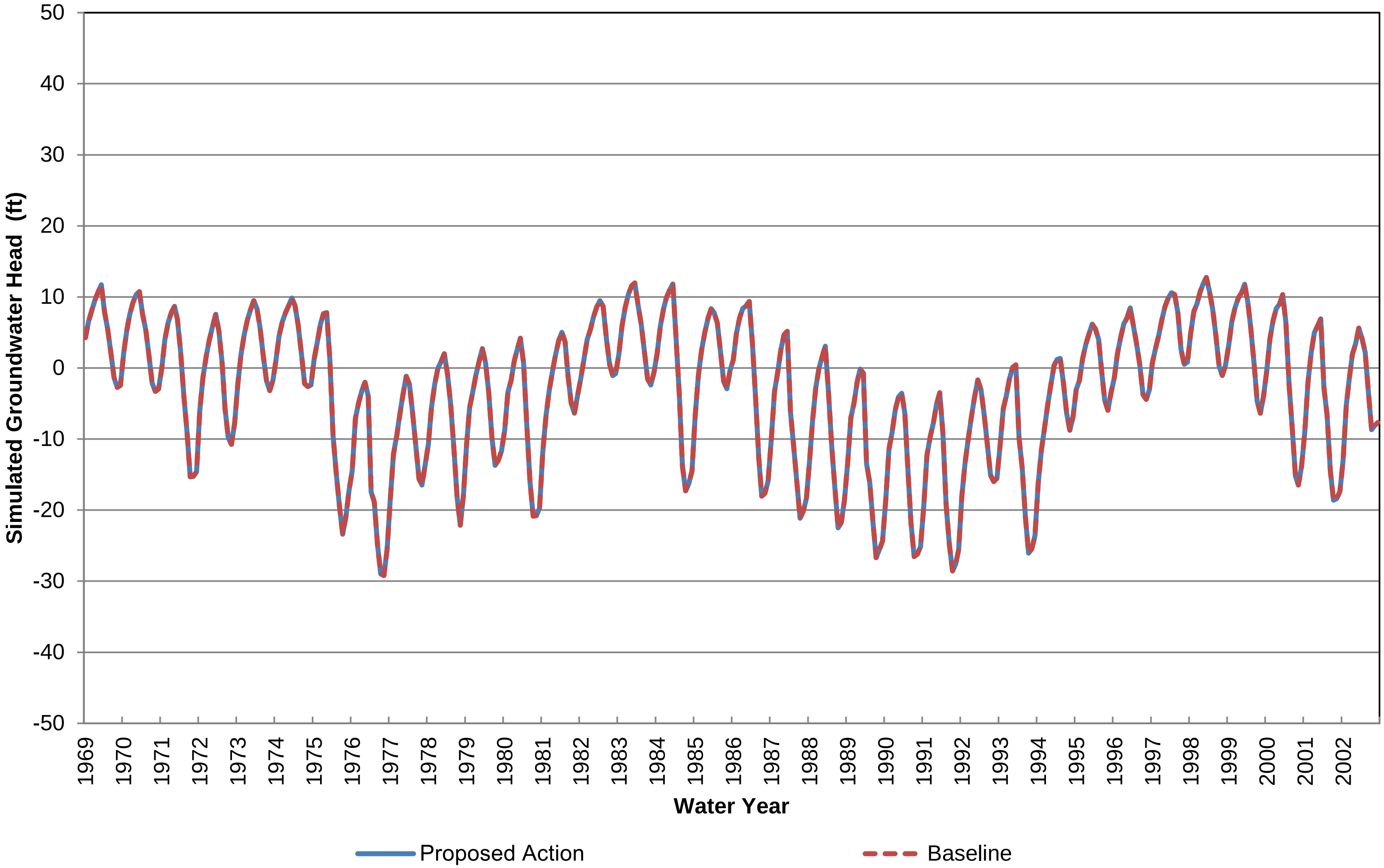
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 25 (Approximately 70-380 ft bgs)



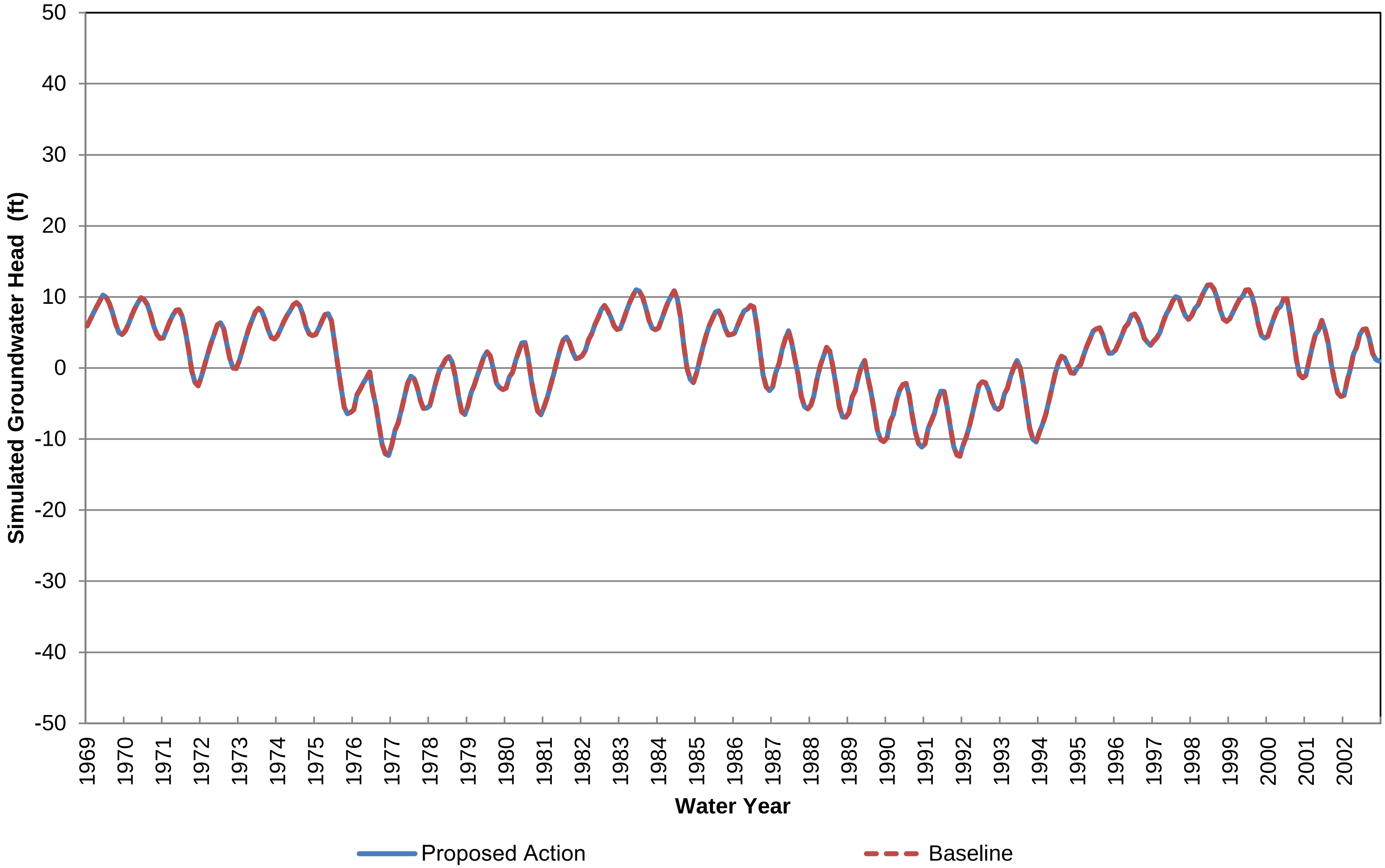
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 25 (Approximately 380-680 ft bgs)



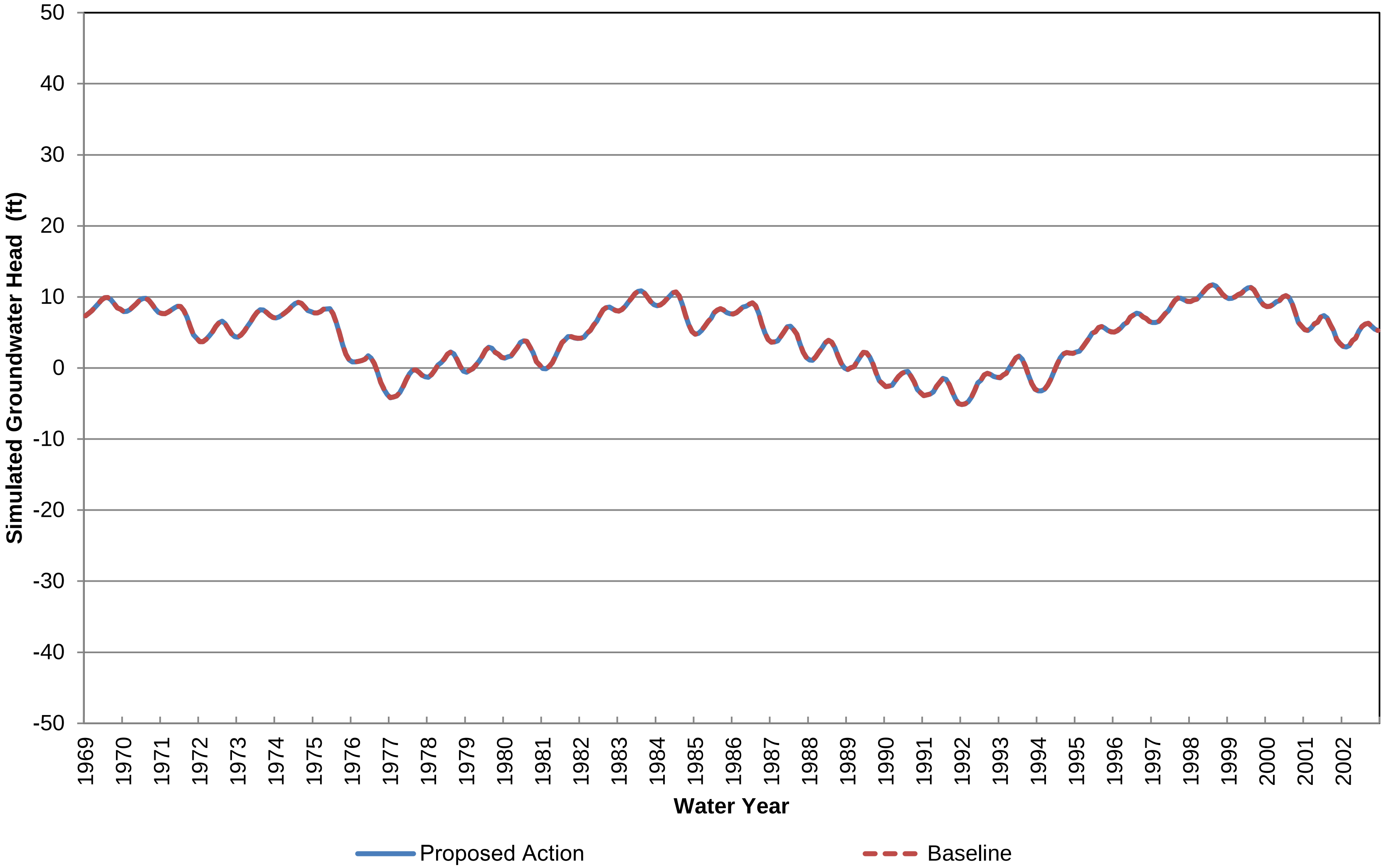
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 25 (Approximately 680-990 ft bgs)

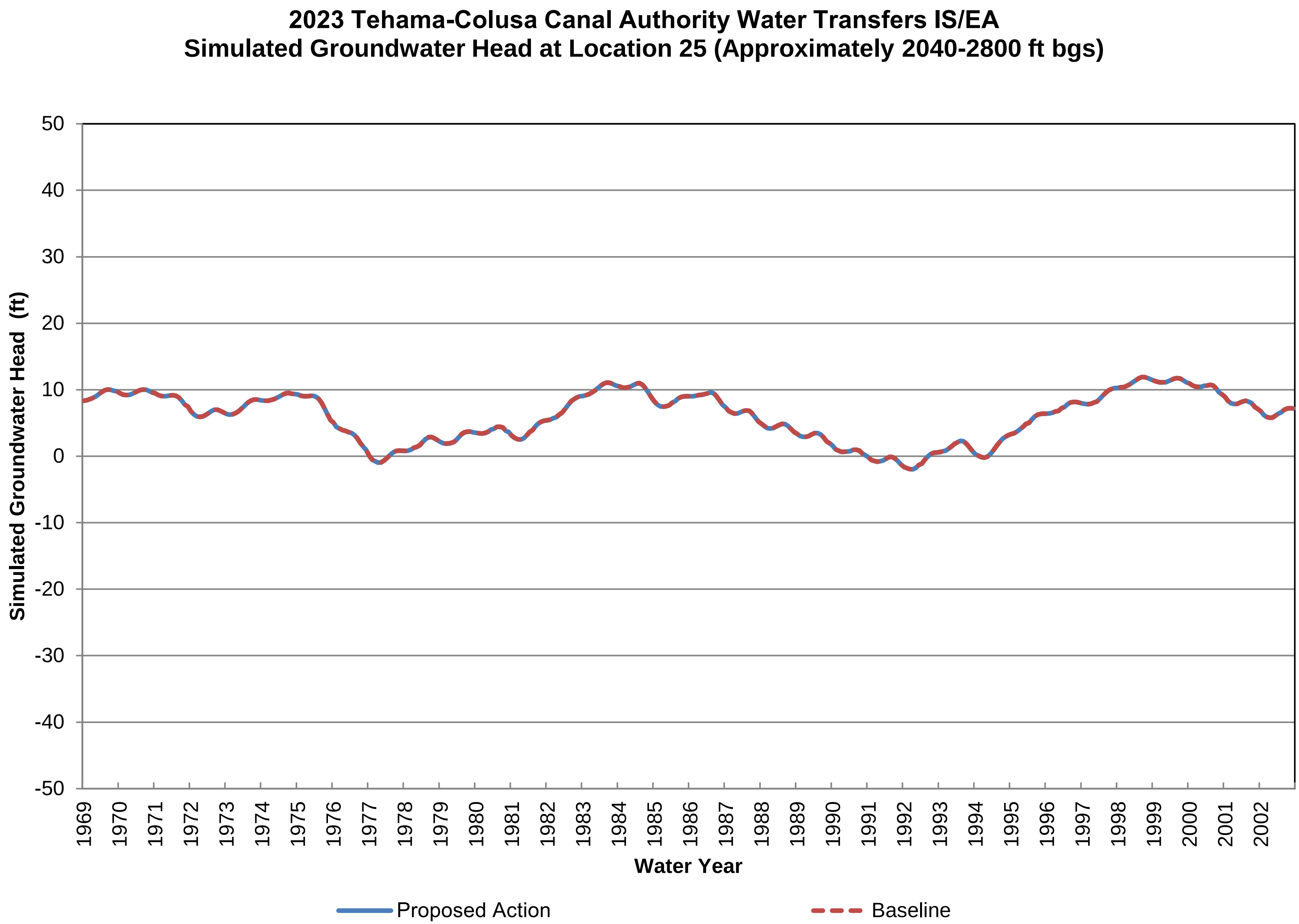


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 25 (Approximately 990-1530 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 25 (Approximately 1530-2040 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 25 (Approximately 2040-2800 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1984
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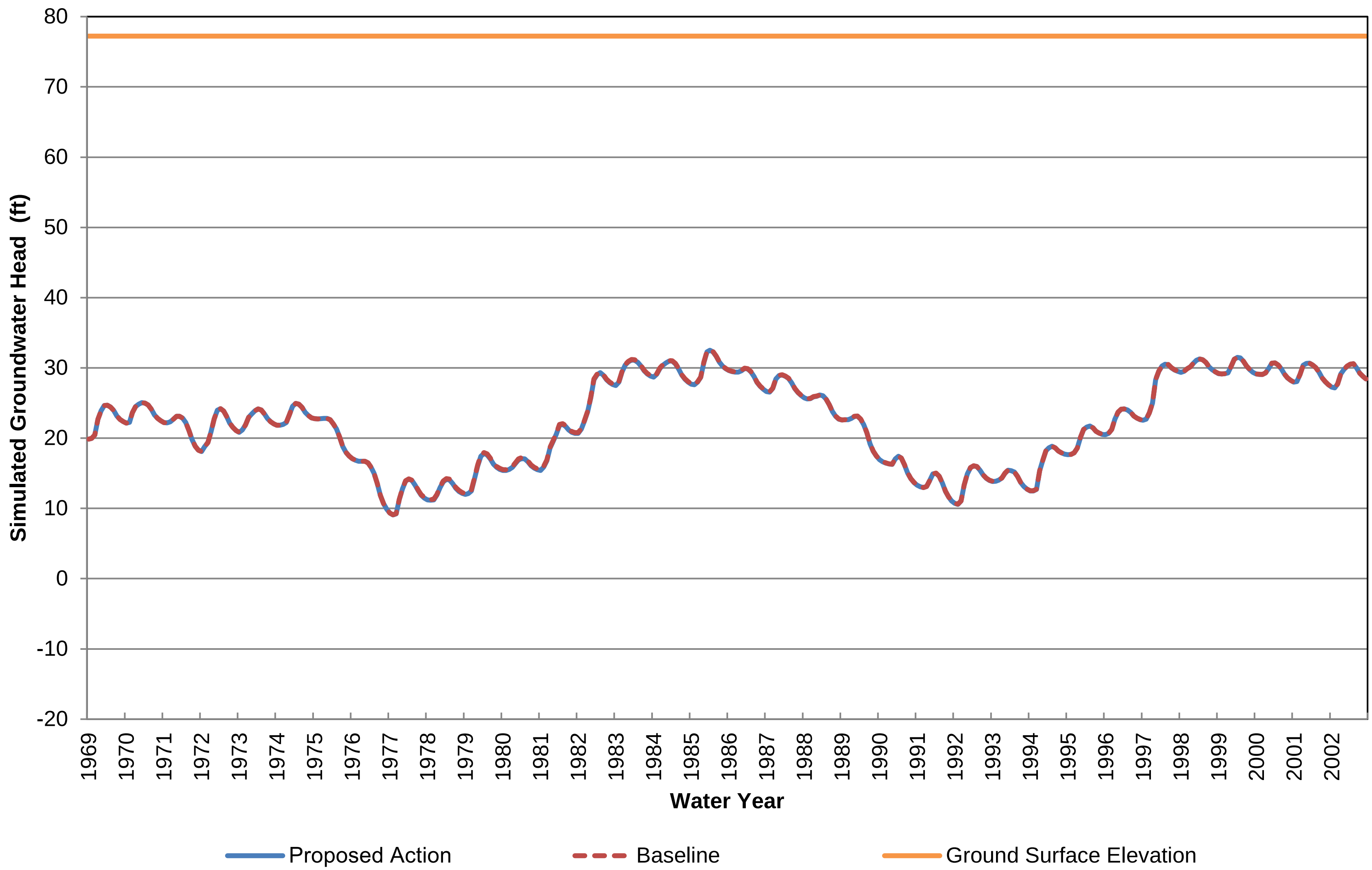
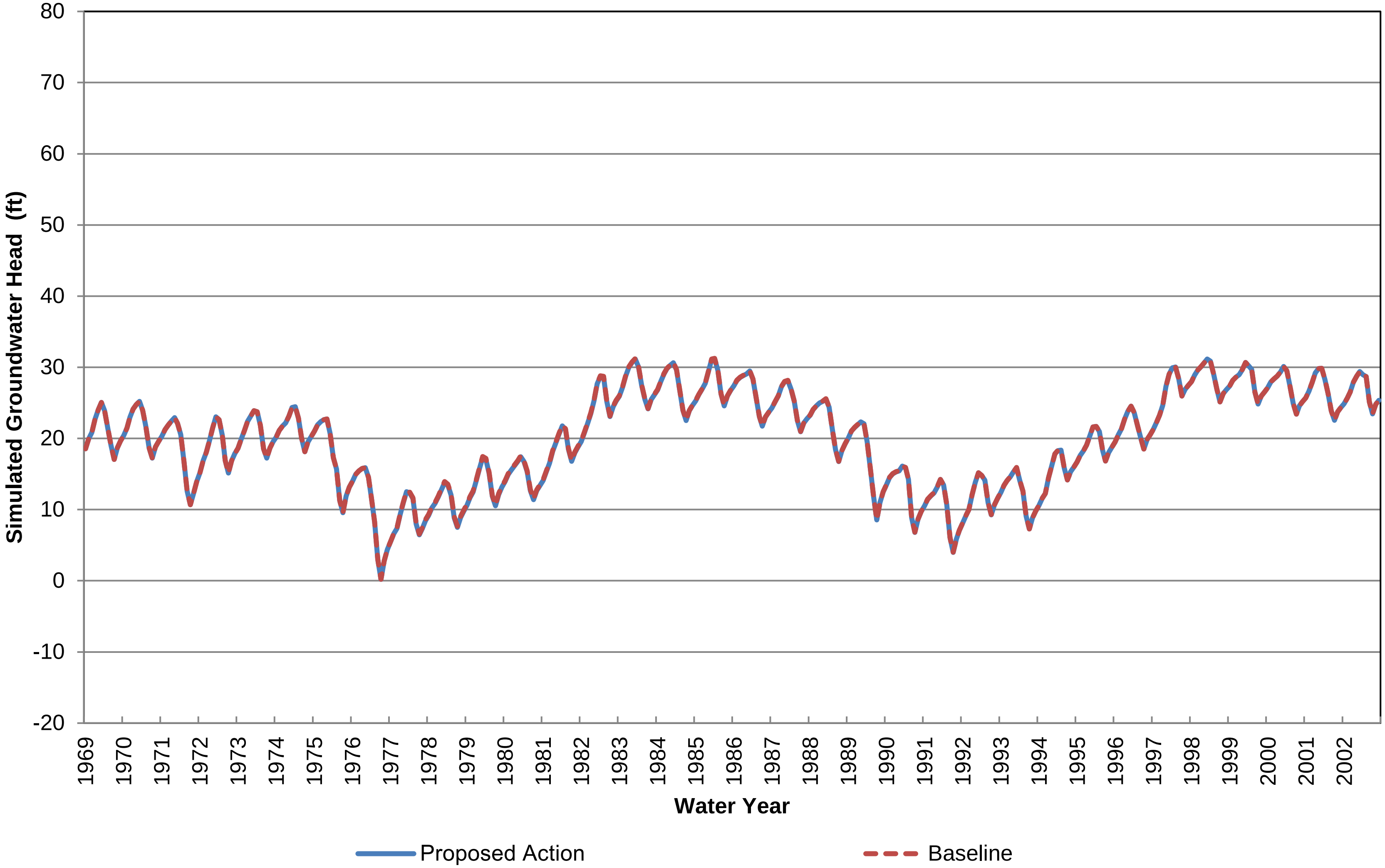
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

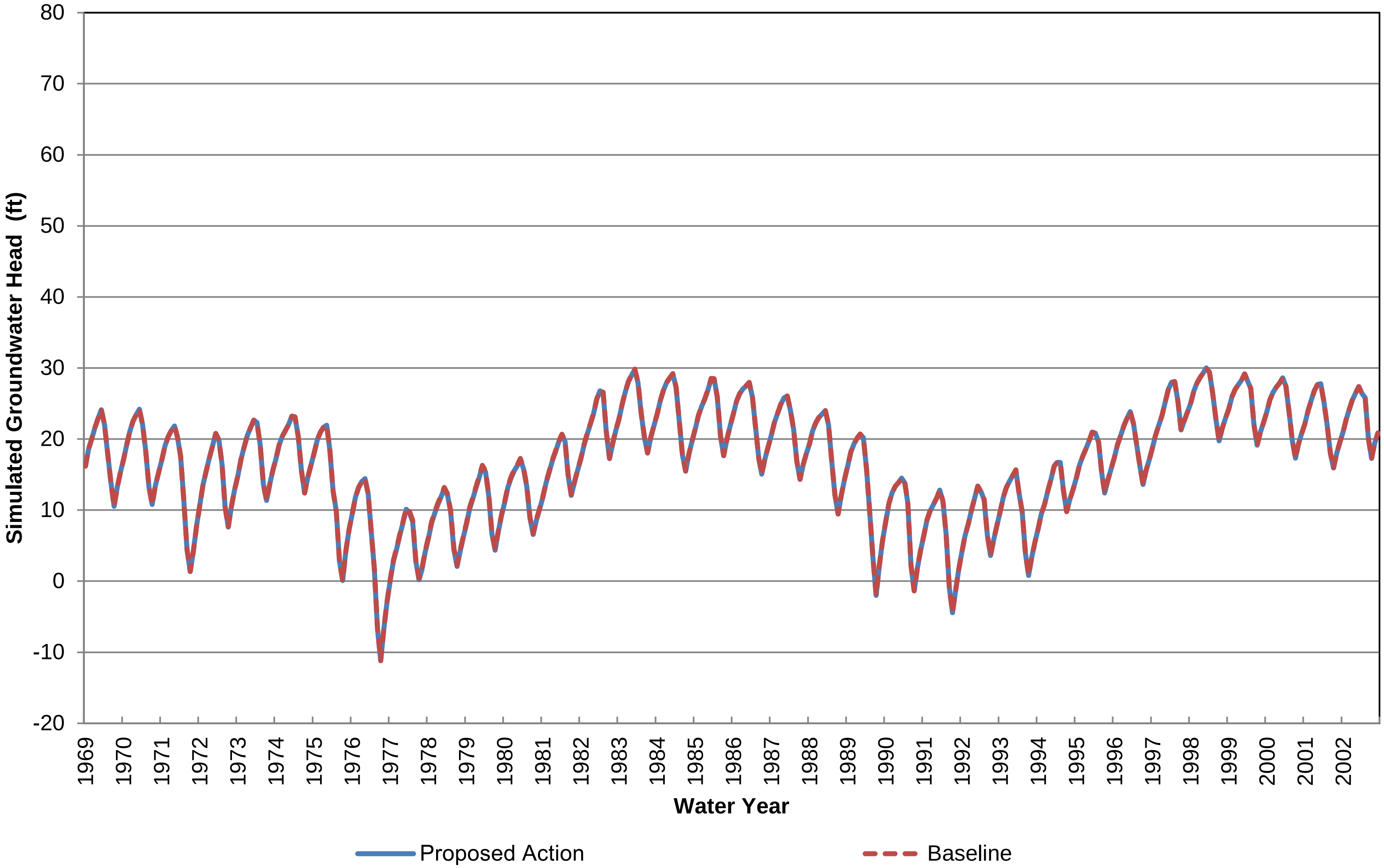
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 26 (Approximately 0-70 ft bgs)

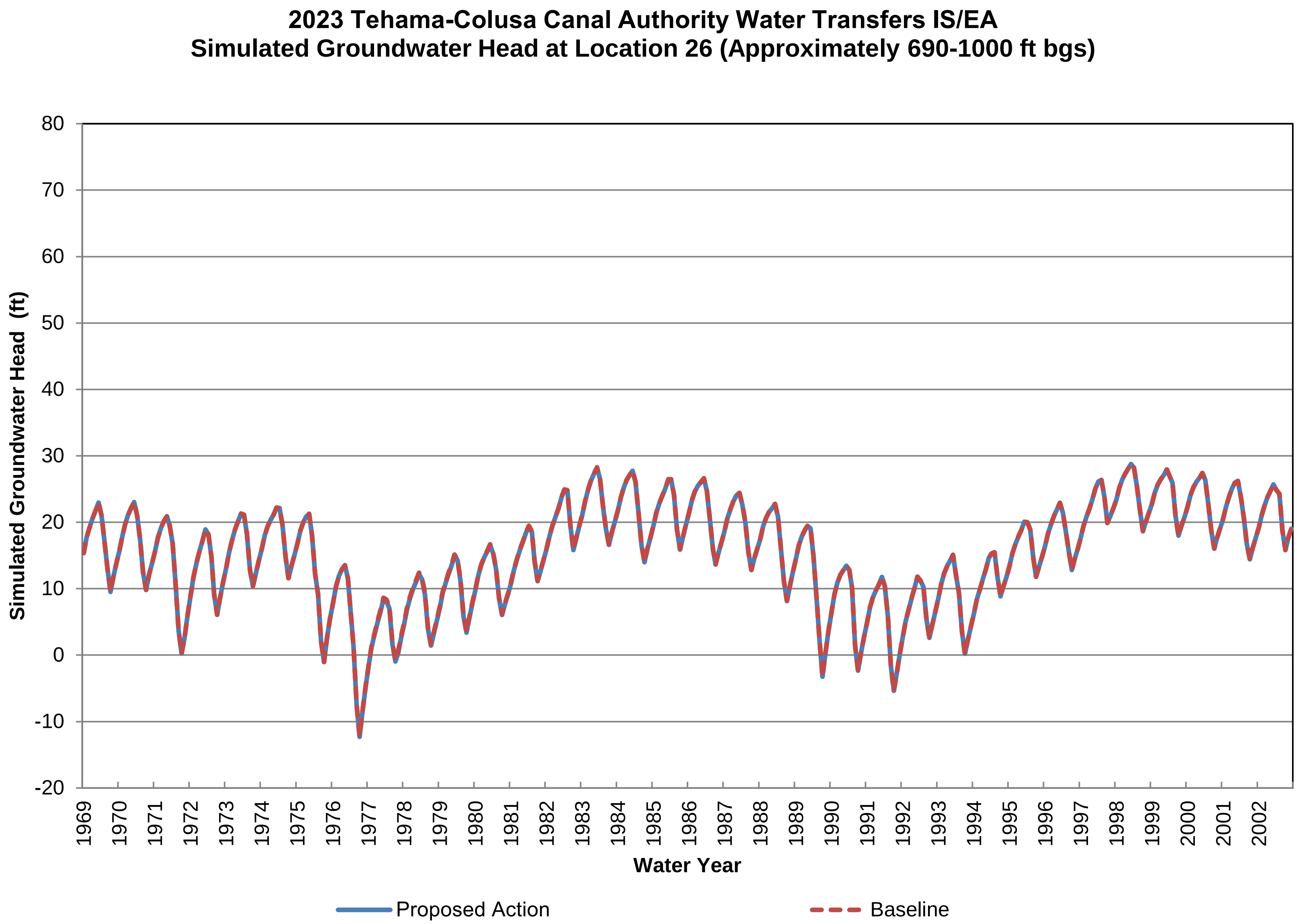


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 26 (Approximately 70-380 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 26 (Approximately 380-690 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 26 (Approximately 690-1000 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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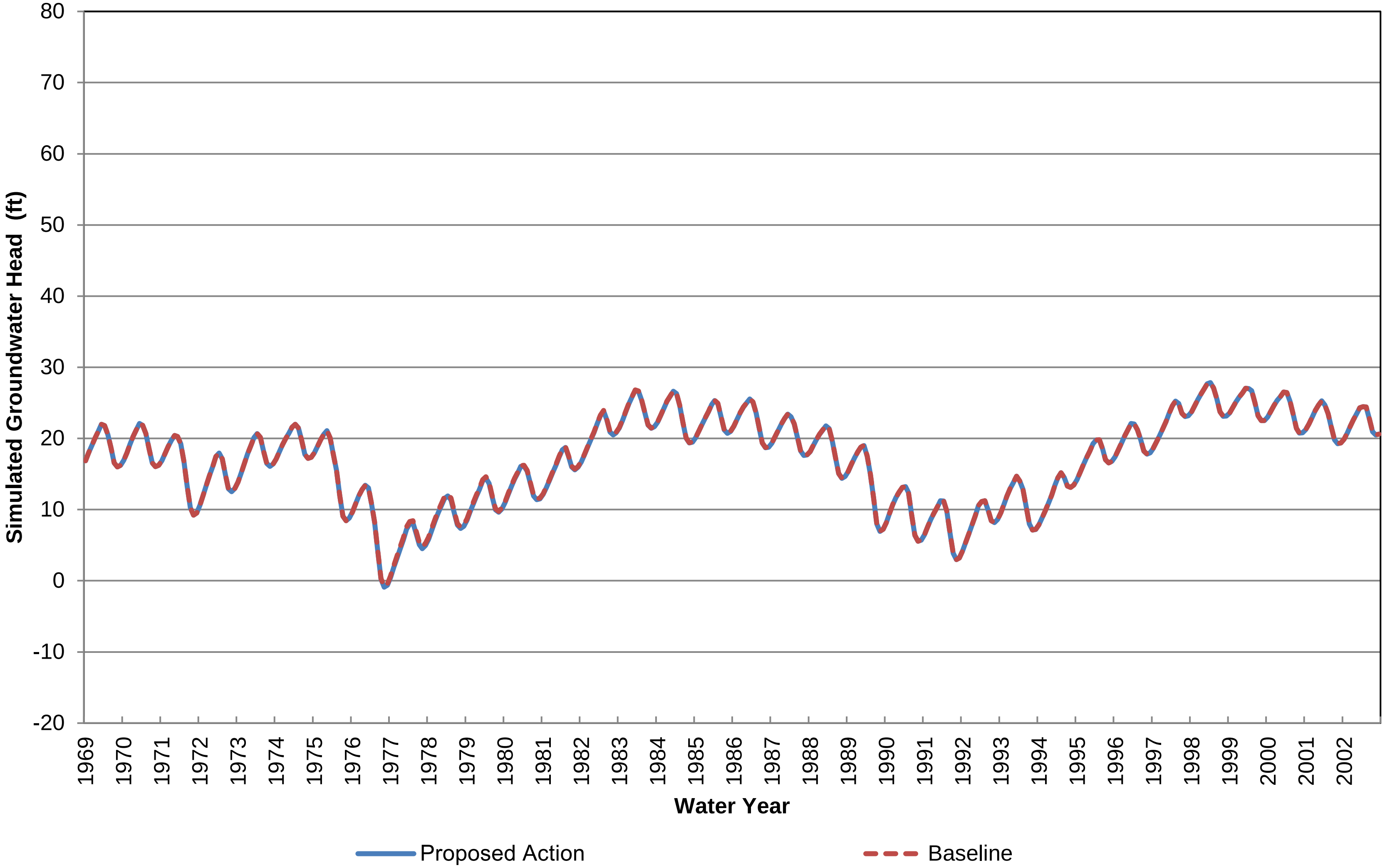
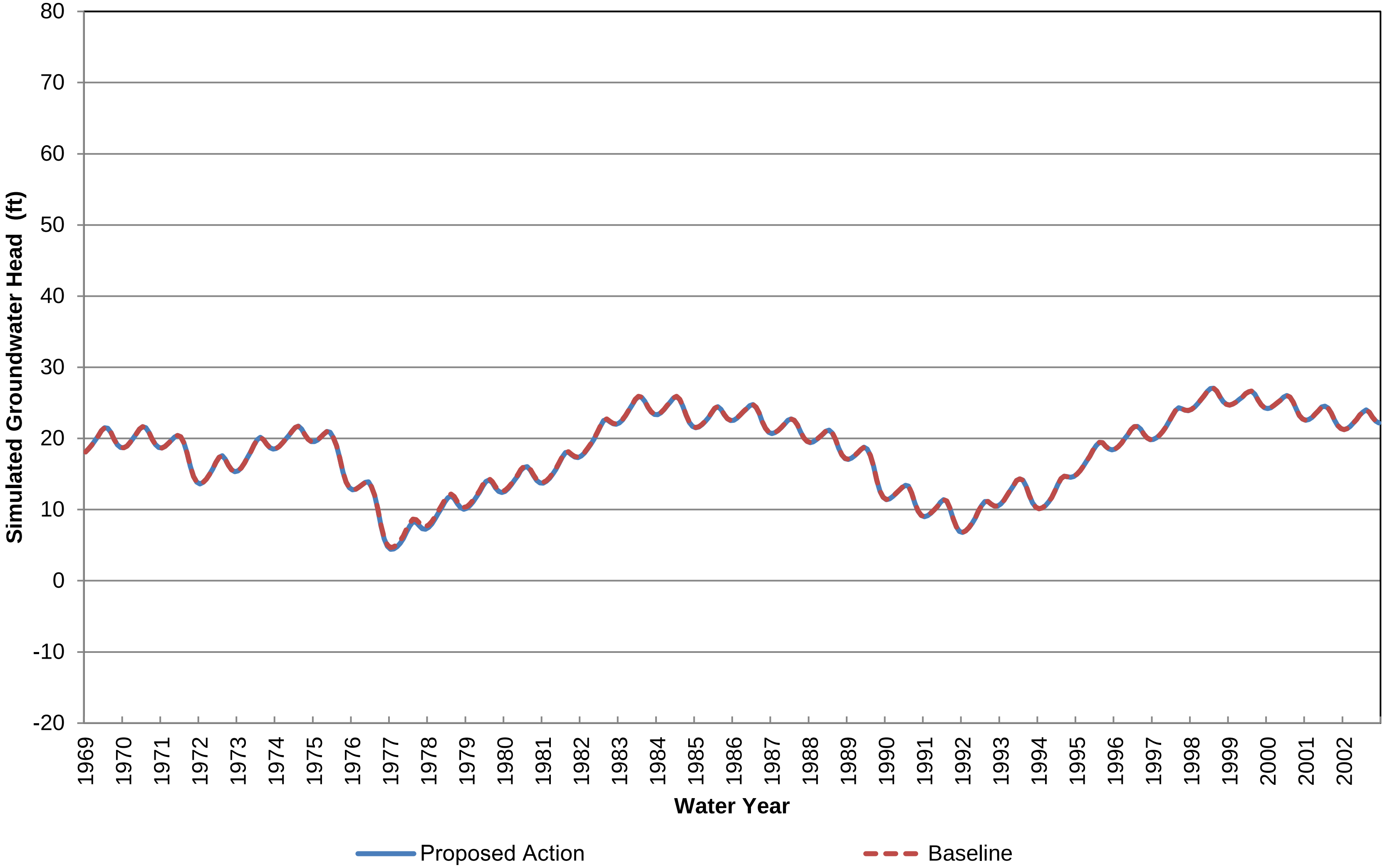
2000
2001
2002
Water Year
Proposed Action
Baseline

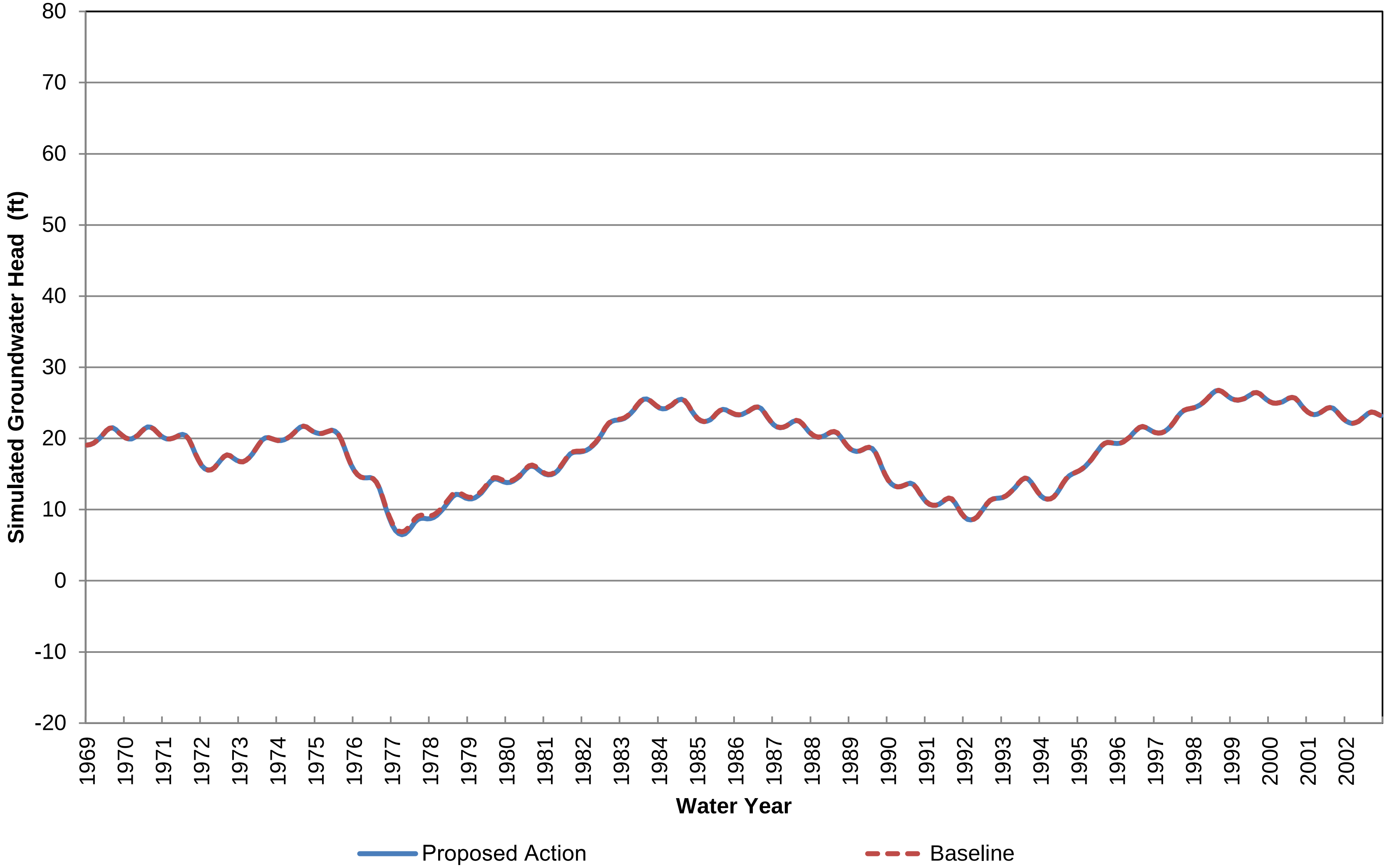
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 26 (Approximately 1000-1550 ft bgs)



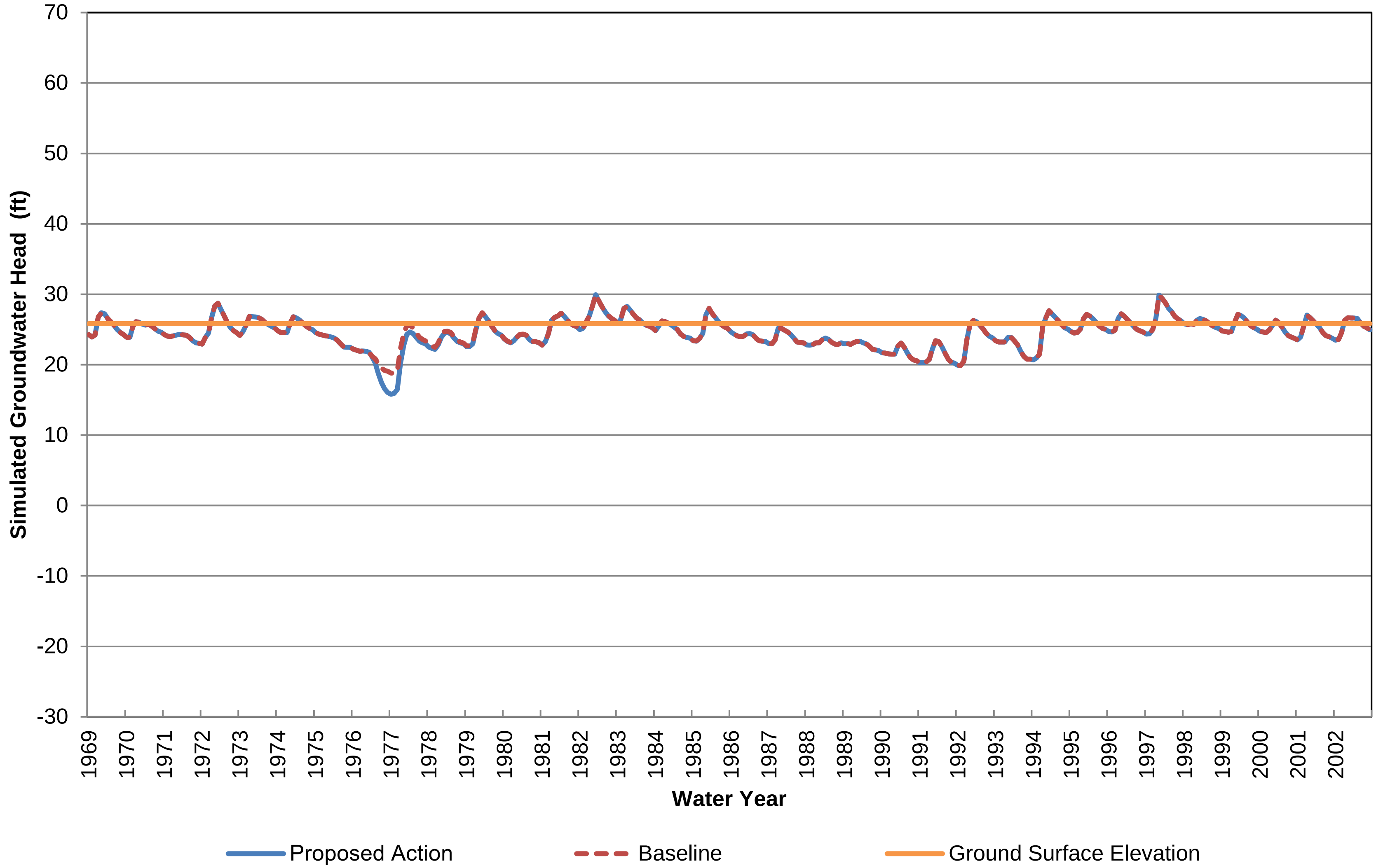
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 26 (Approximately 1550-2070 ft bgs)



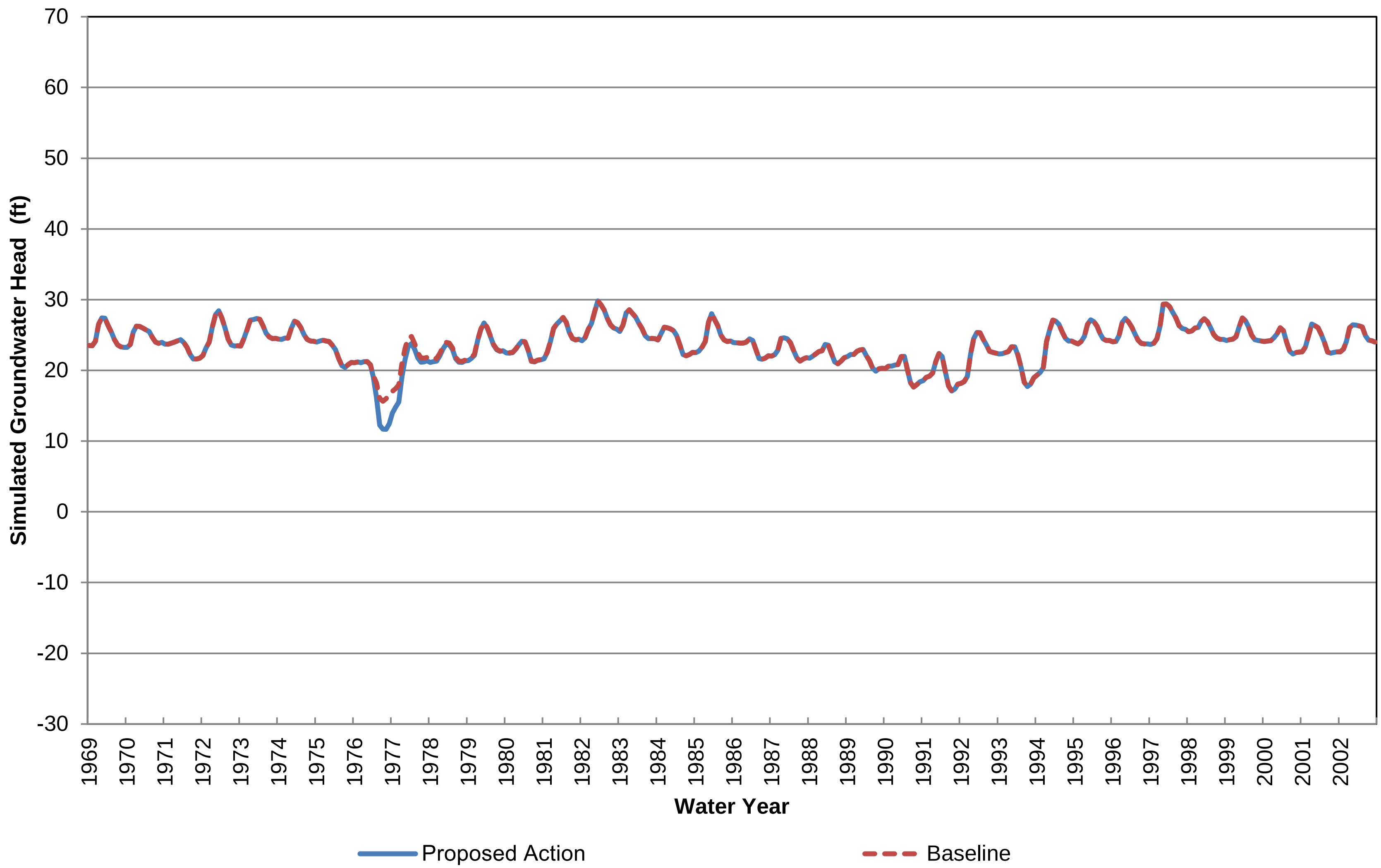
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 26 (Approximately 2070-2840 ft bgs)

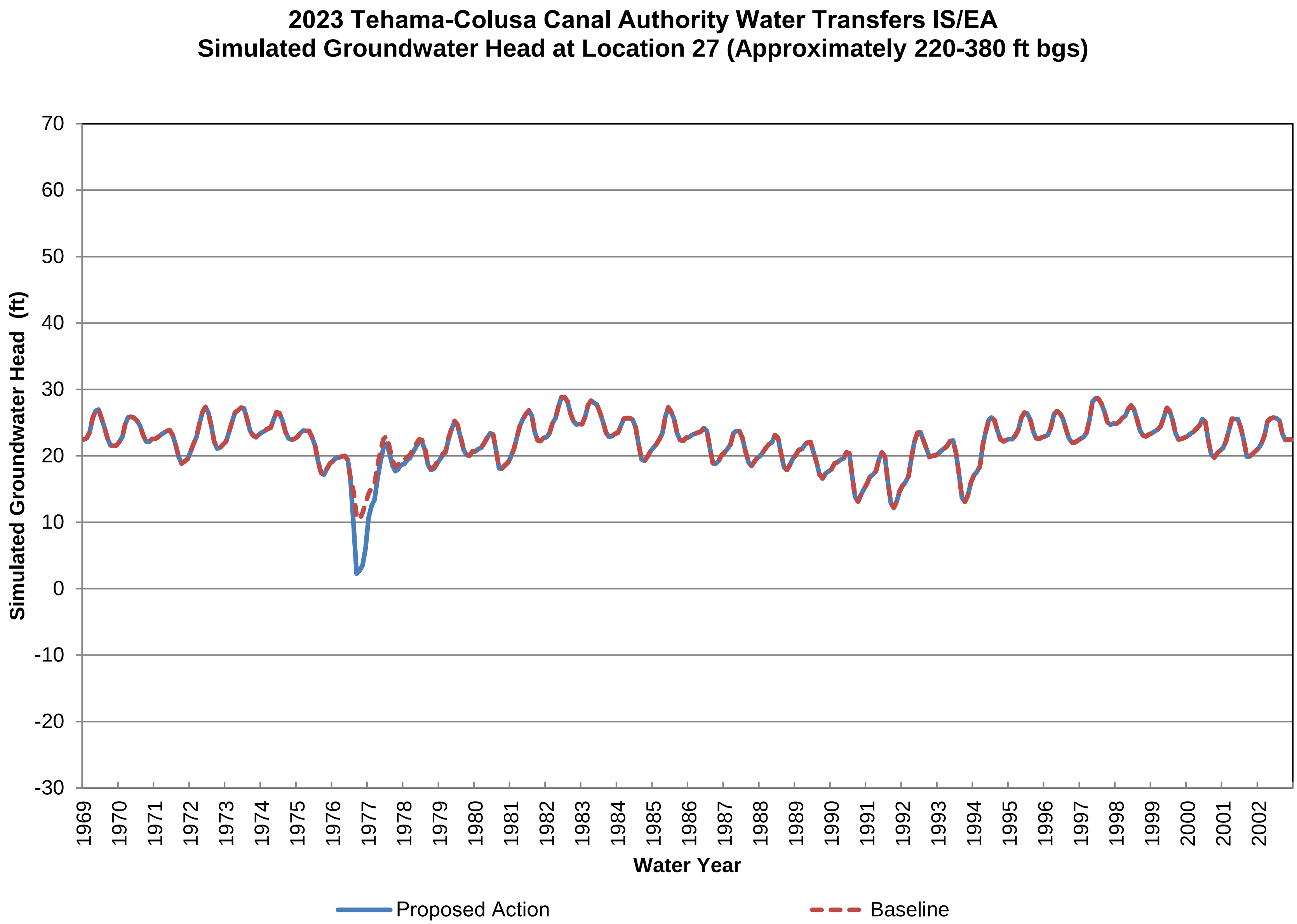


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 27 (Approximately 0-70 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 27 (Approximately 70-220 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 27 (Approximately 220-380 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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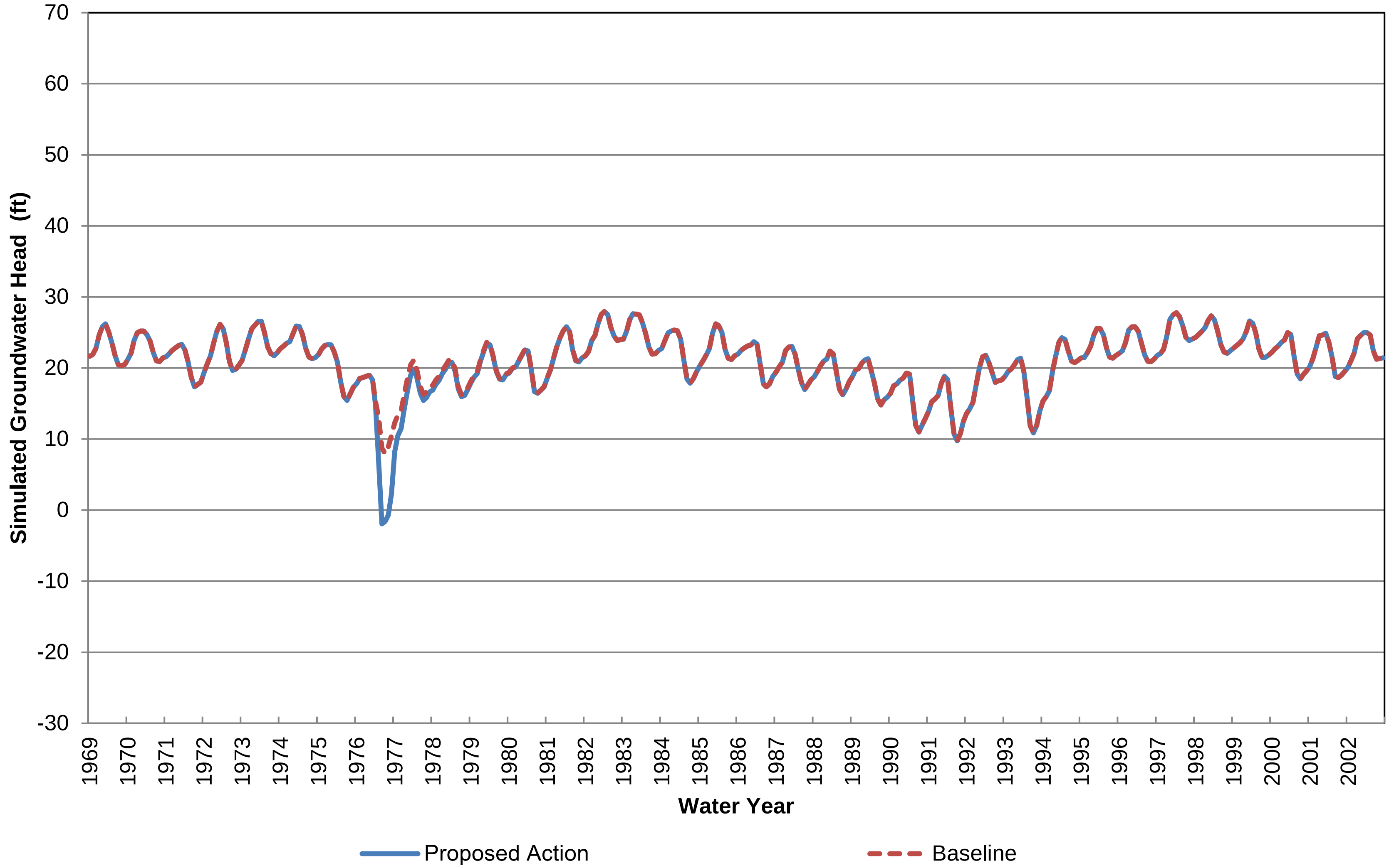
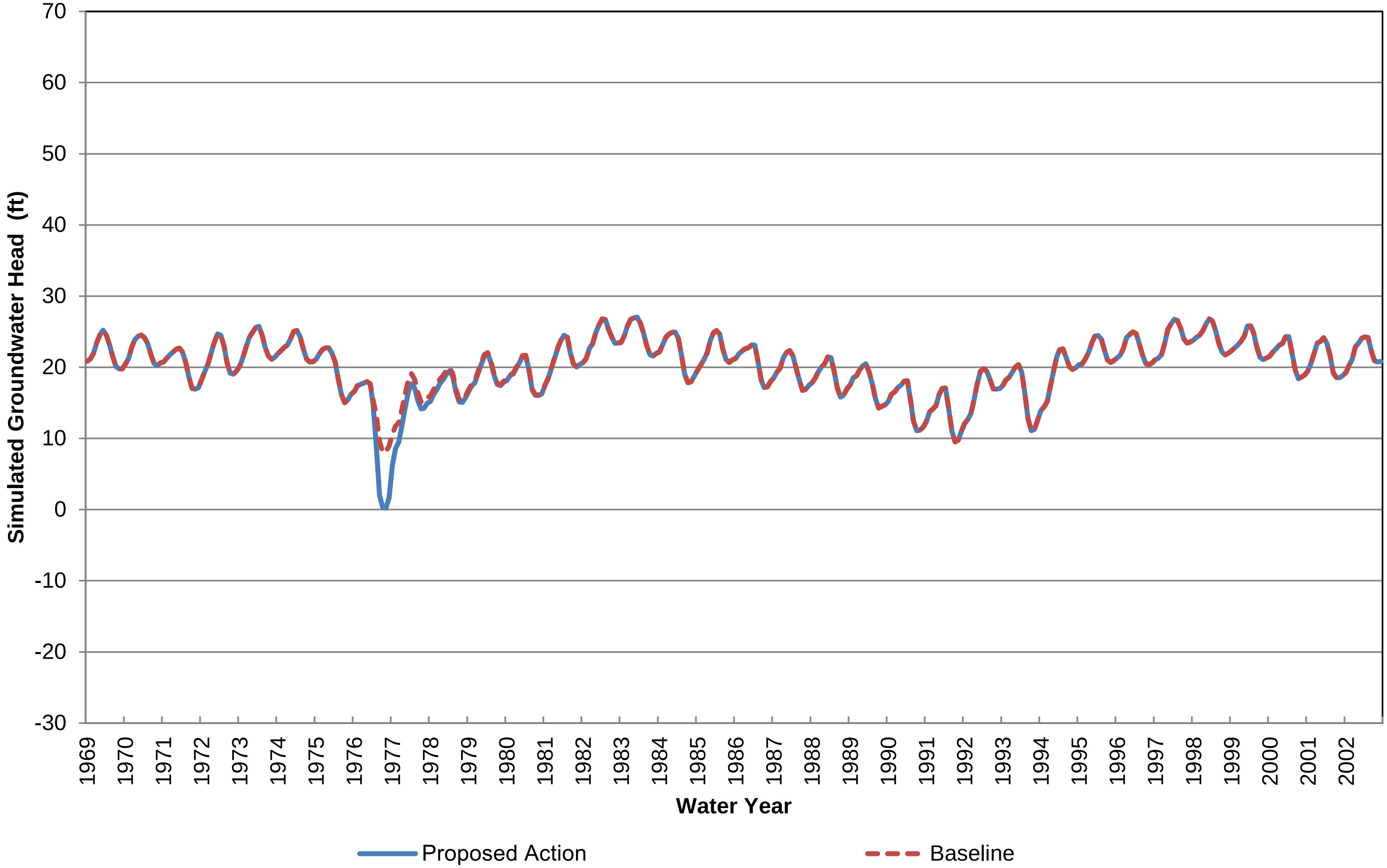
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

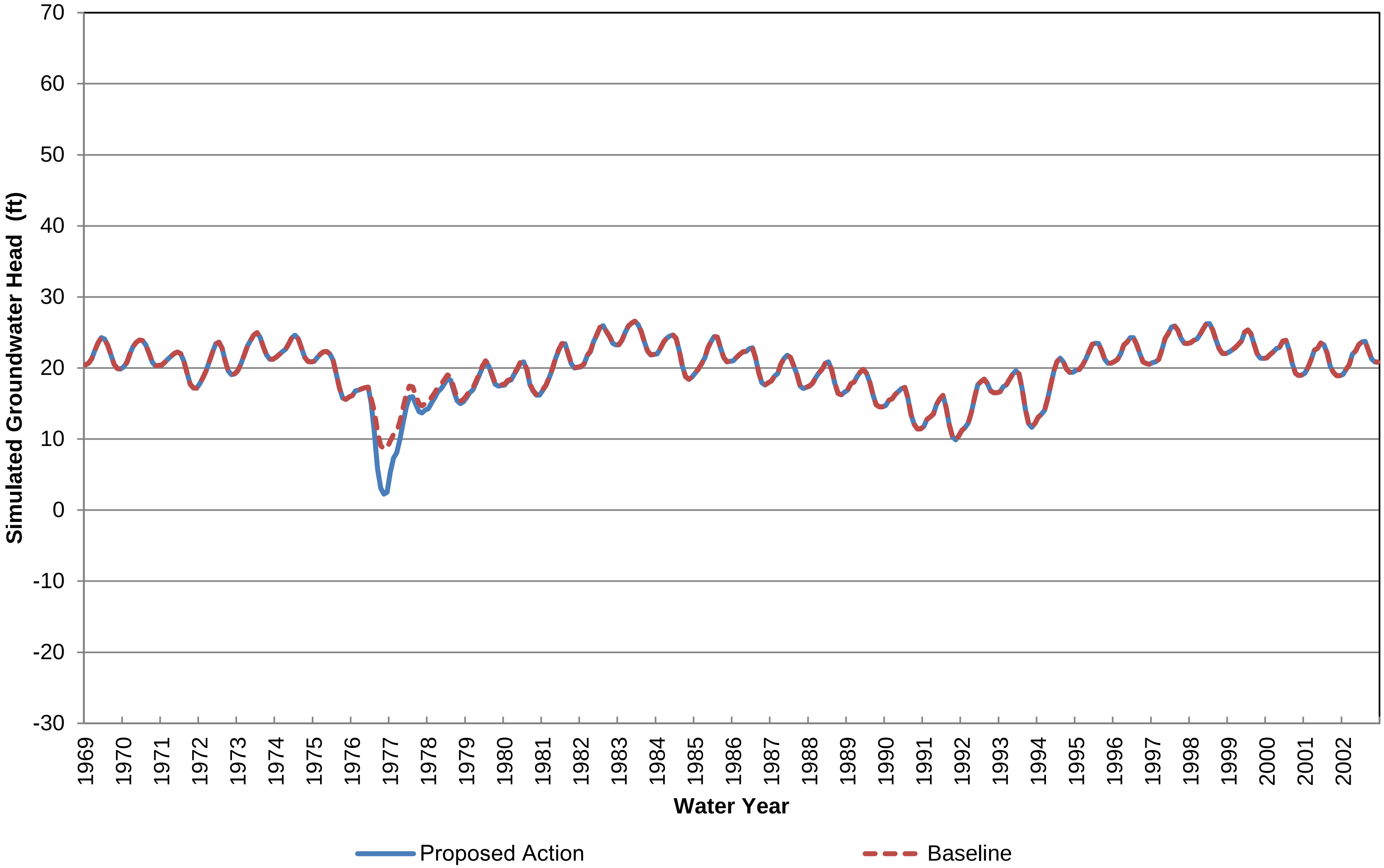
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 27 (Approximately 380-530 ft bgs)



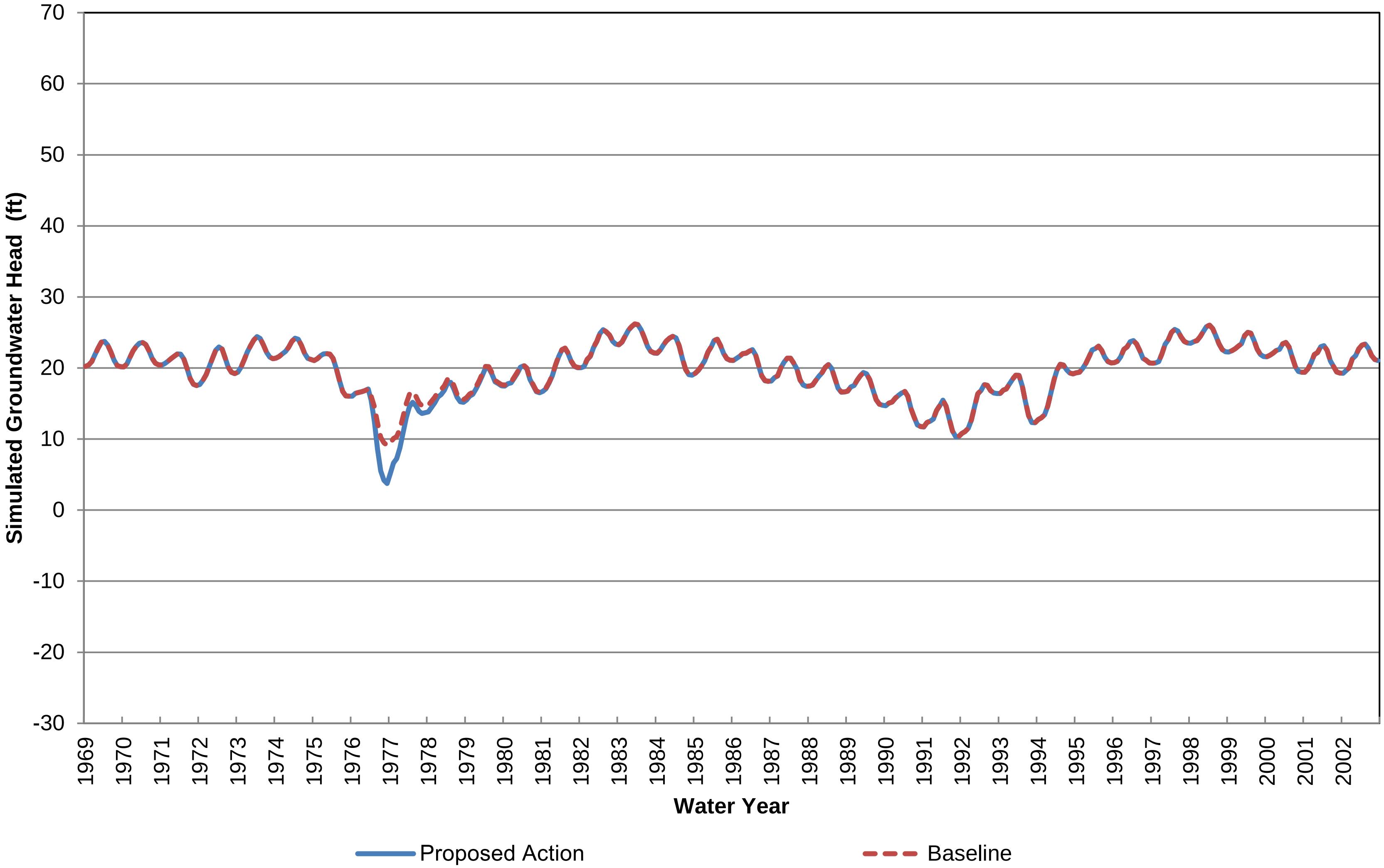
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 27 (Approximately 530-770 ft bgs)

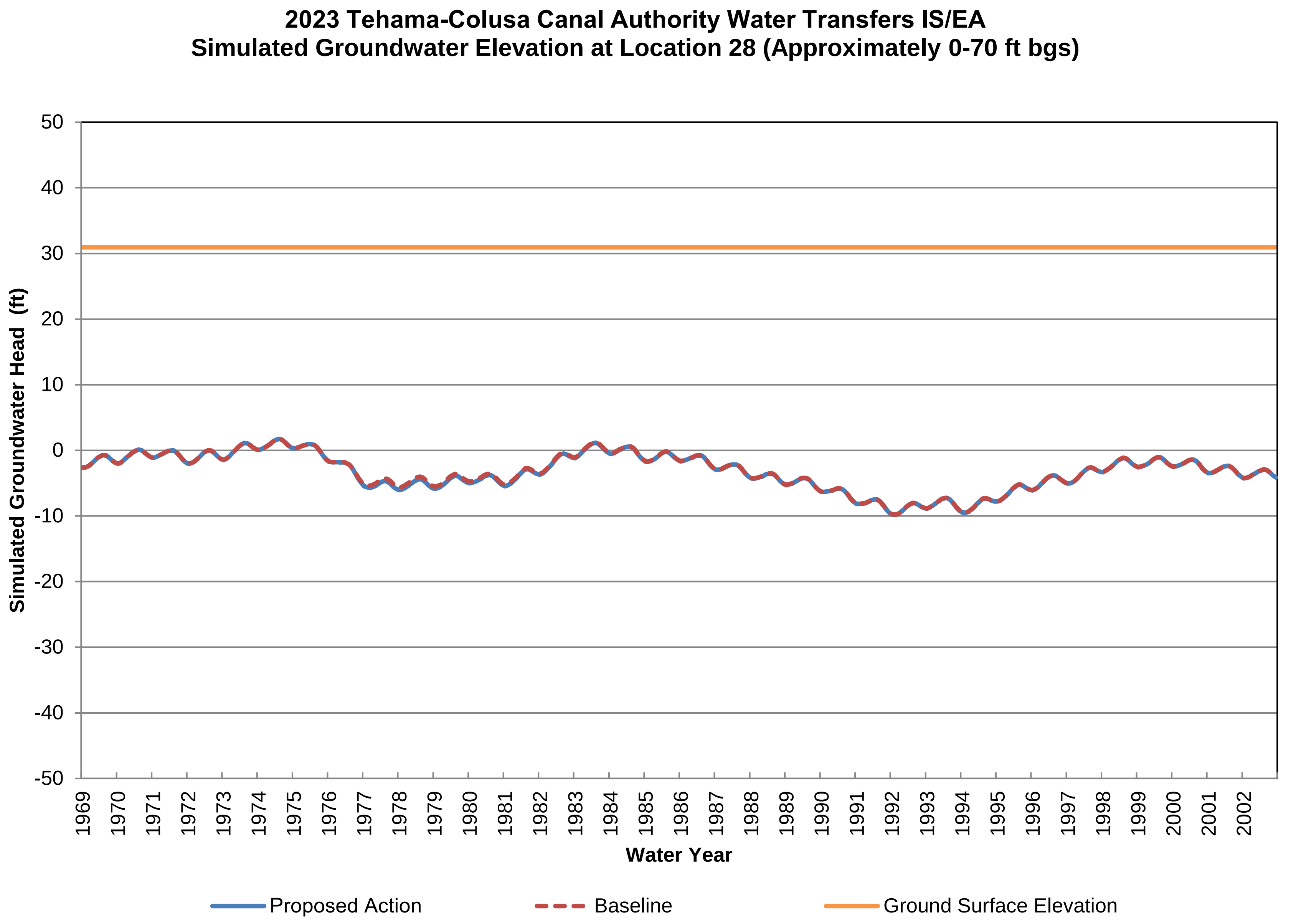


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 27 (Approximately 770-1030 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 27 (Approximately 1030-1410 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 28 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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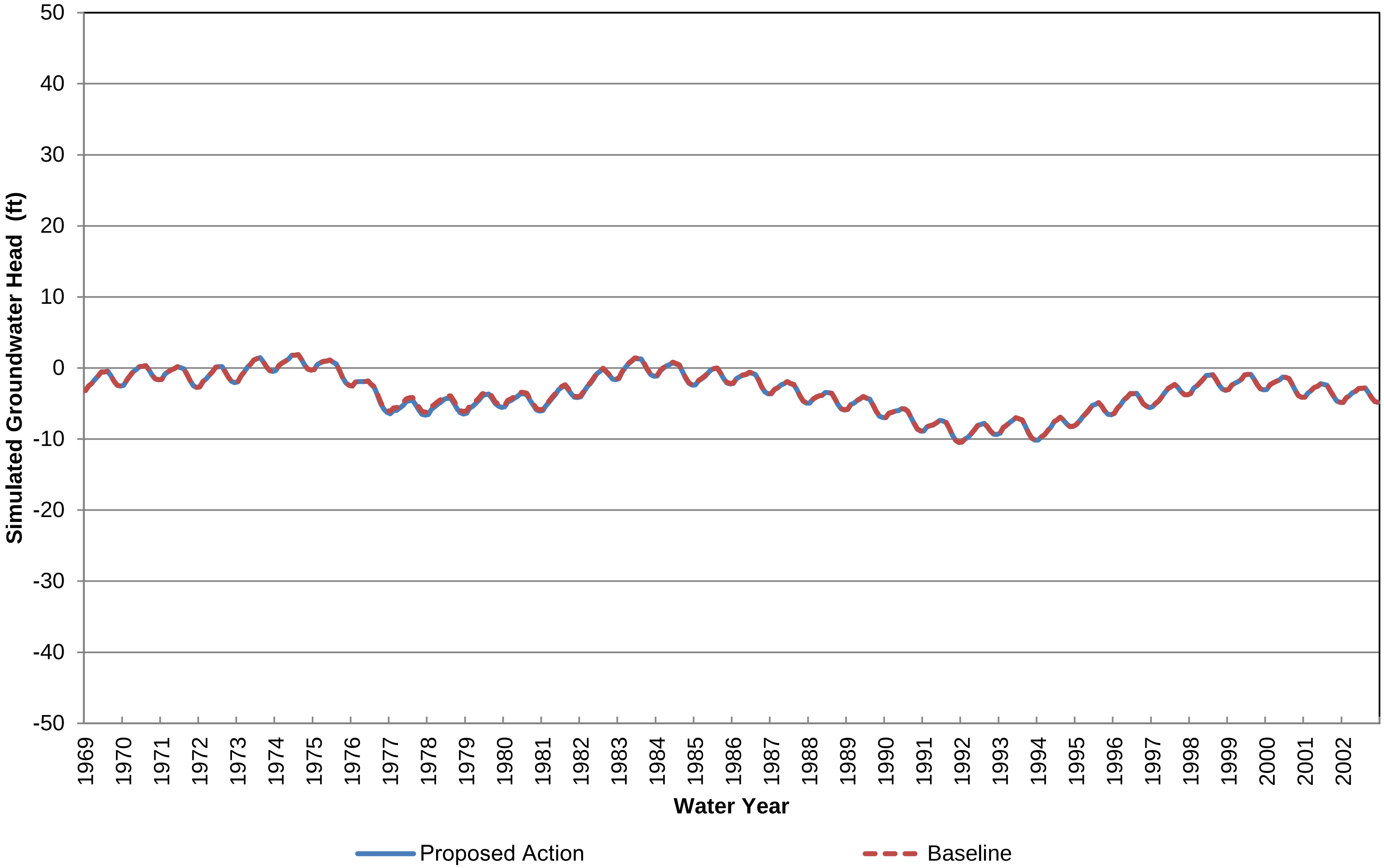
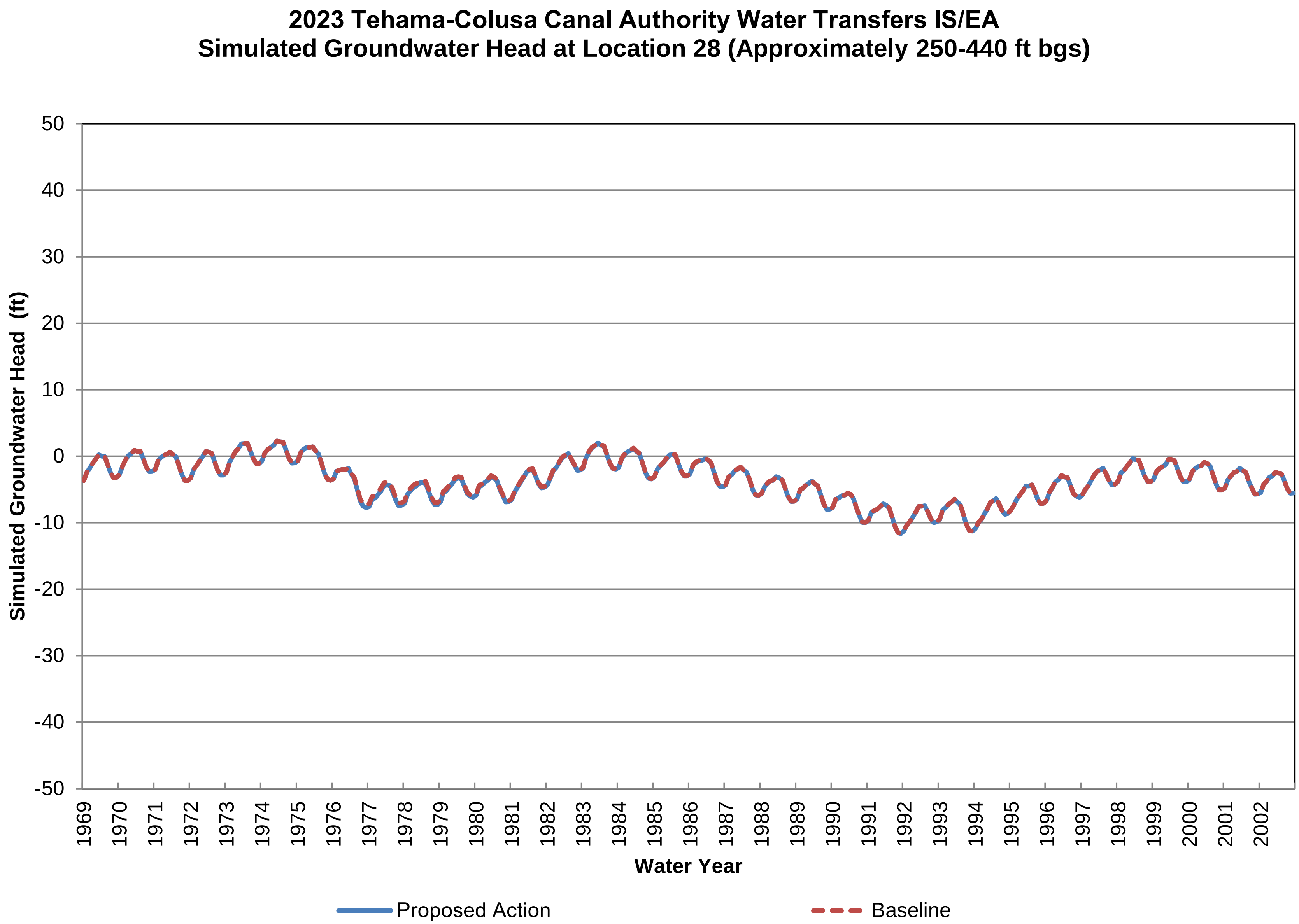
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 28 (Approximately 70-250 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 28 (Approximately 250-440 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
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1995
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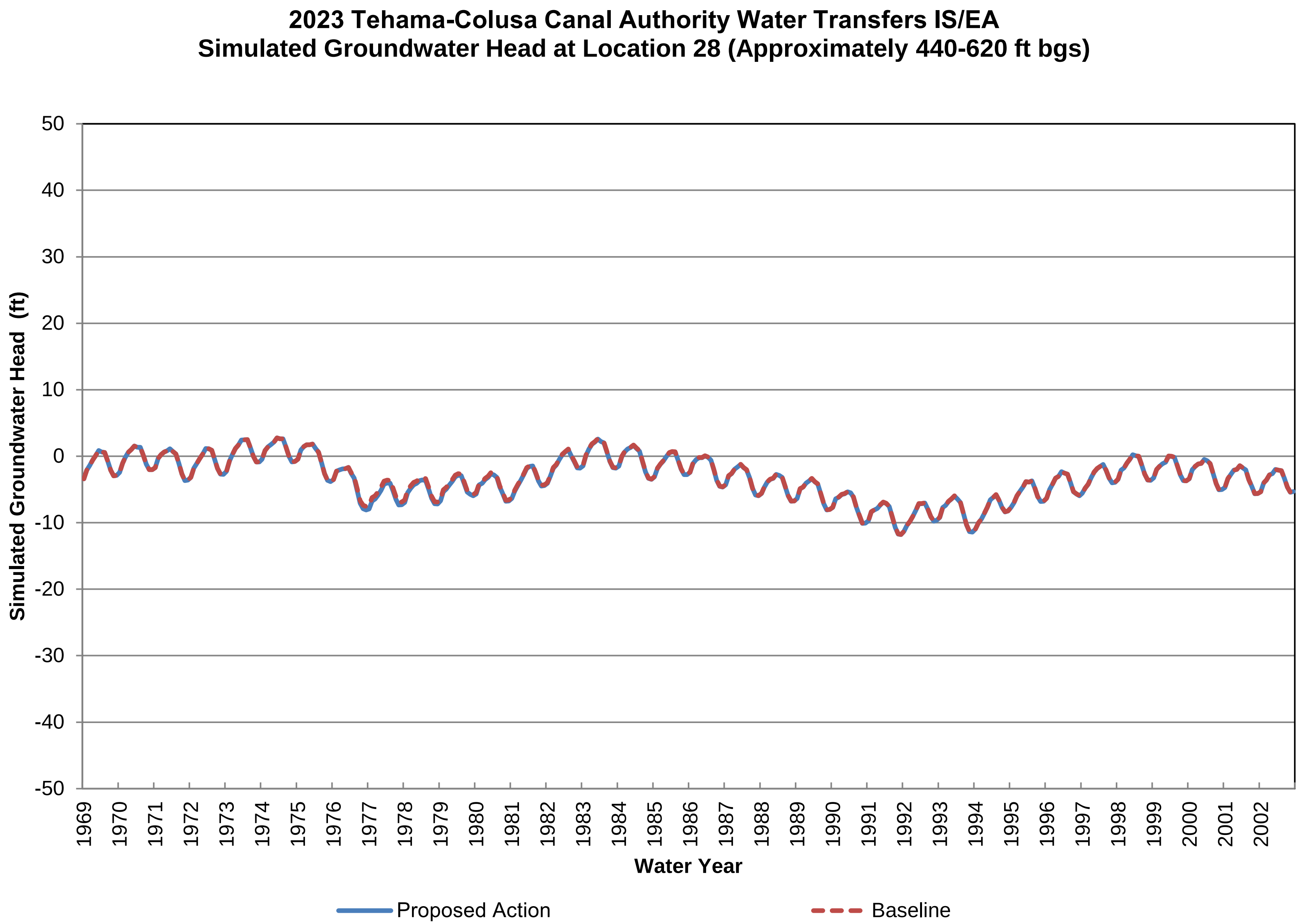
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 28 (Approximately 440-620 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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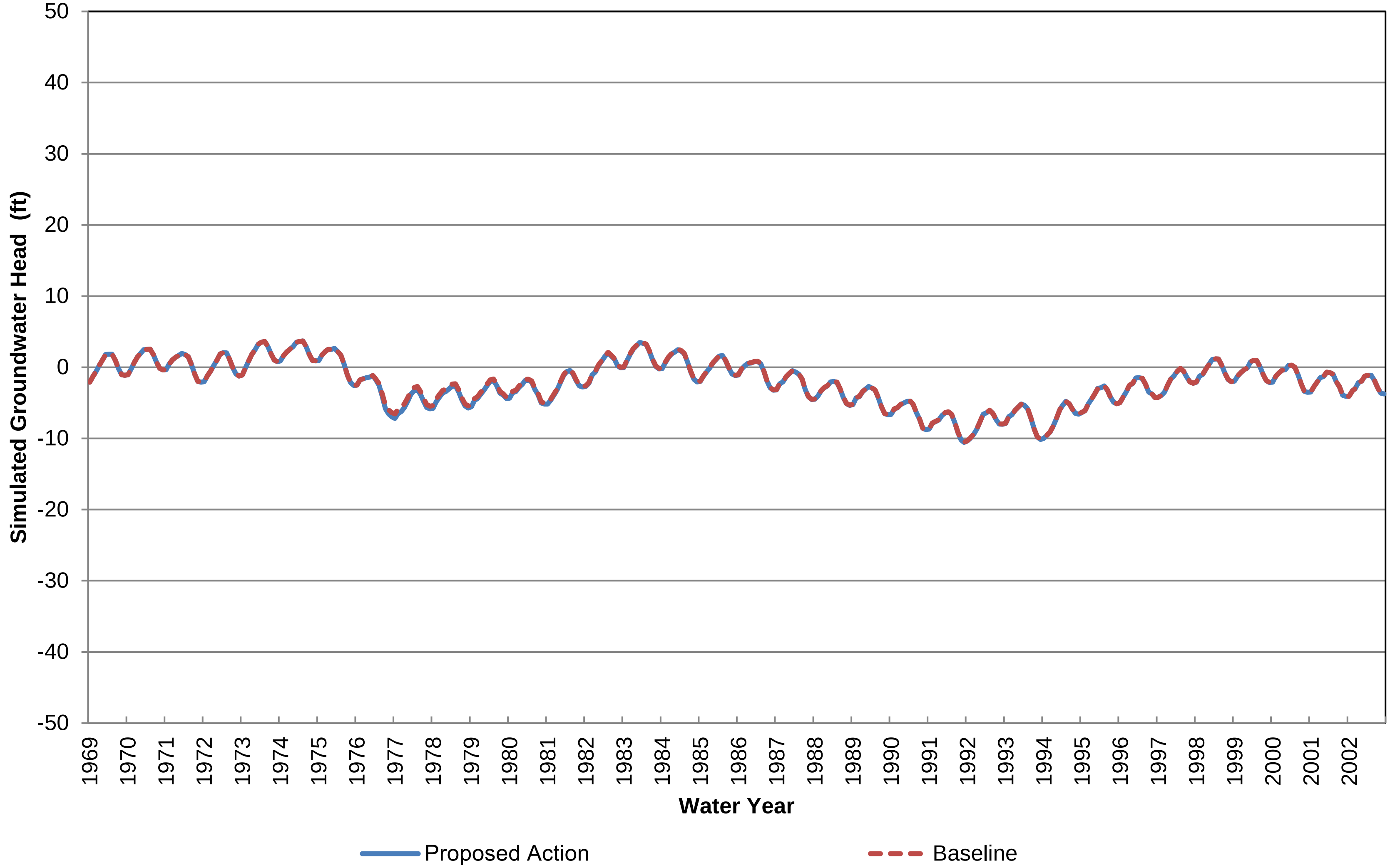
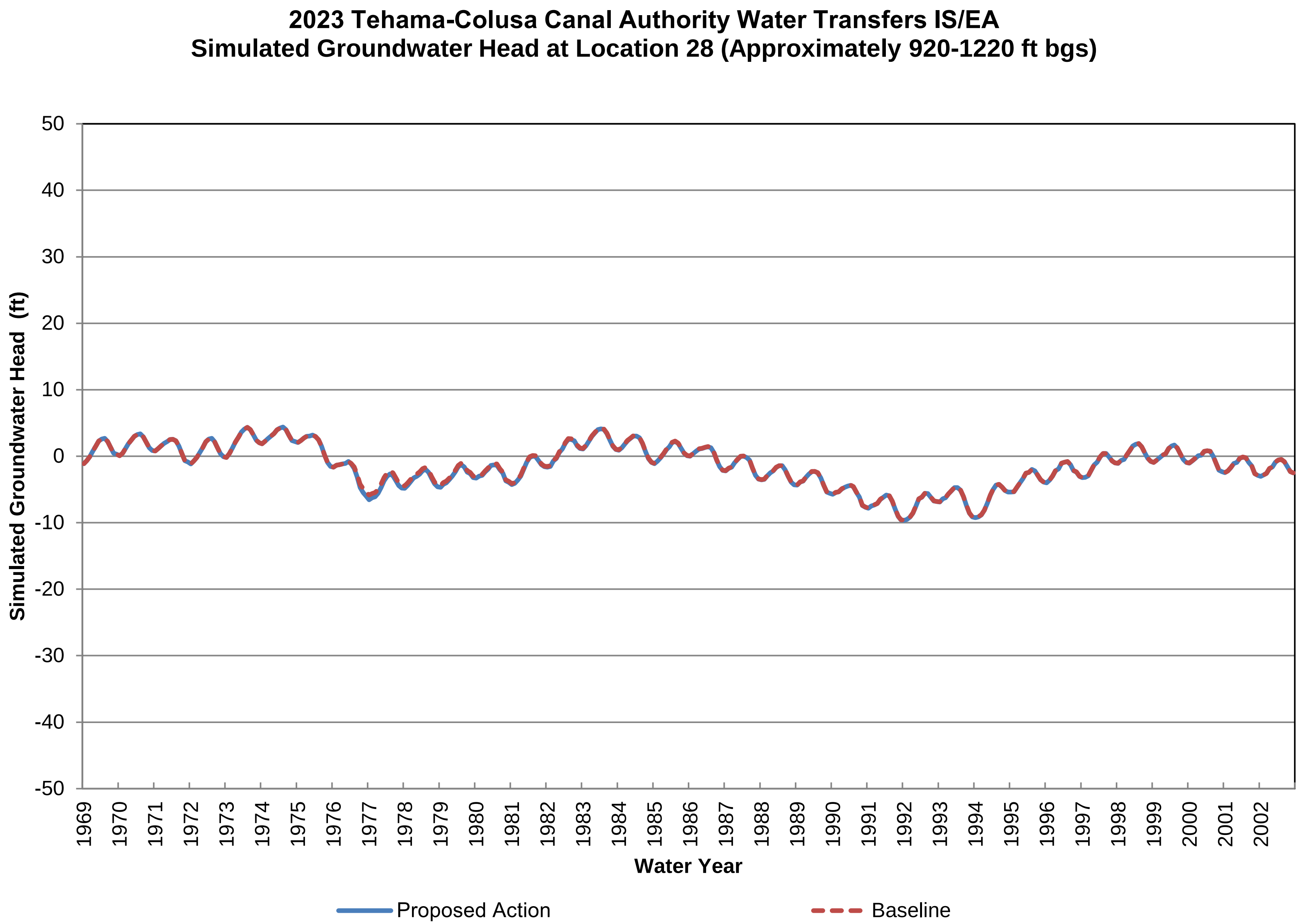
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 28 (Approximately 620-920 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 28 (Approximately 920-1220 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
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1988
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1990
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1997
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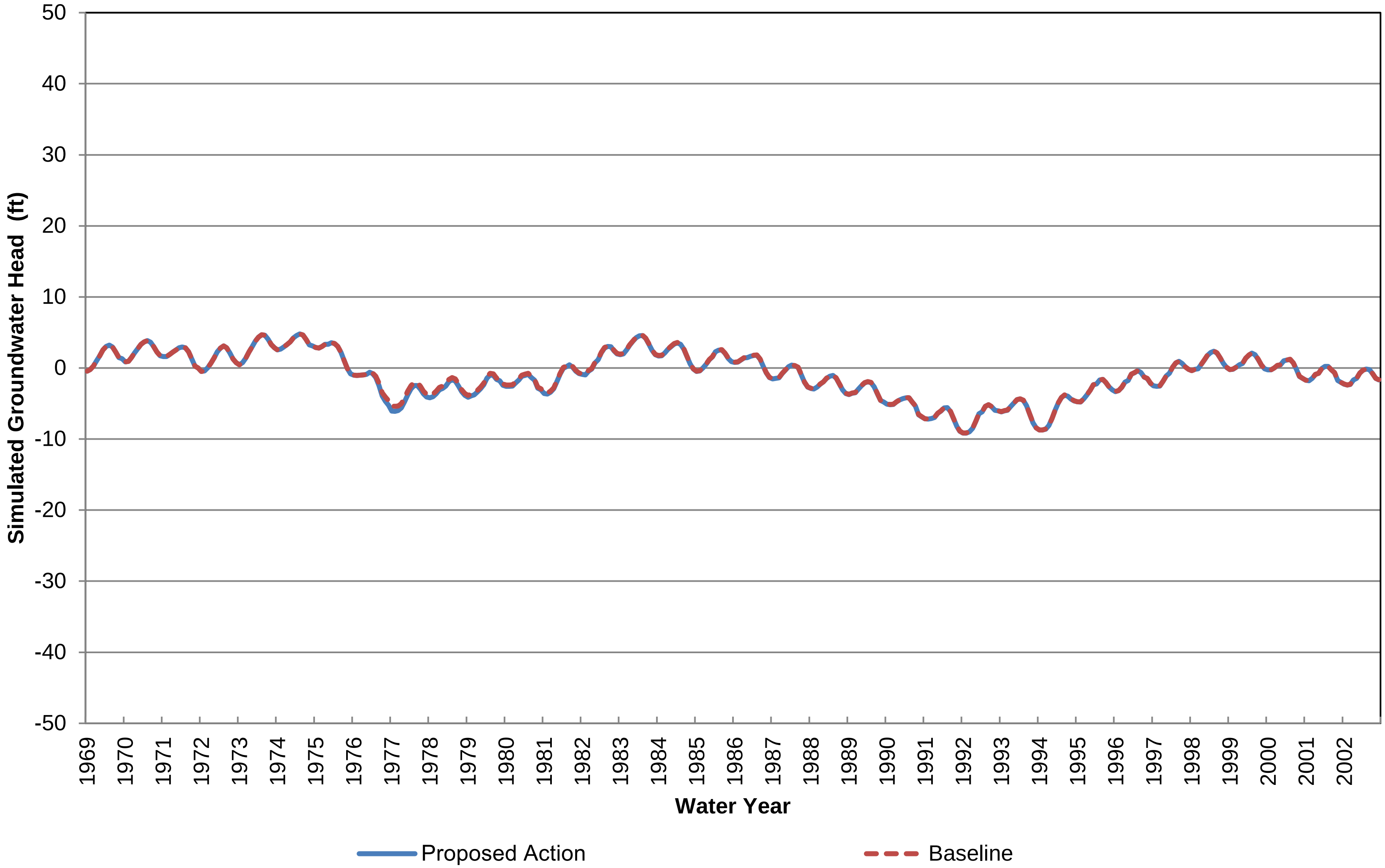
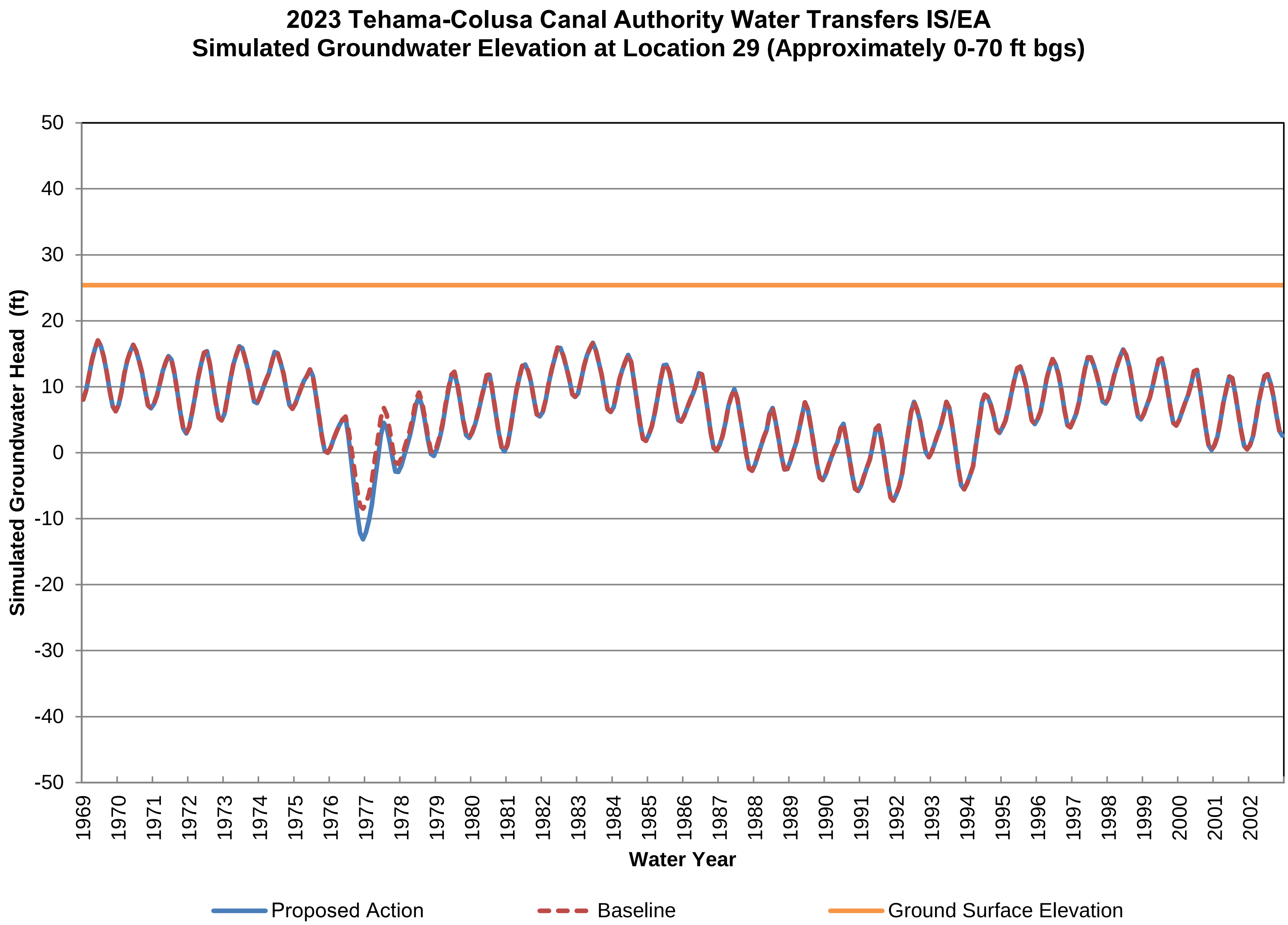
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 28 (Approximately 1220-1680 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 29 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1984
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1990
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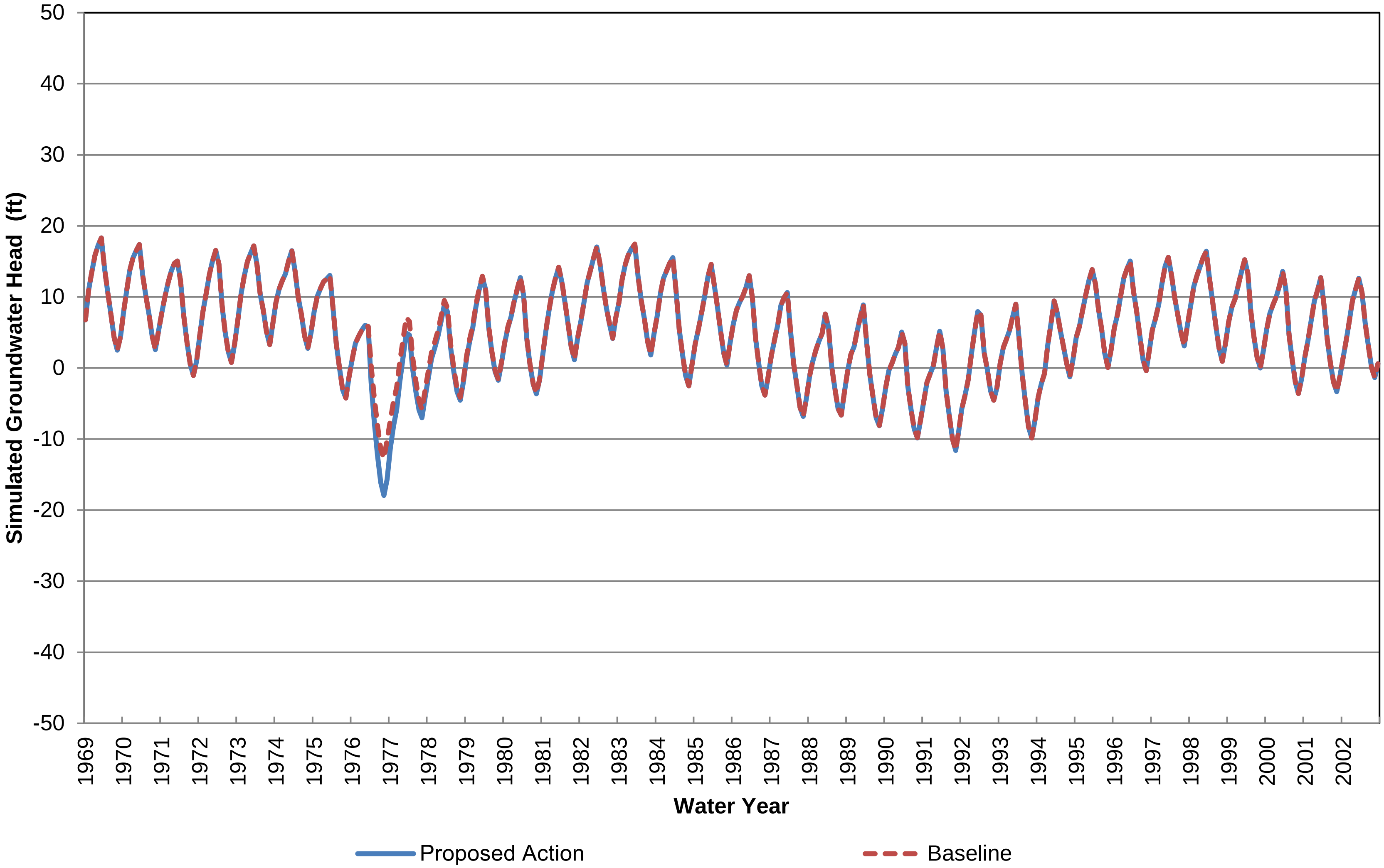
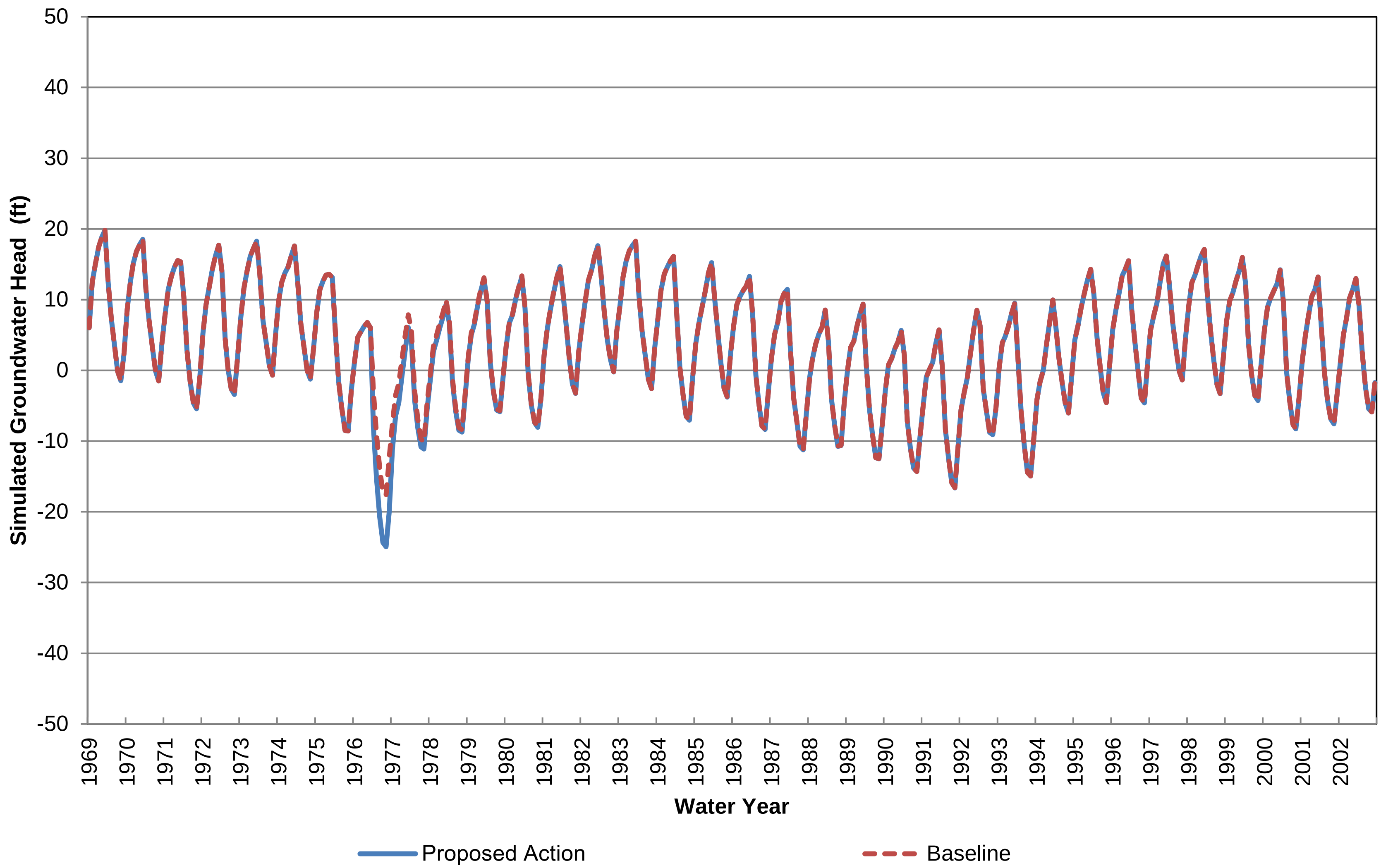
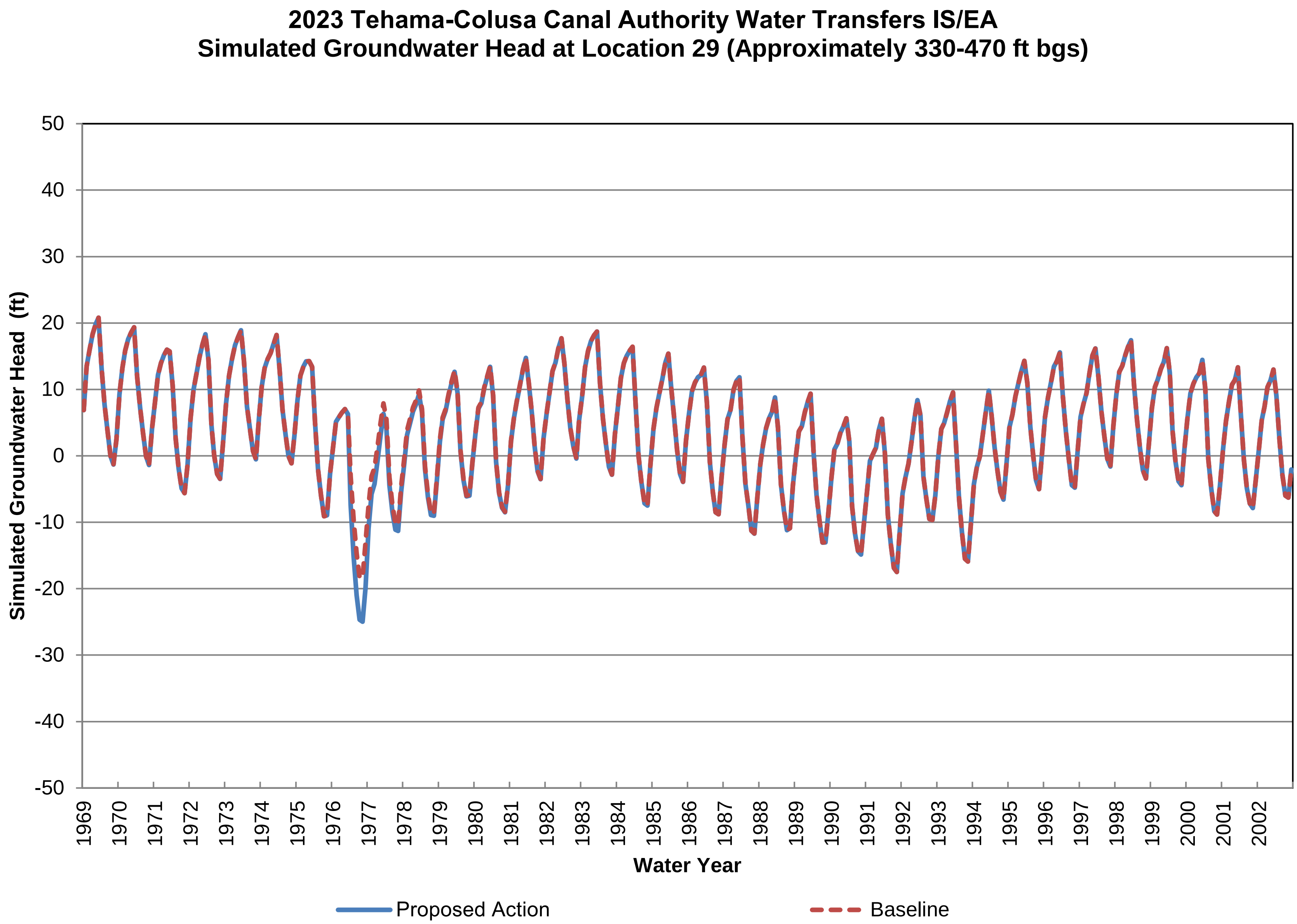
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 29 (Approximately 70-200 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 29 (Approximately 200-330 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 29 (Approximately 330-470 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
1989
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1991
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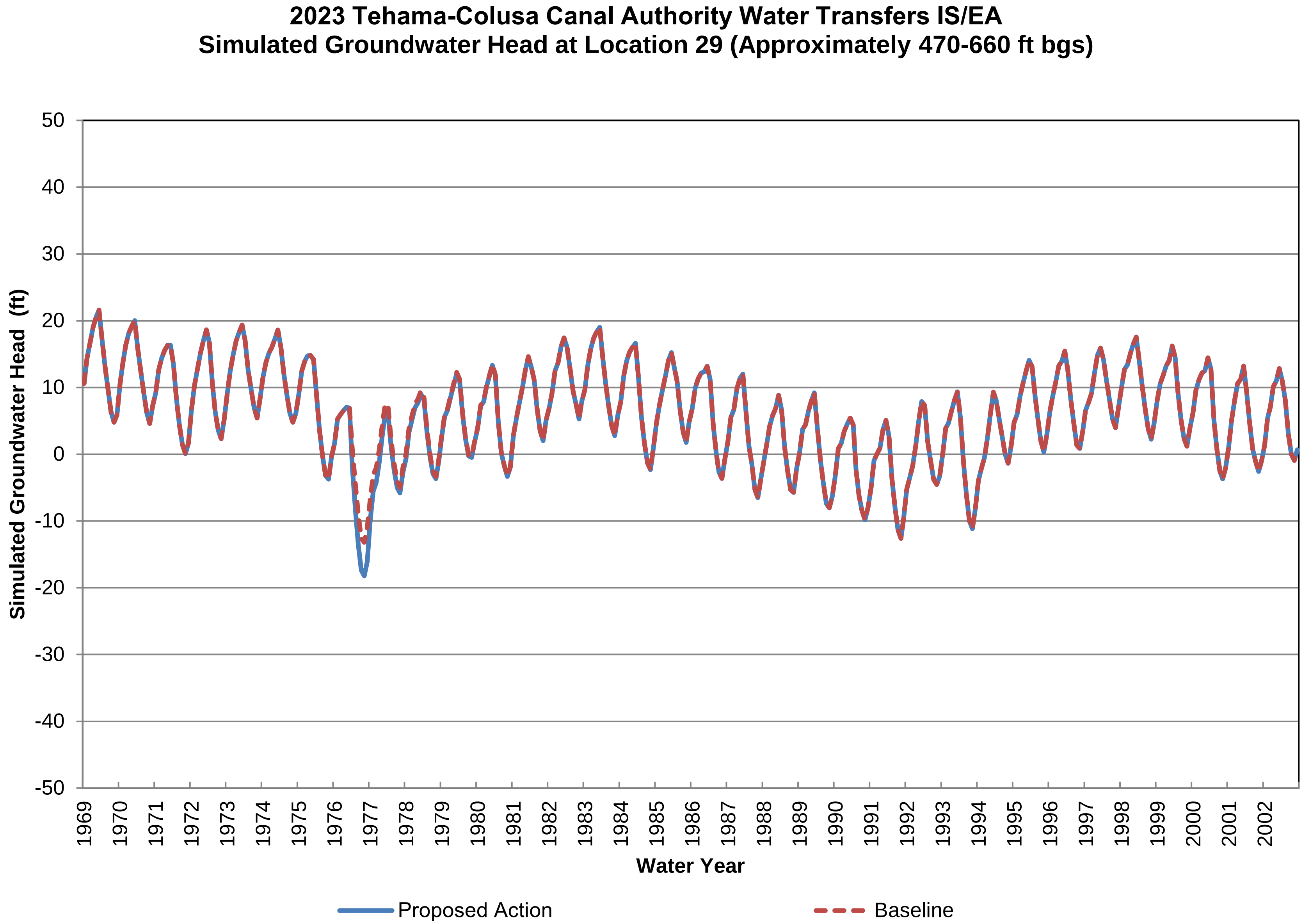
1999
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 29 (Approximately 470-660 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
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1991
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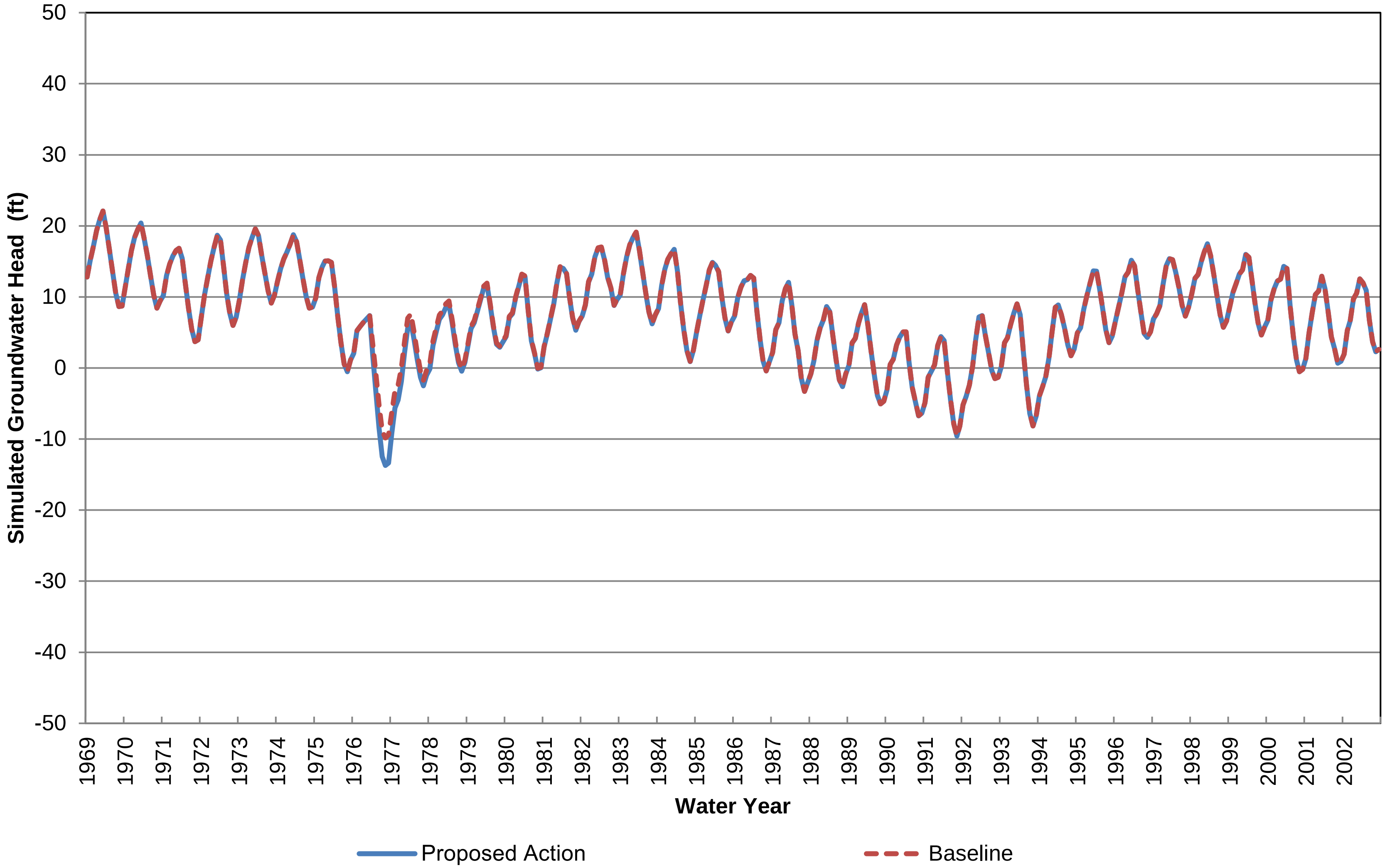
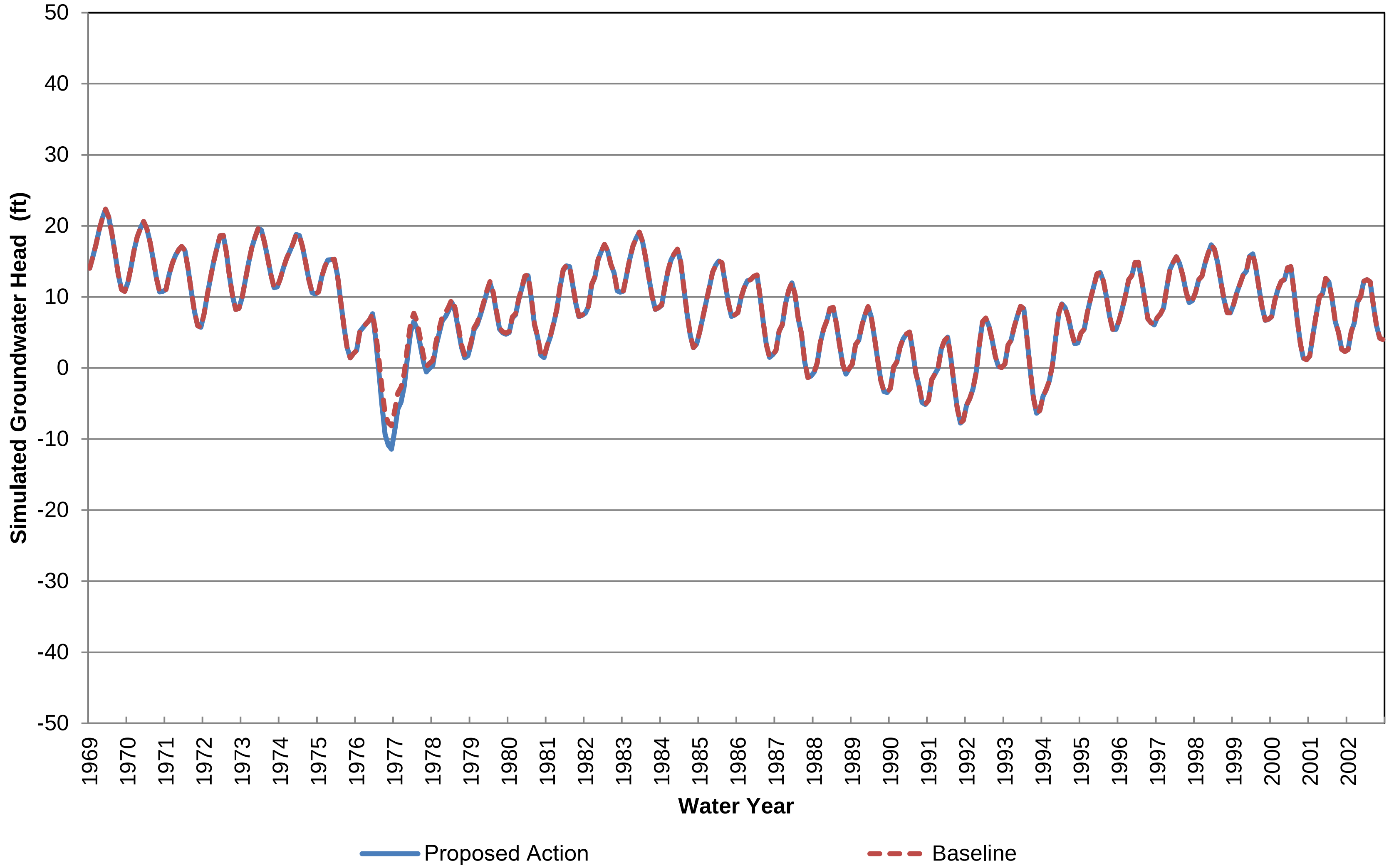
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

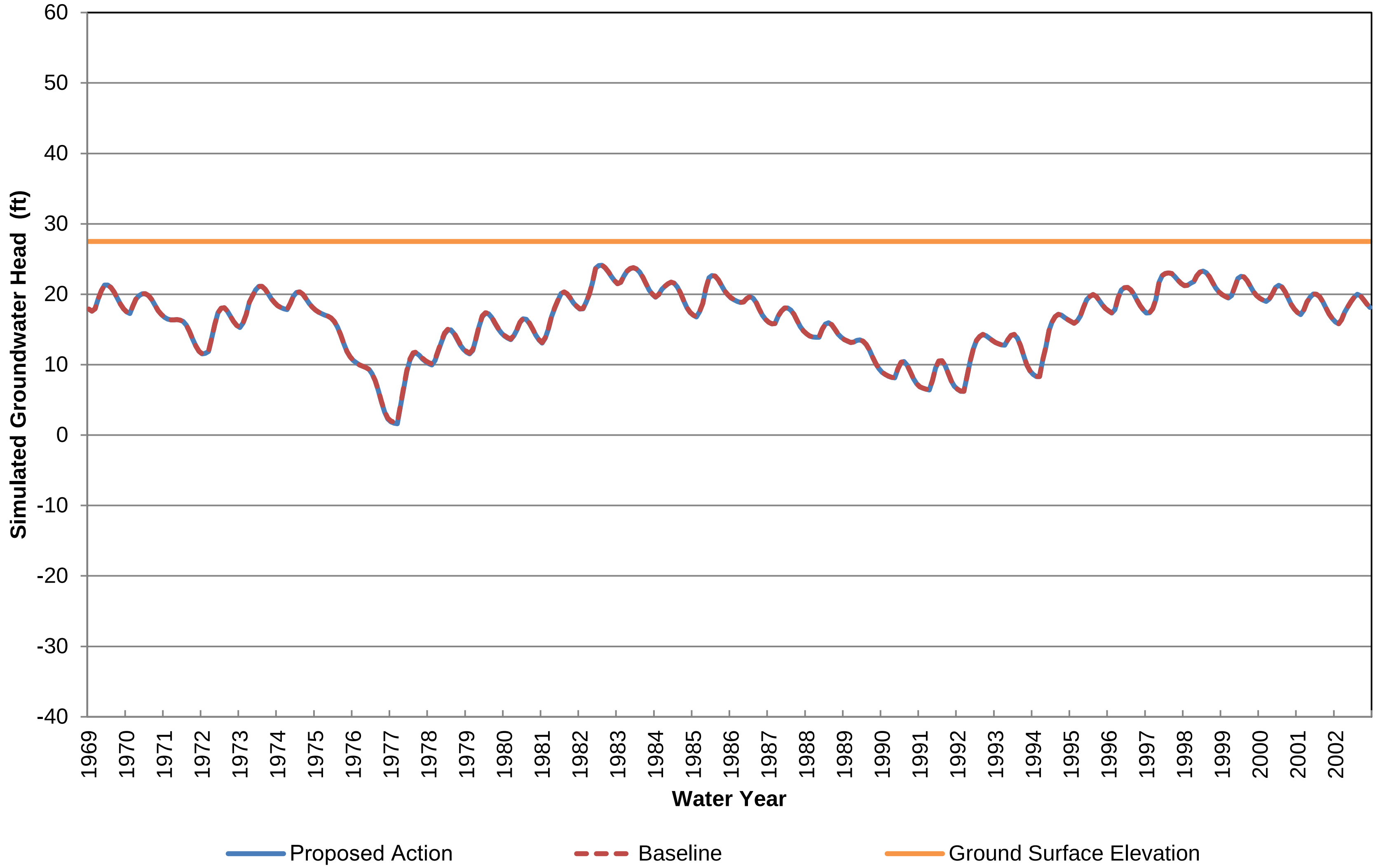
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 29 (Approximately 660-880 ft bgs)

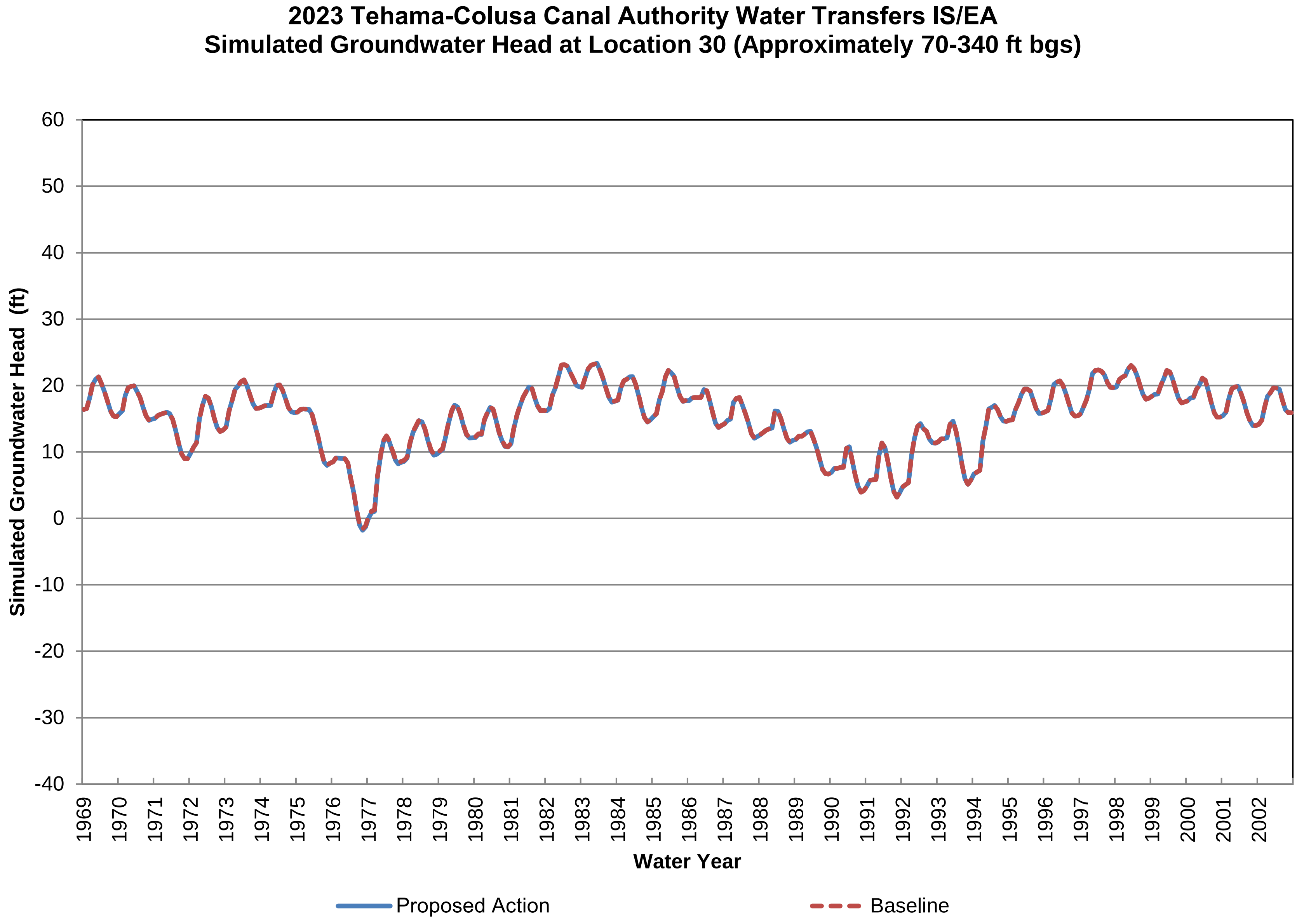


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 29 (Approximately 880-1210 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 30 (Approximately 0-70 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 30 (Approximately 70-340 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
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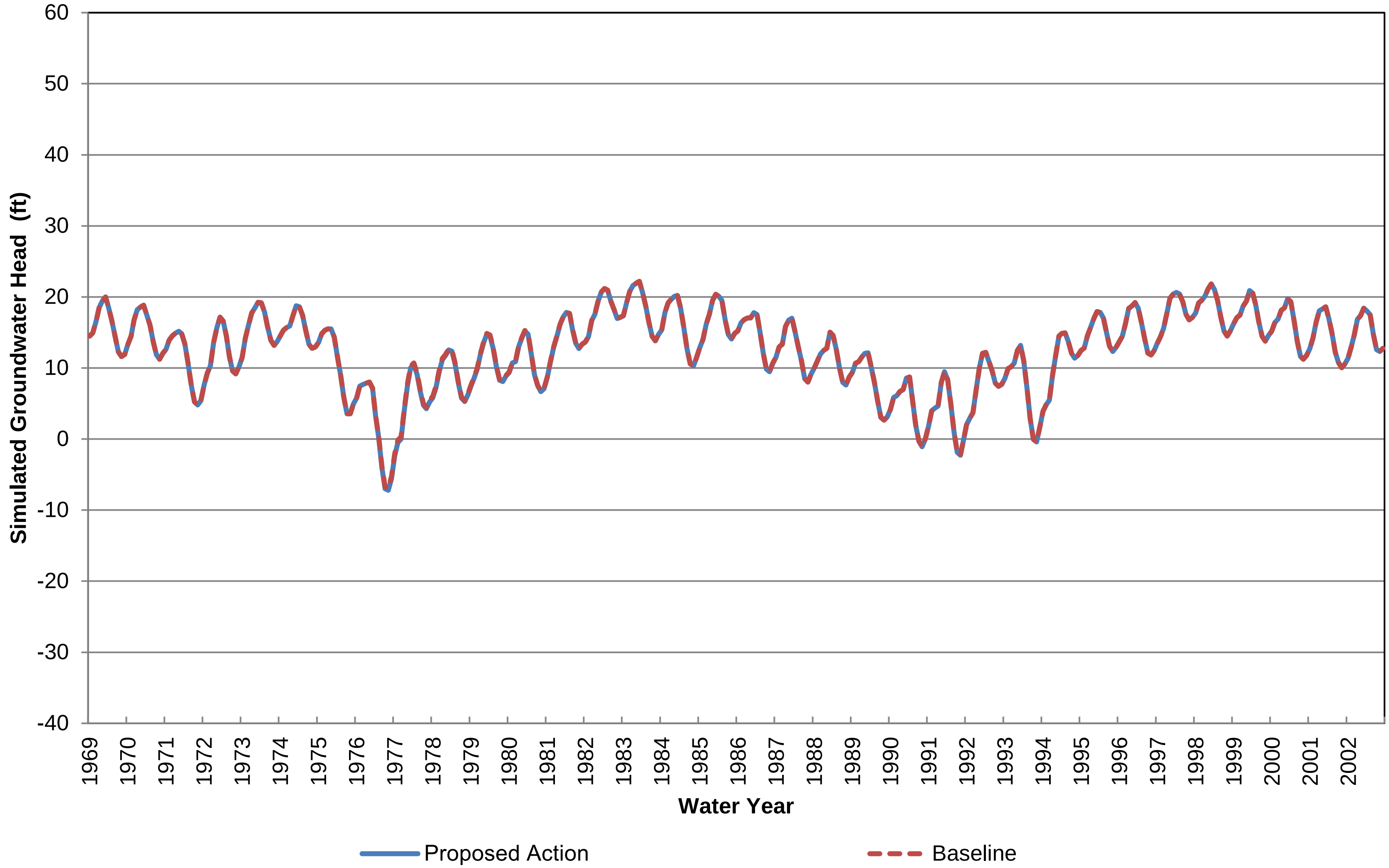
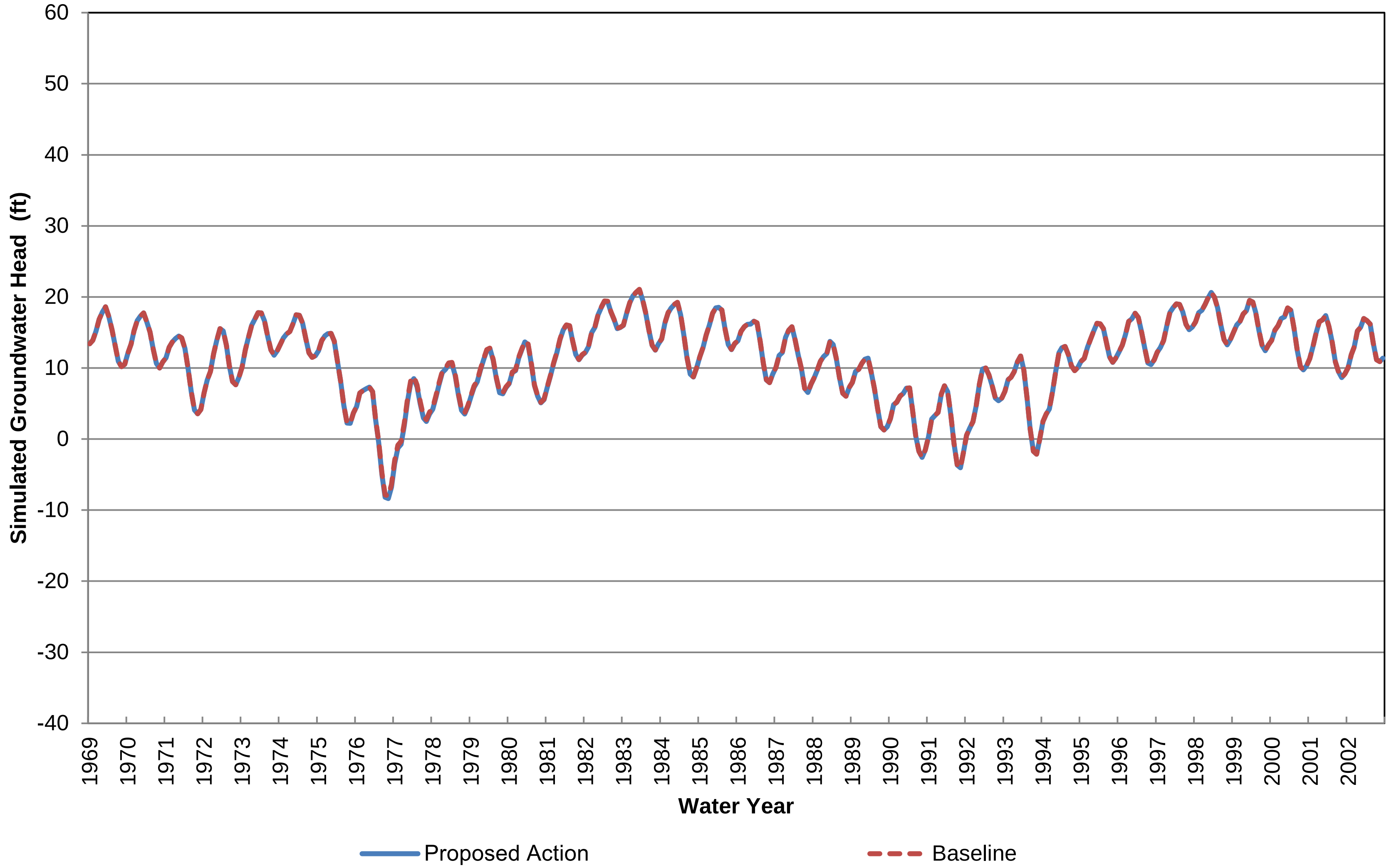
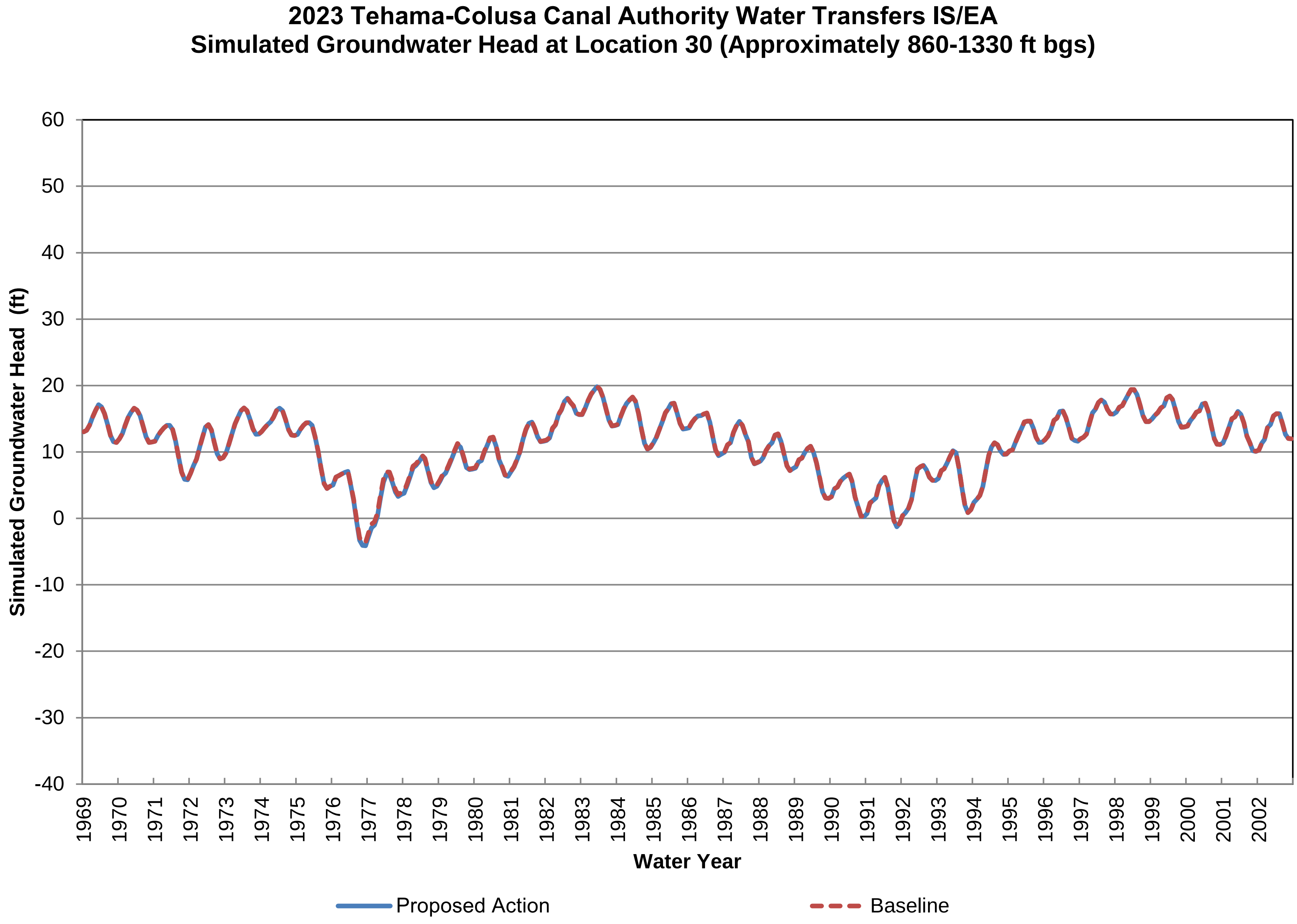
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 30 (Approximately 340-600 ft bgs)

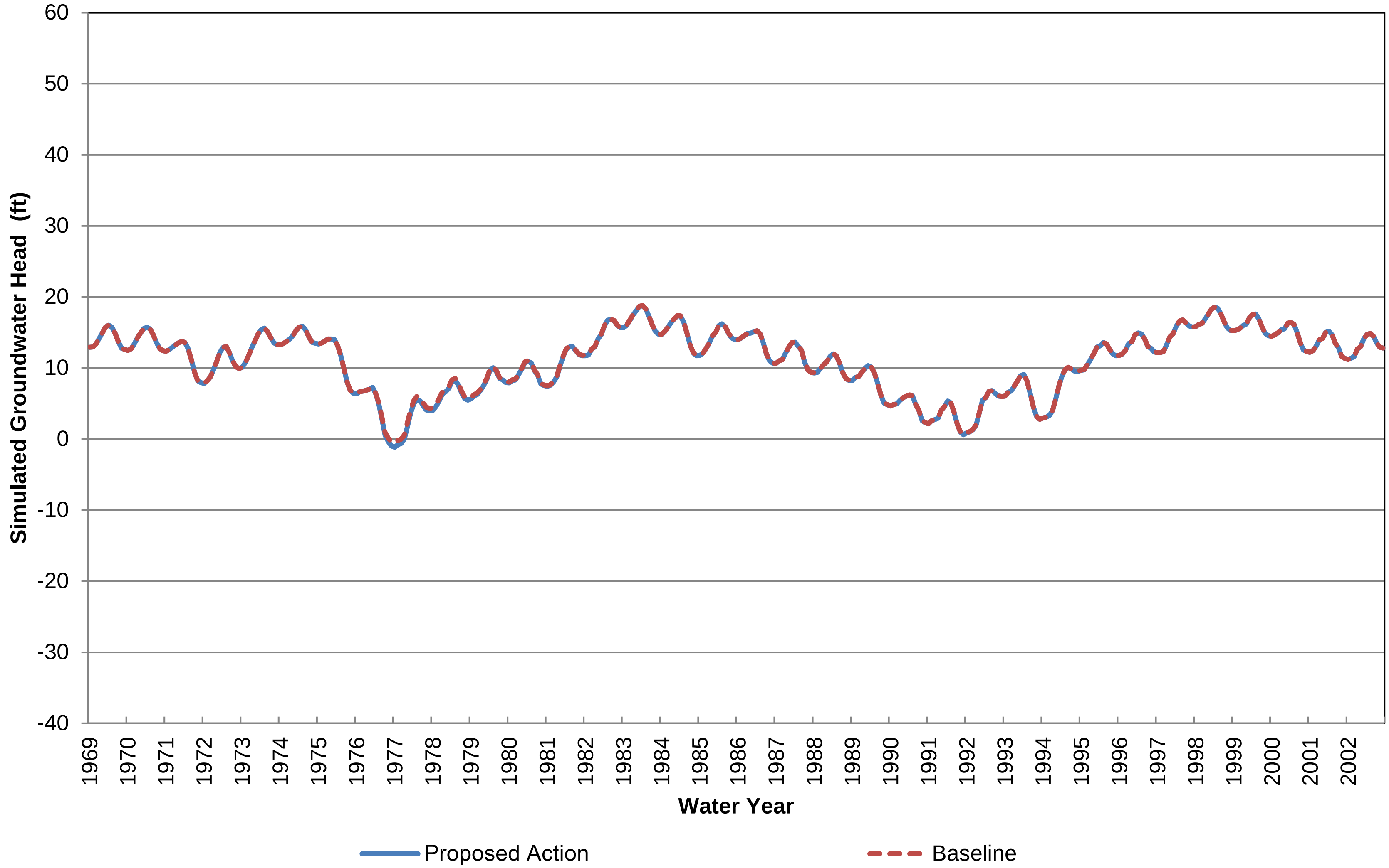


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 30 (Approximately 600-860 ft bgs)

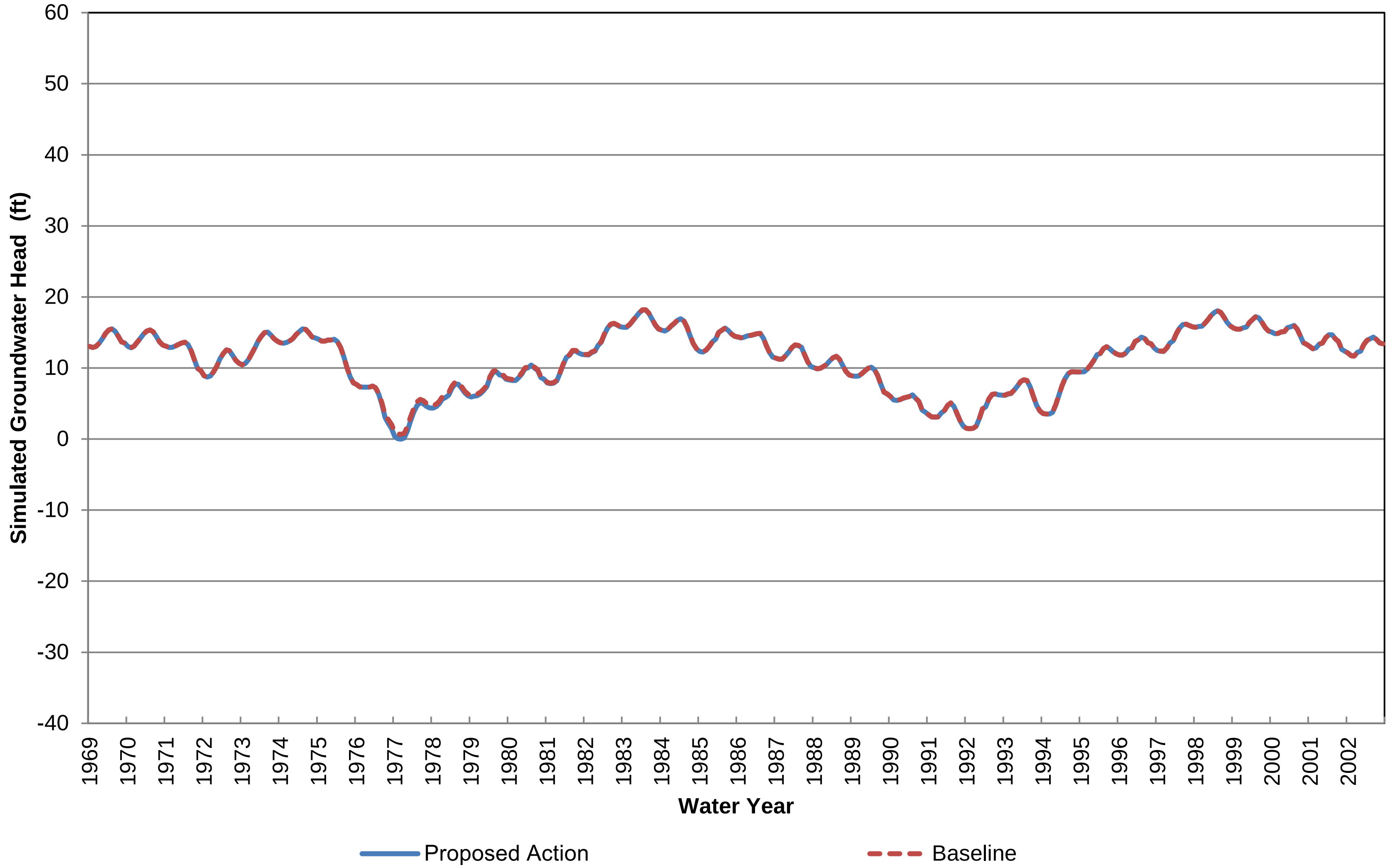



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 30 (Approximately 860-1330 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

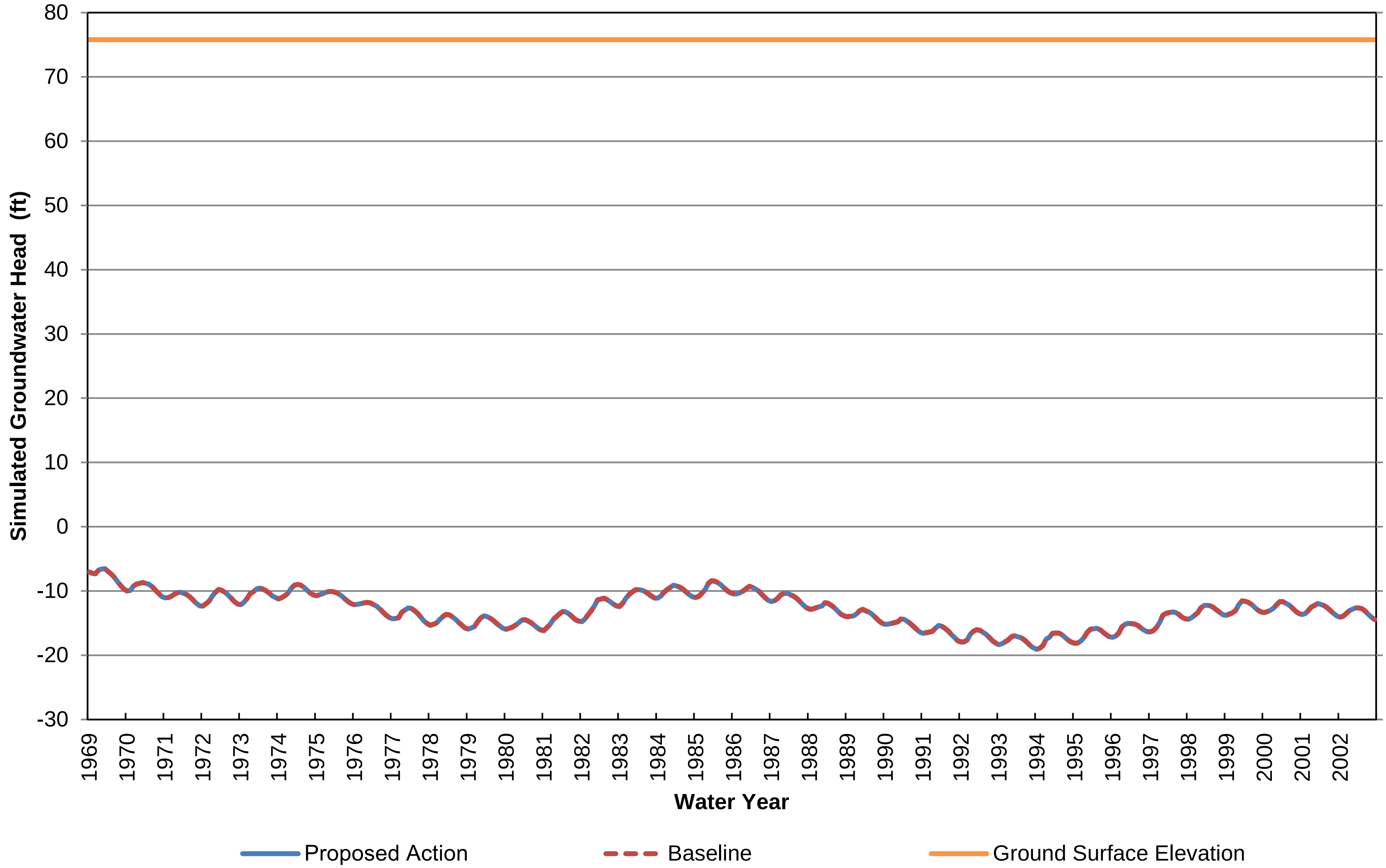
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 30 (Approximately 1330-1770 ft bgs)

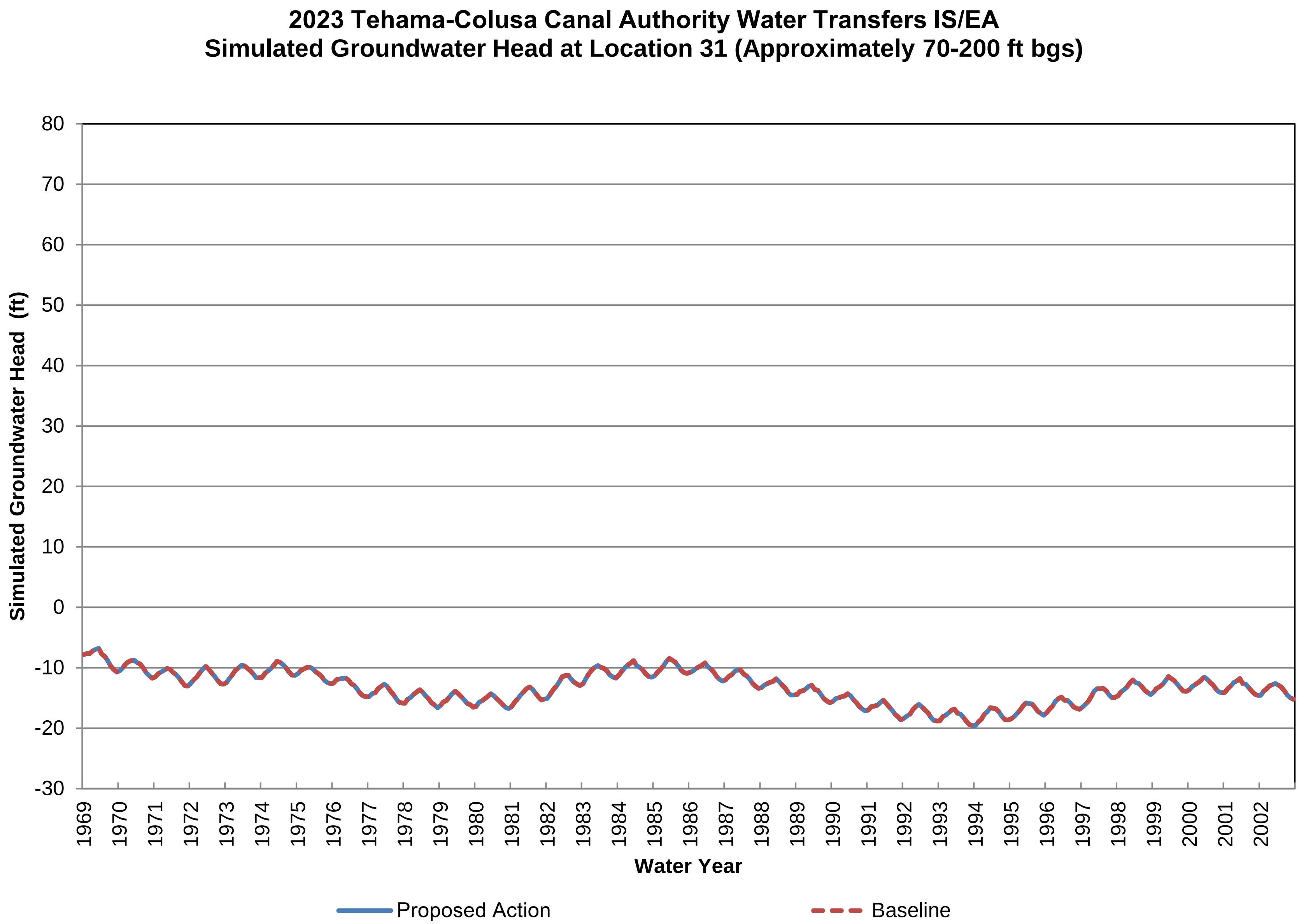


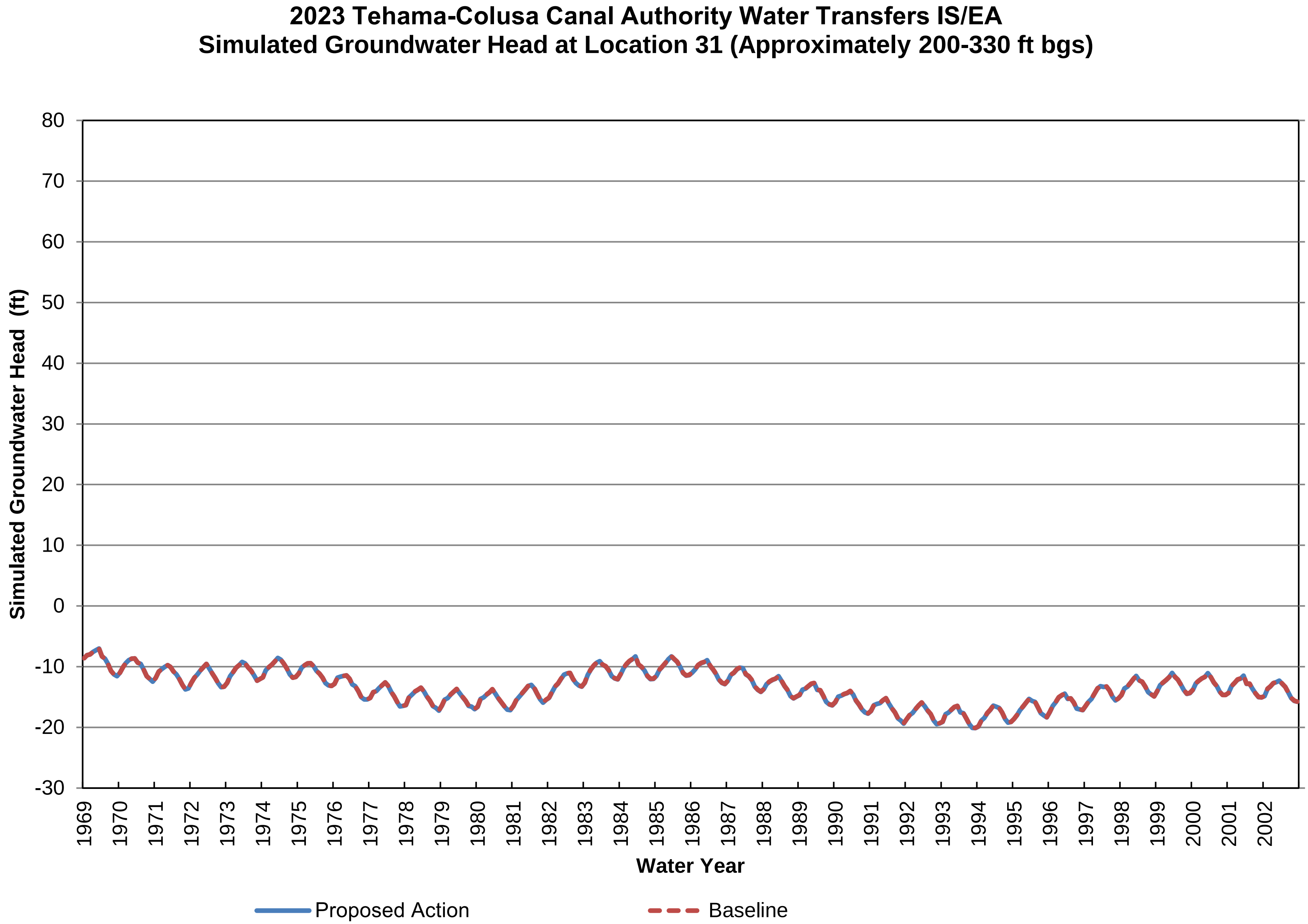
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 30 (Approximately 1770-2430 ft bgs)



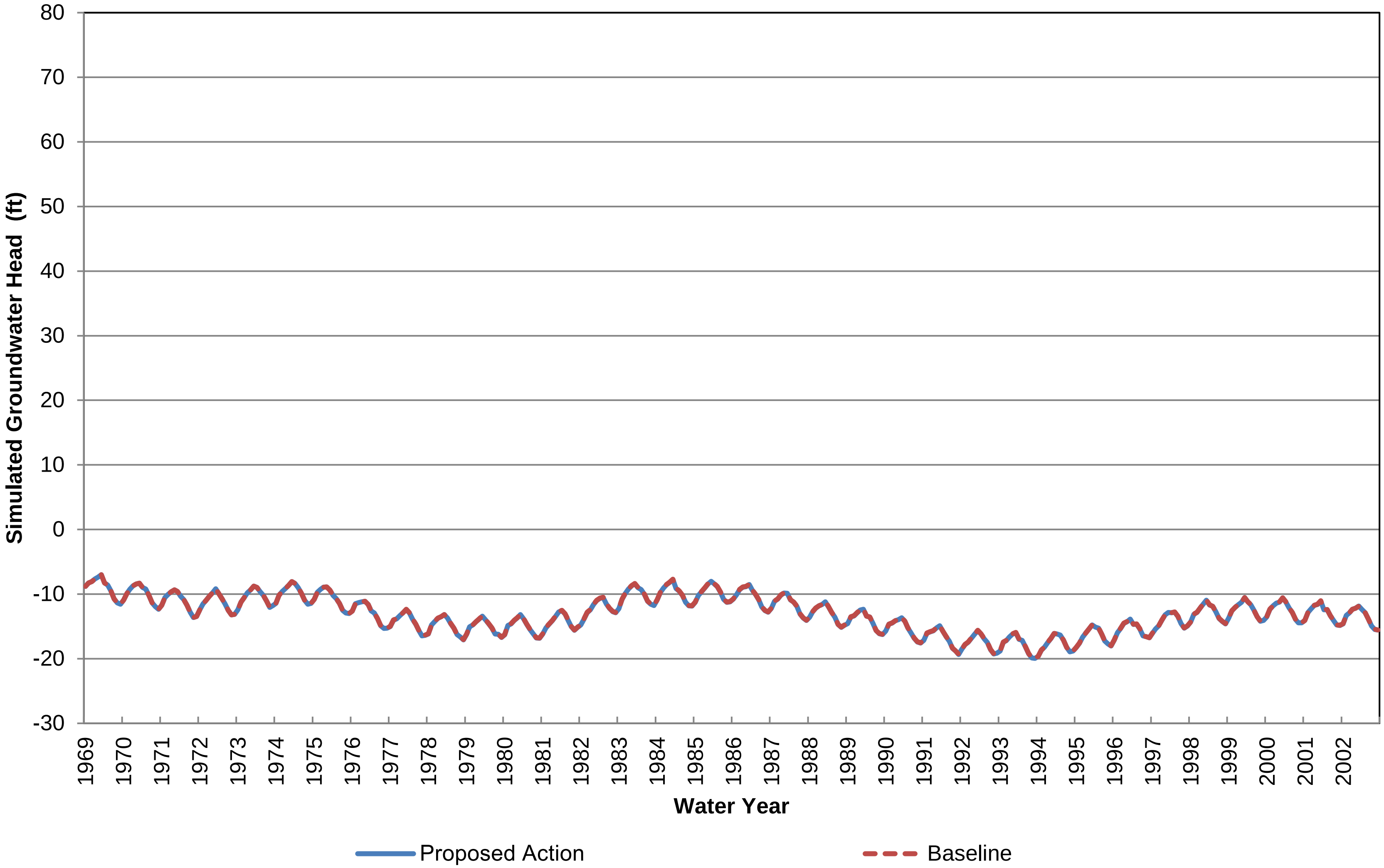
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 31 (Approximately 0-70 ft bgs)



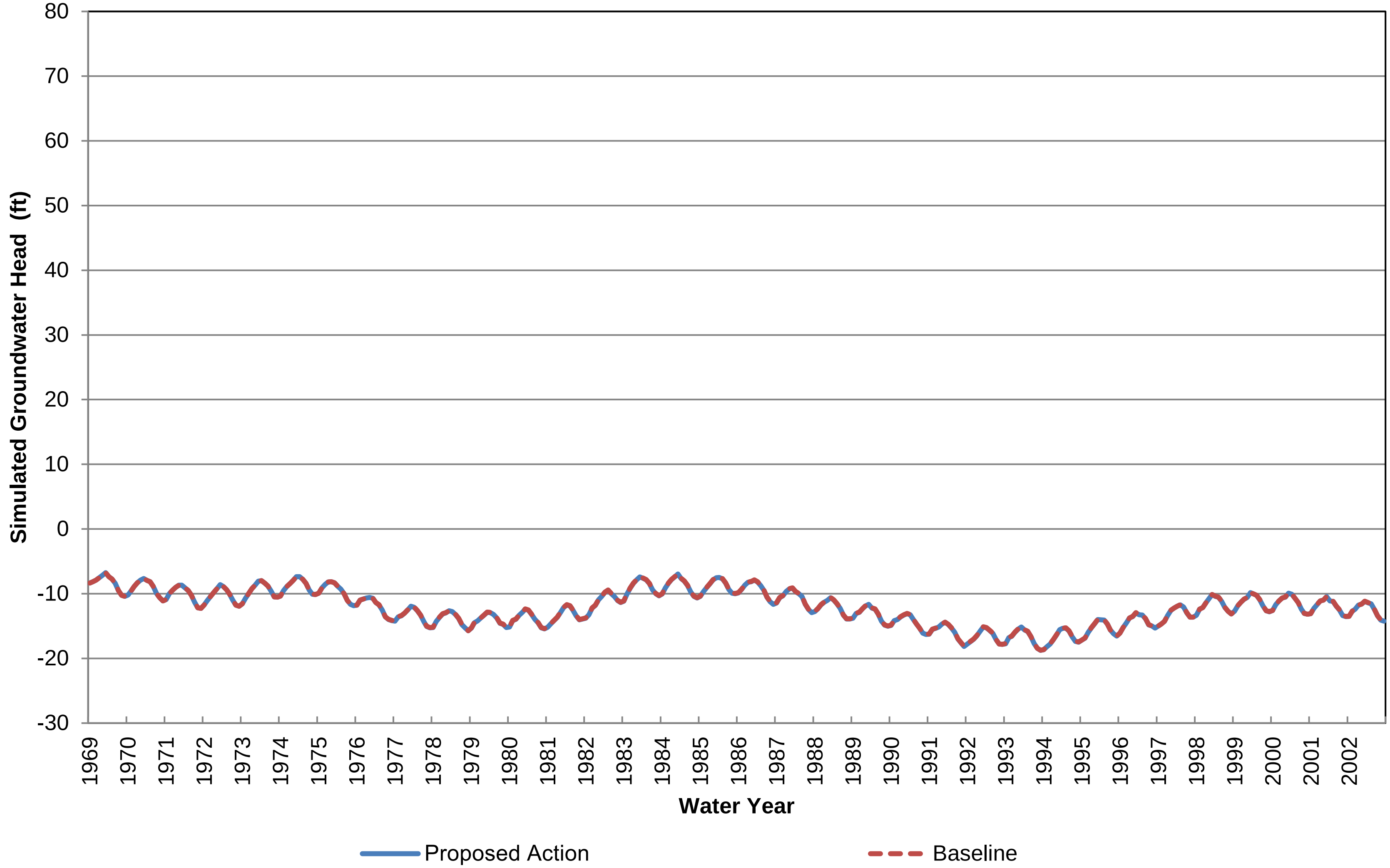

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 31 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 31 (Approximately 200-330 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

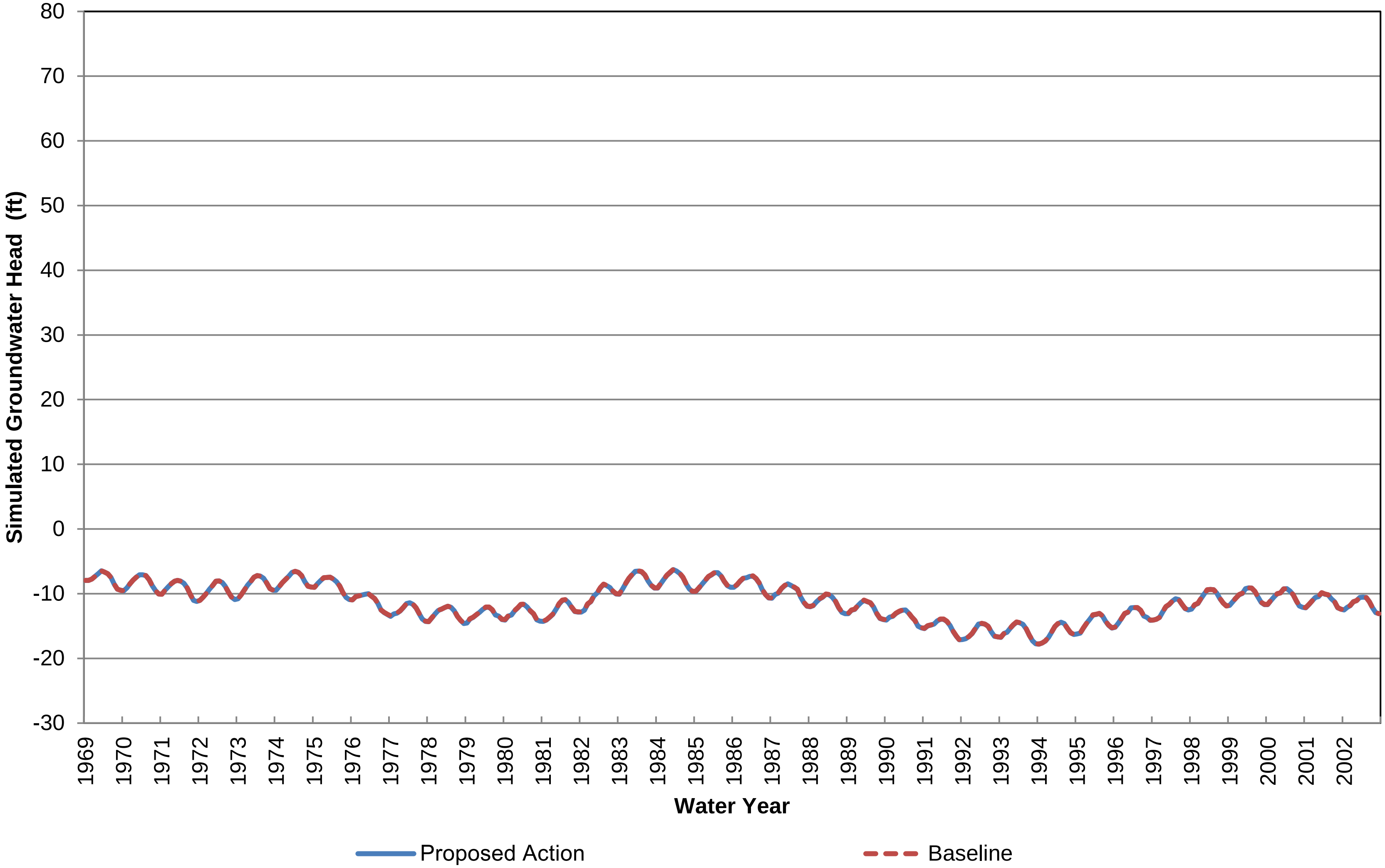
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 31 (Approximately 330-460 ft bgs)

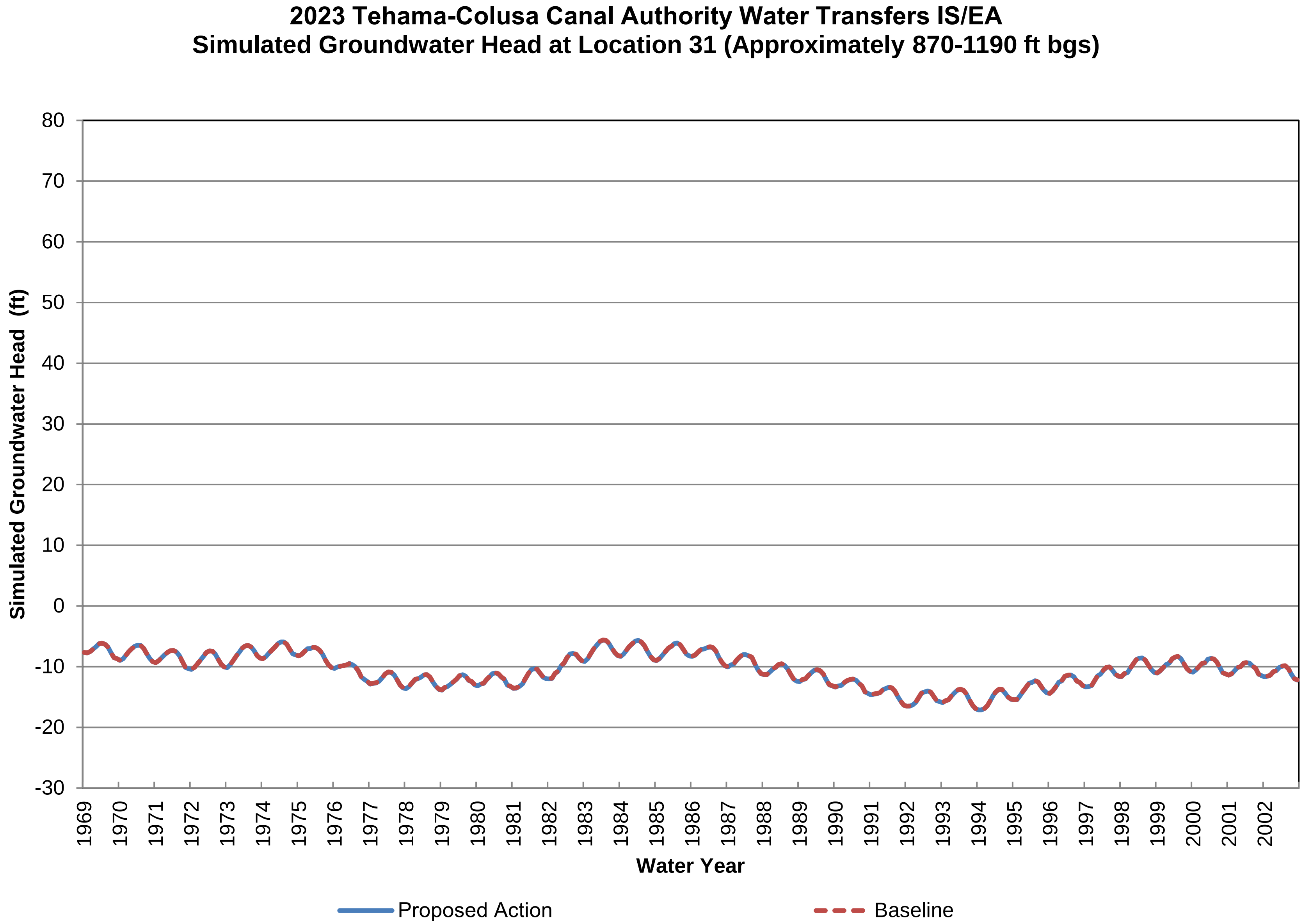


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 31 (Approximately 460-650 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 31 (Approximately 650-870 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 31 (Approximately 870-1190 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
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1988
1989
1990
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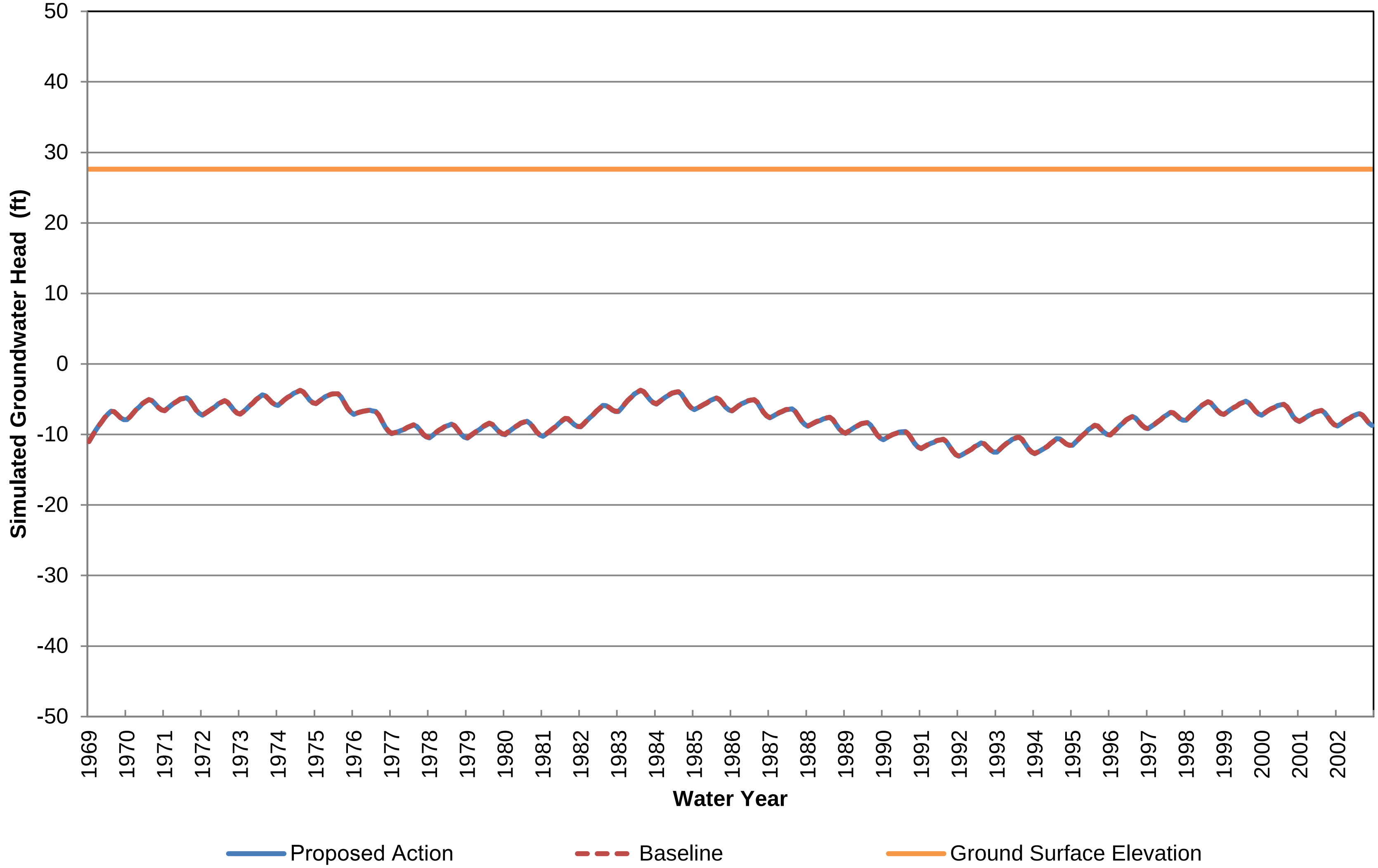
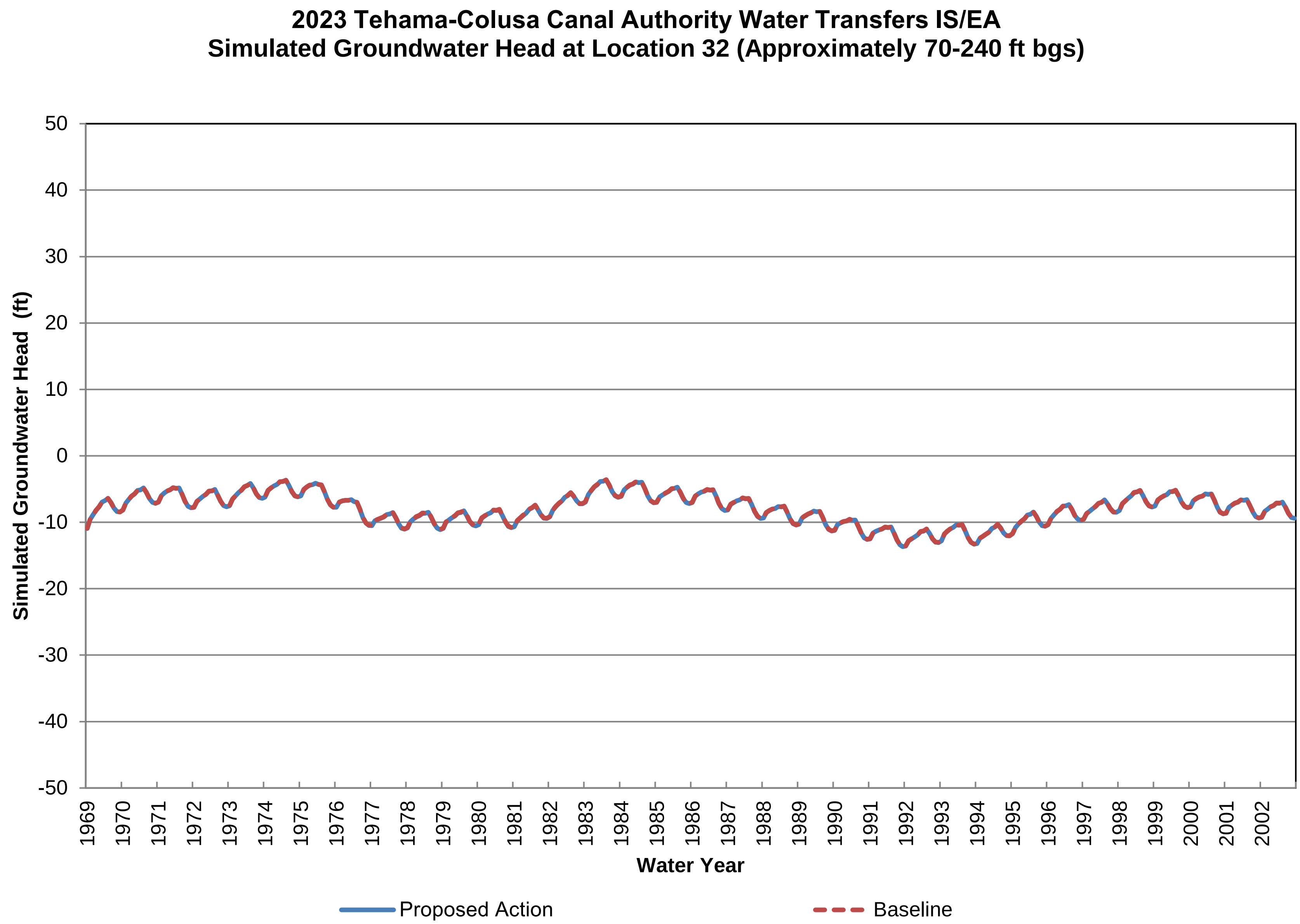
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

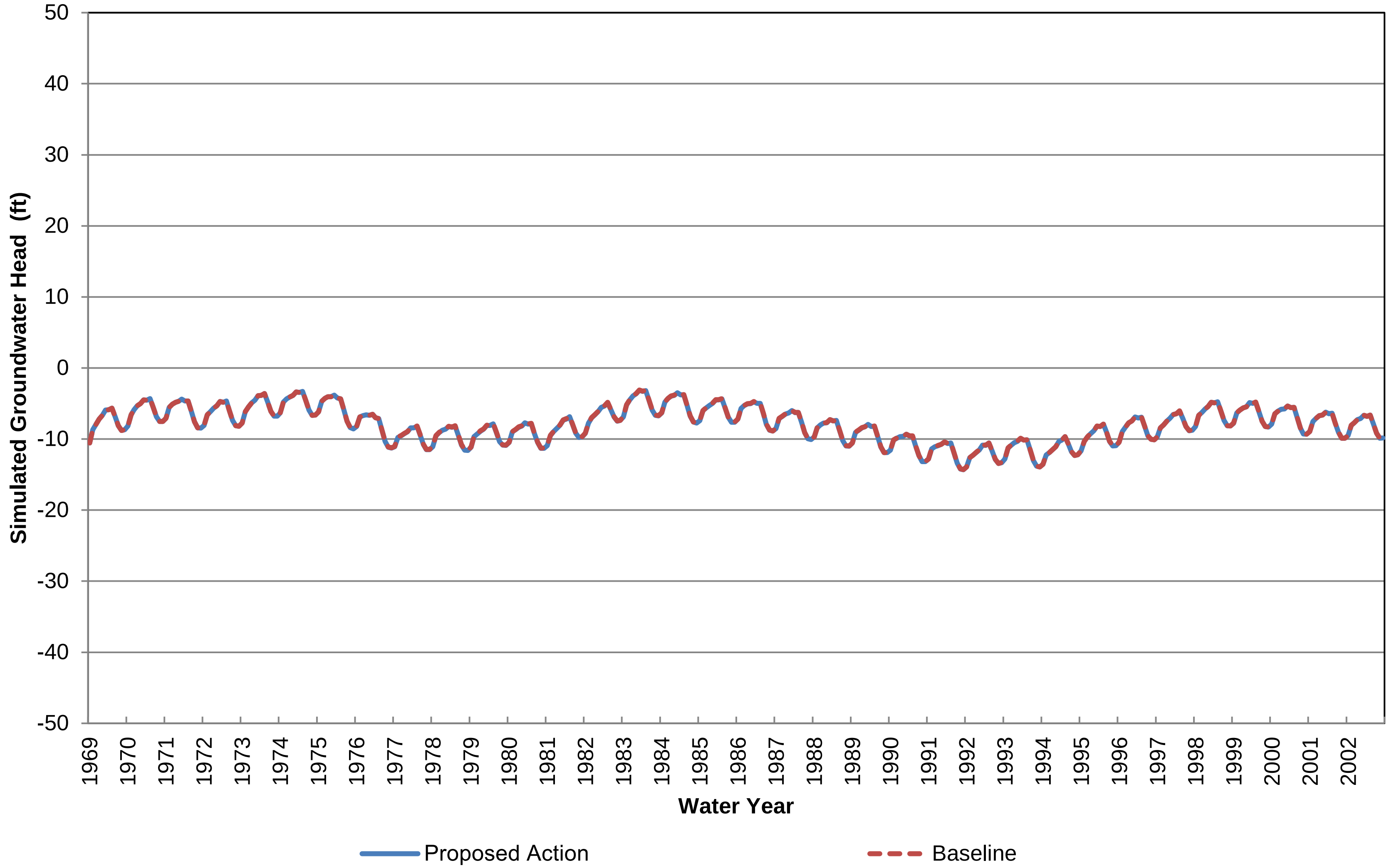
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 32 (Approximately 0-70 ft bgs)

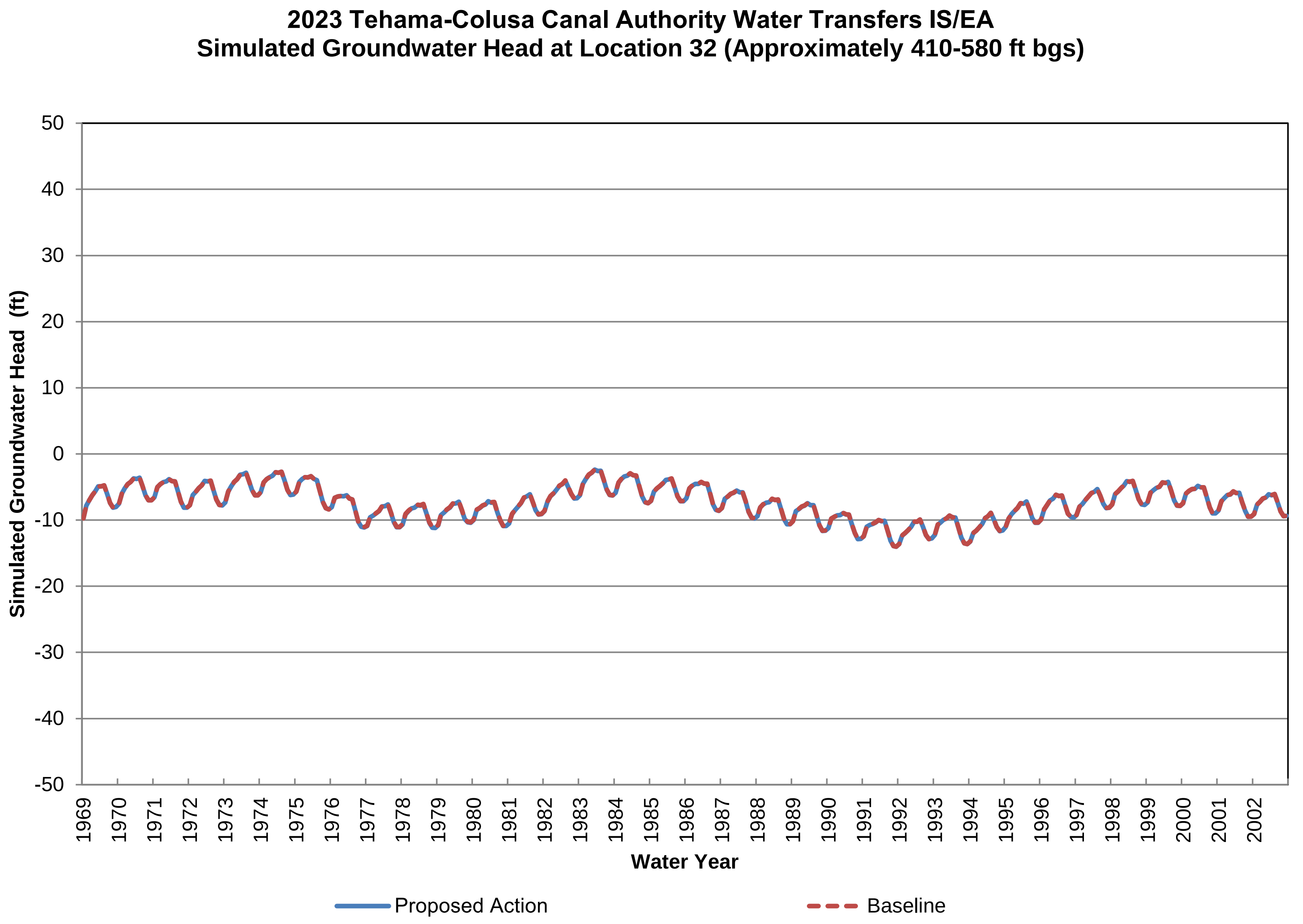




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 32 (Approximately 70-240 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

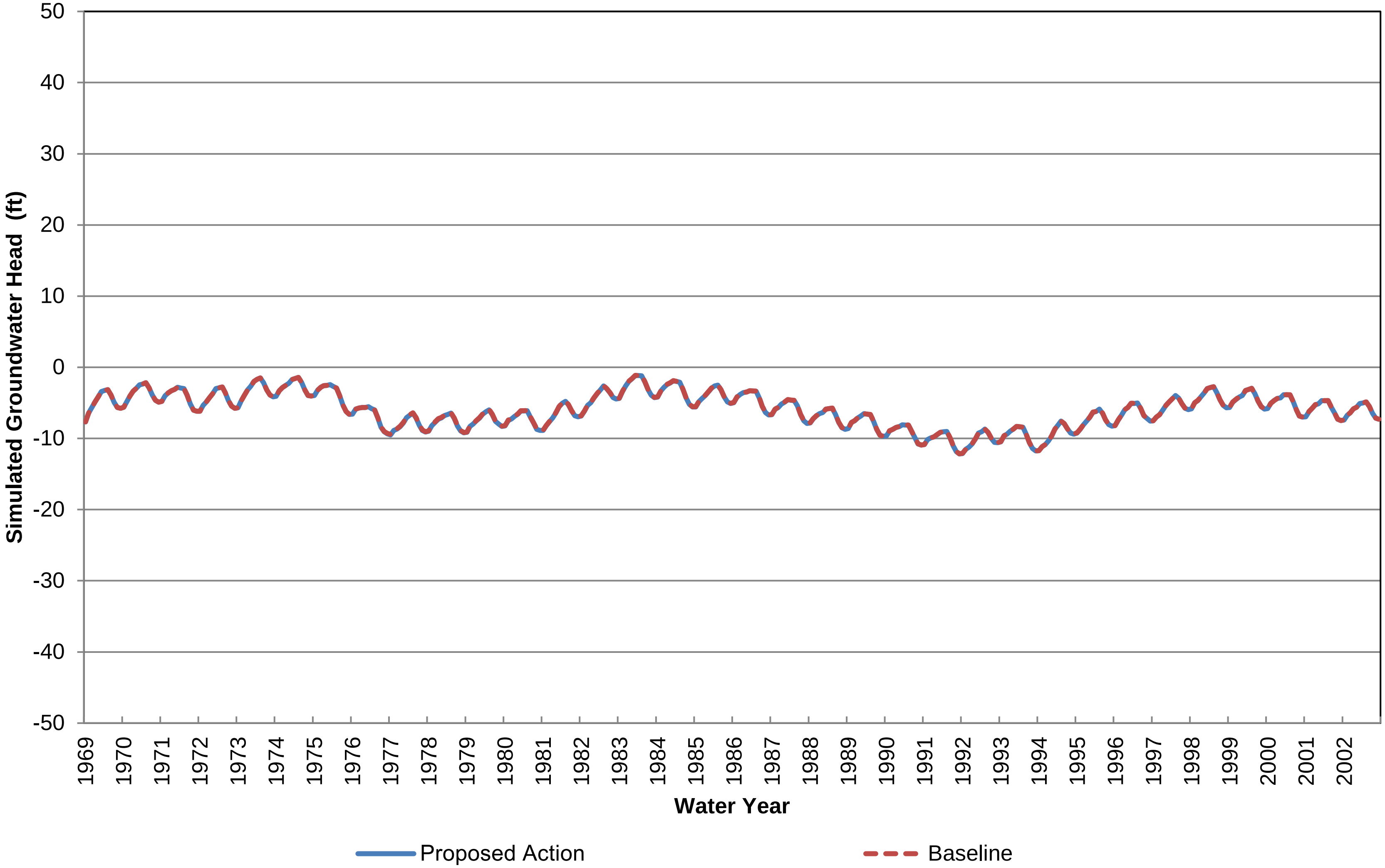
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 32 (Approximately 240-410 ft bgs)



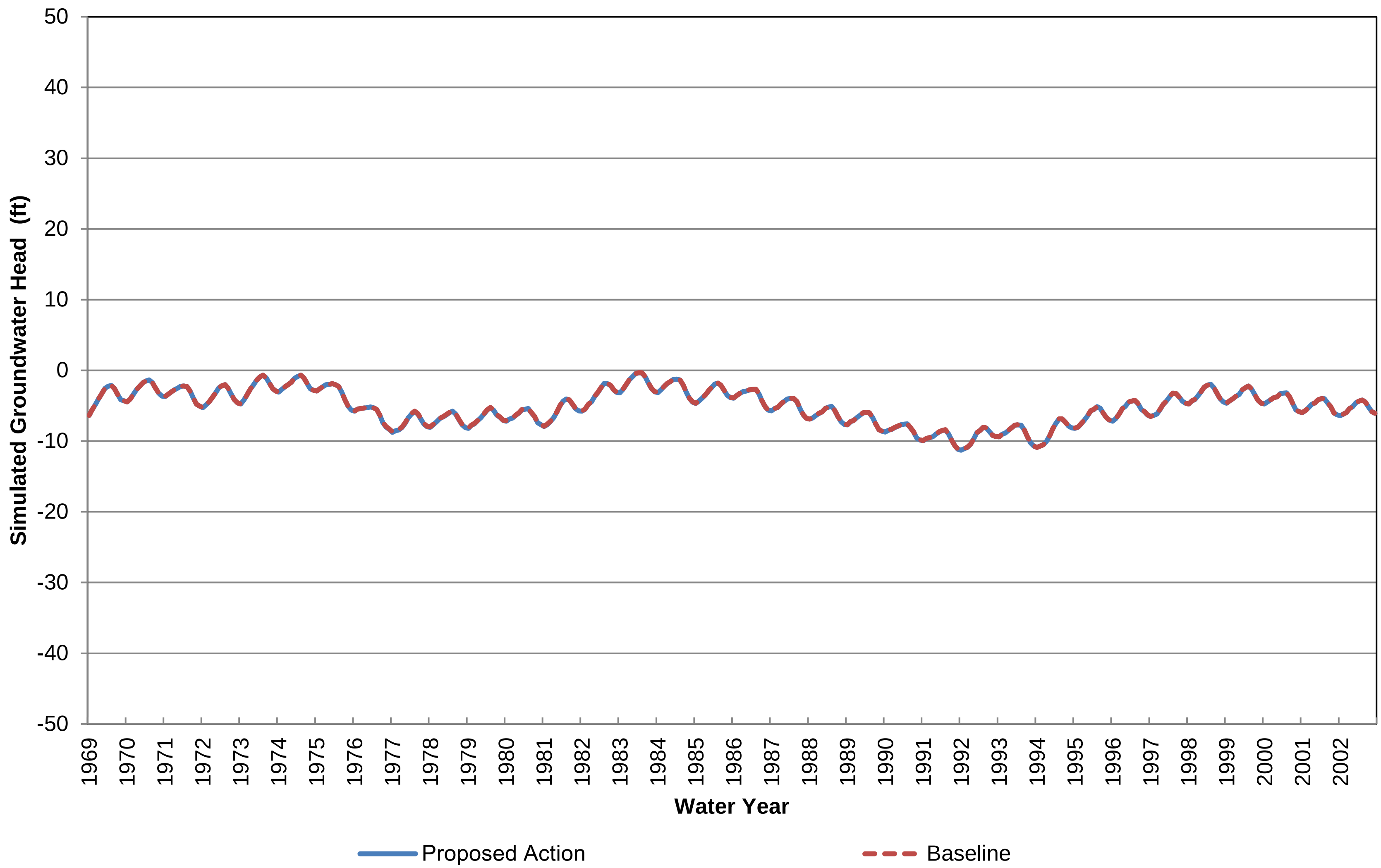


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 32 (Approximately 410-580 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

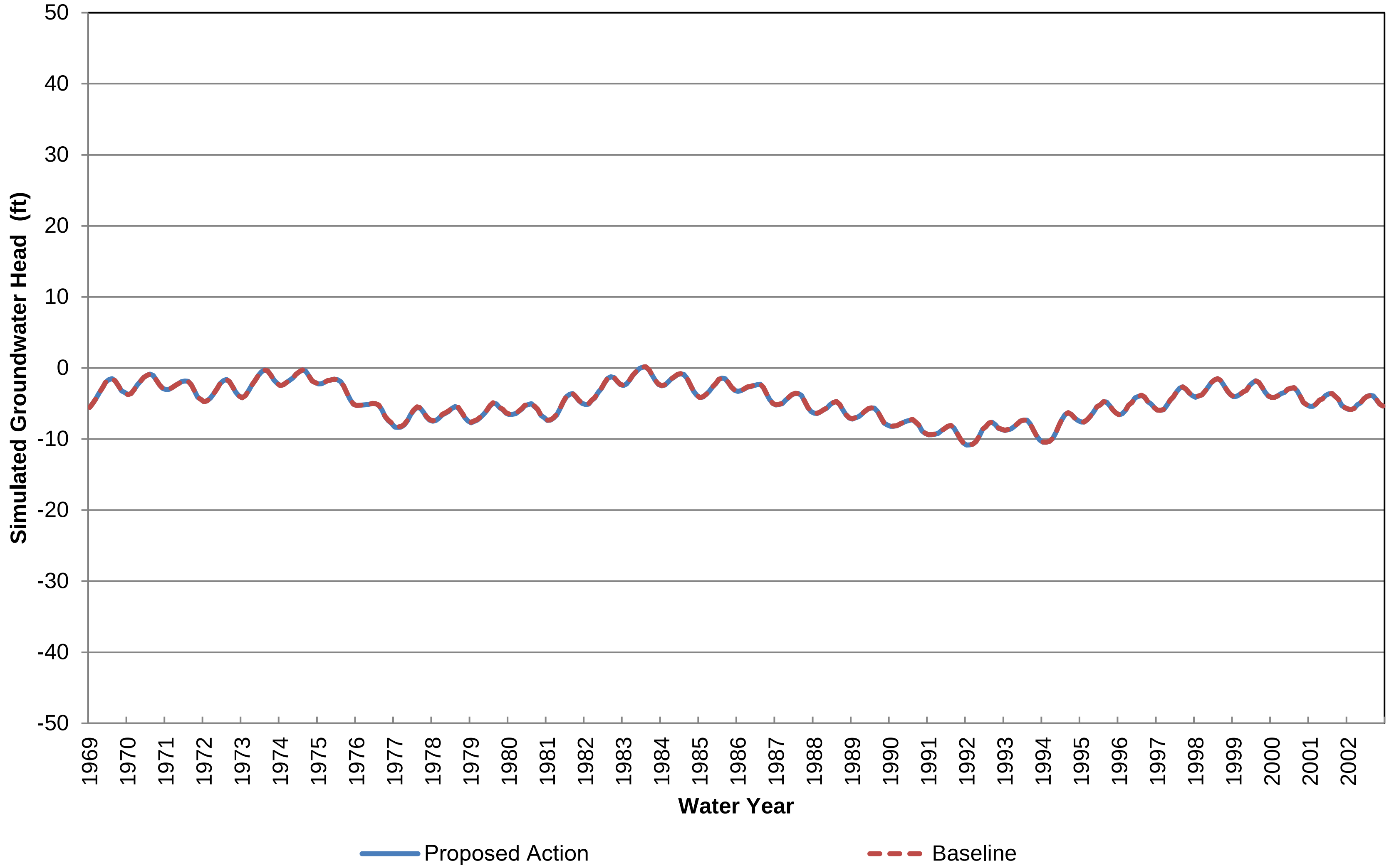
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 32 (Approximately 580-850 ft bgs)

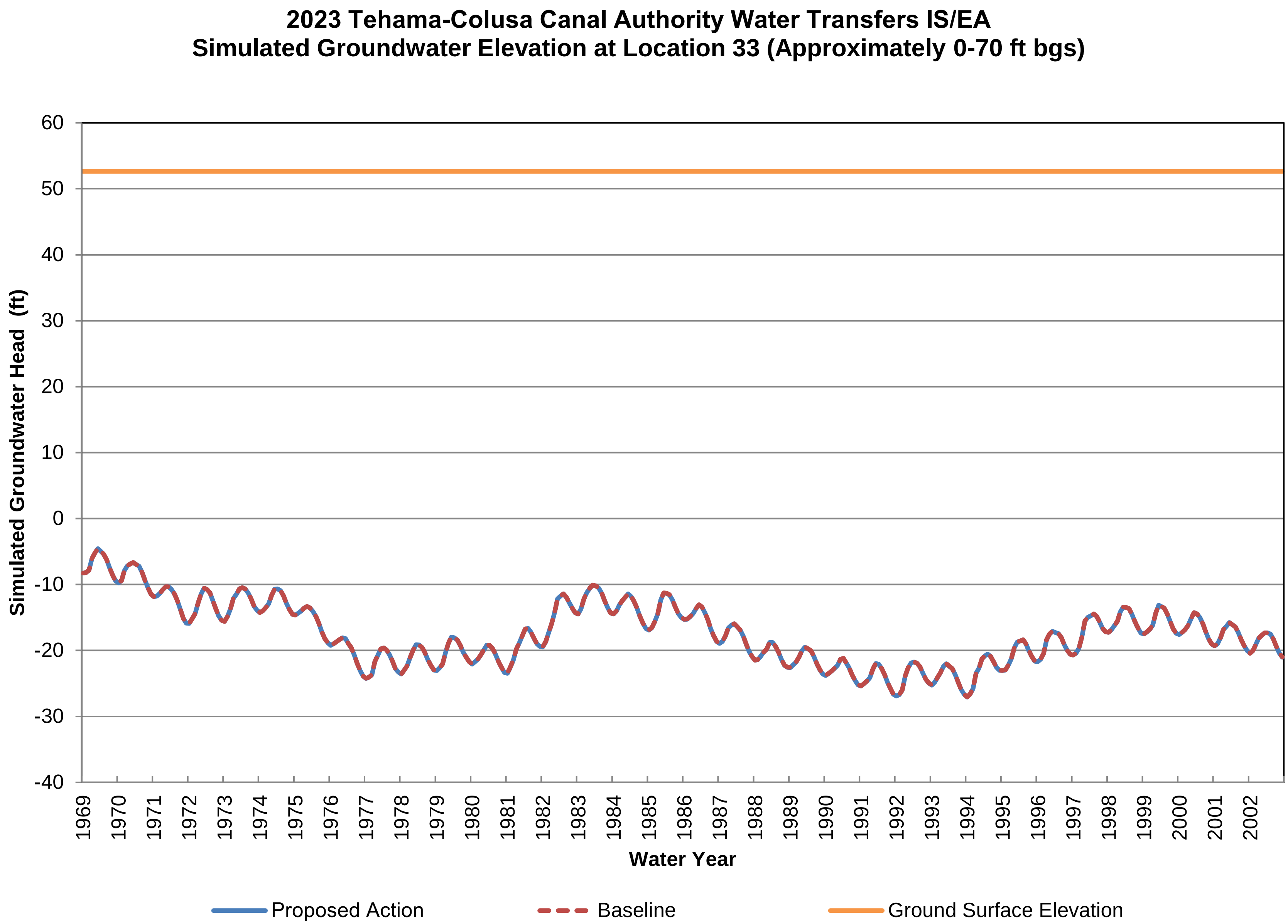


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 32 (Approximately 850-1140 ft bgs)

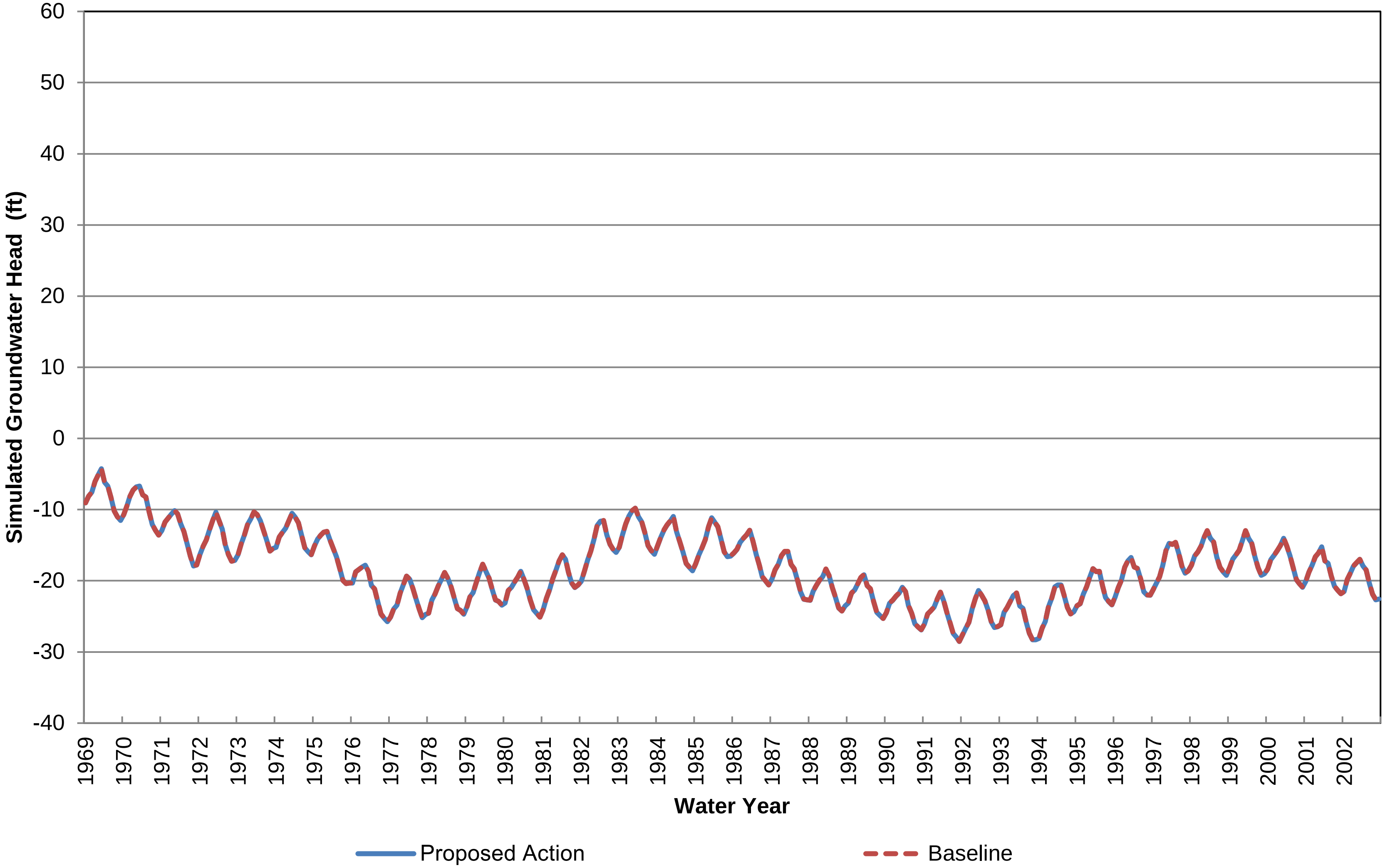


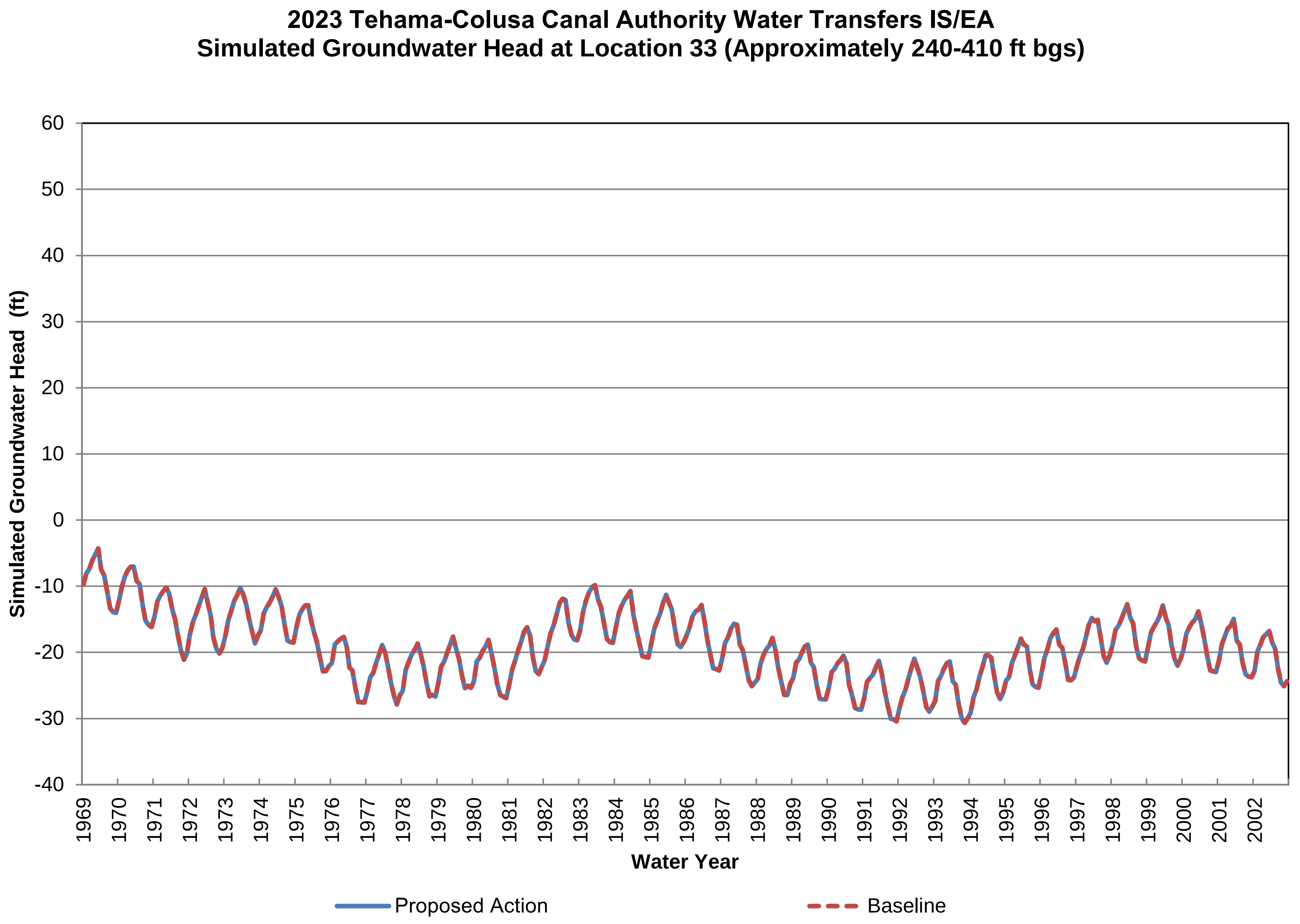
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 32 (Approximately 1140-1560 ft bgs)




2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 33 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline
Ground Surface Elevation

2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 33 (Approximately 70-240 ft bgs)





2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 33 (Approximately 240-410 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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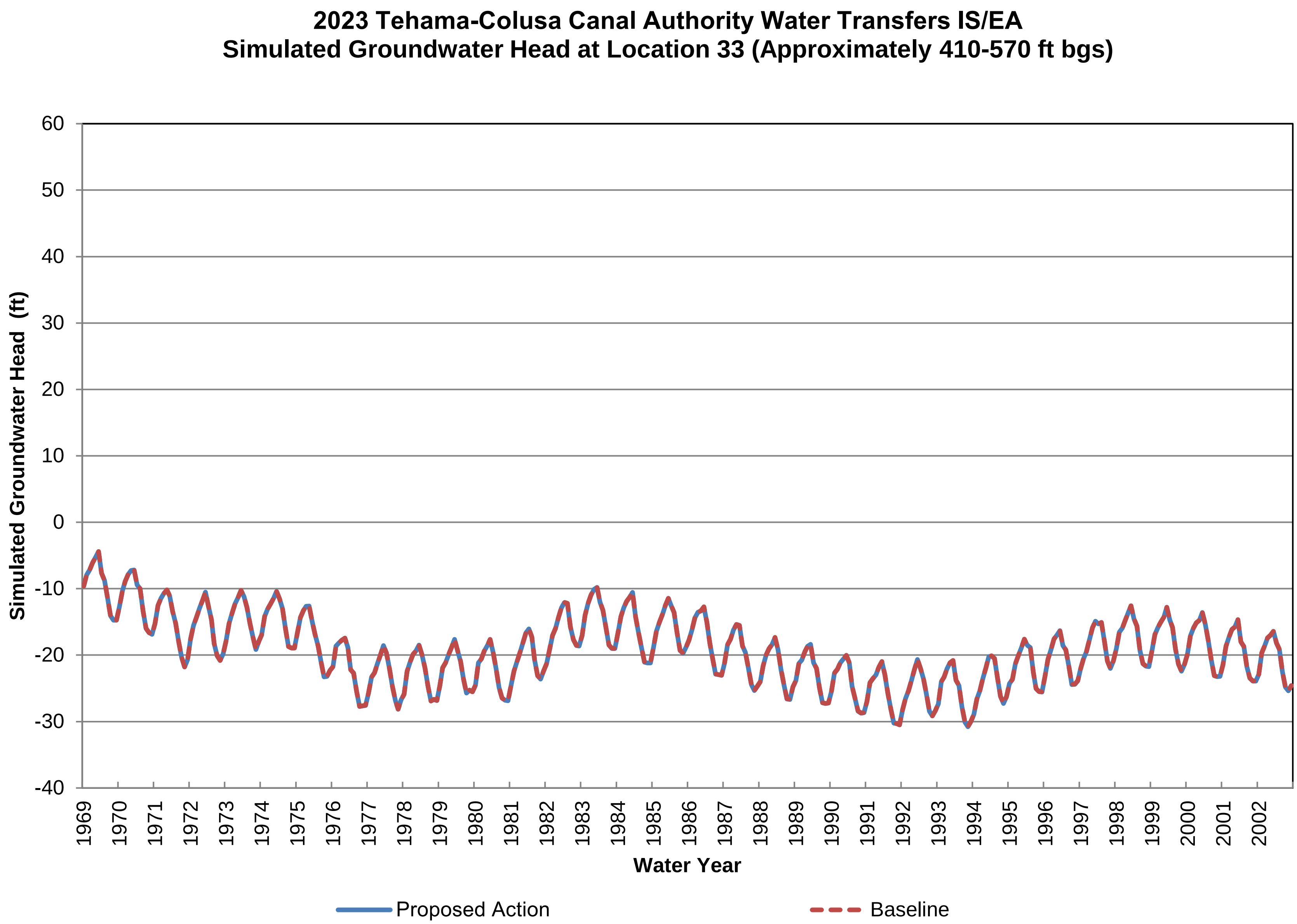
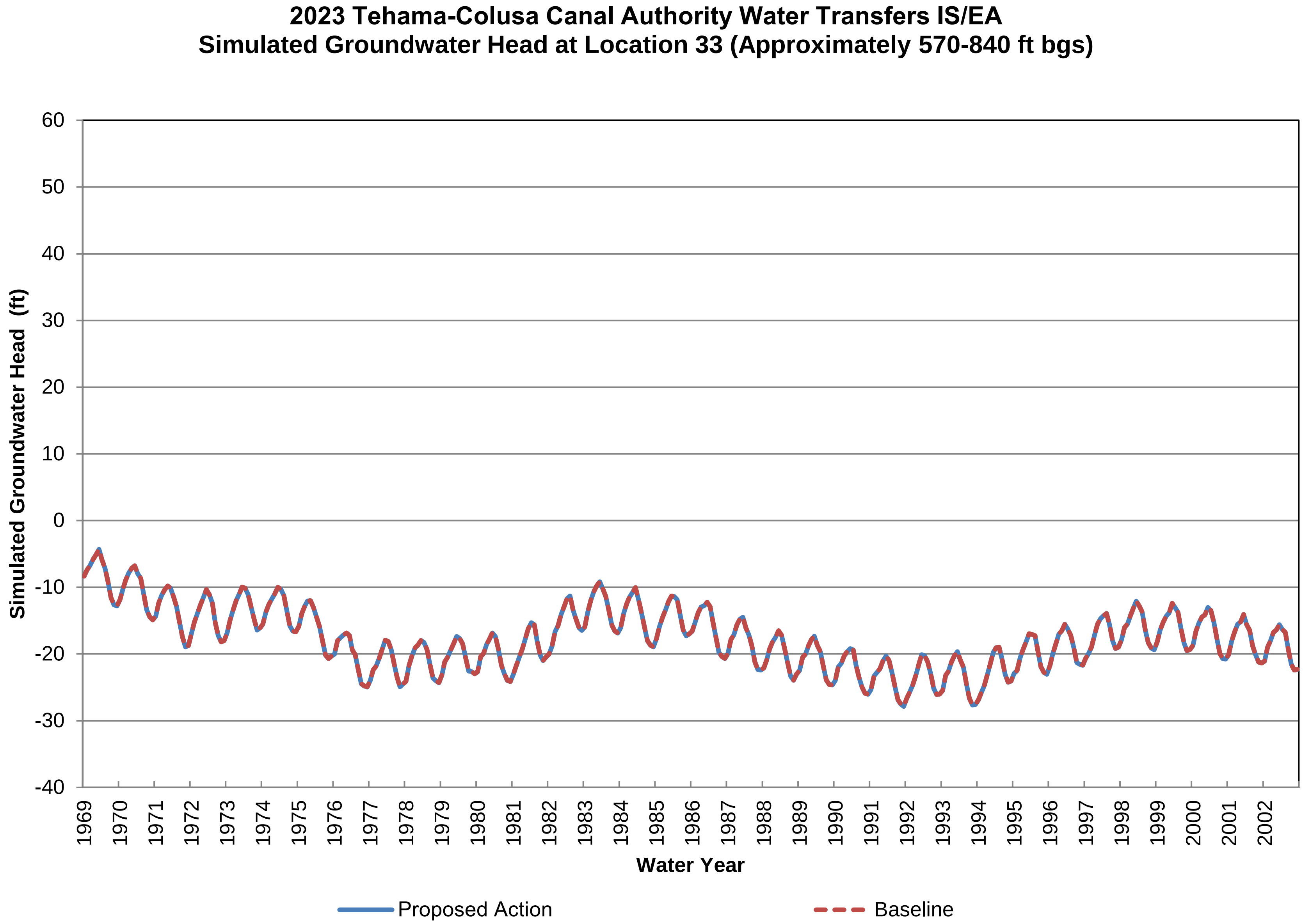
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

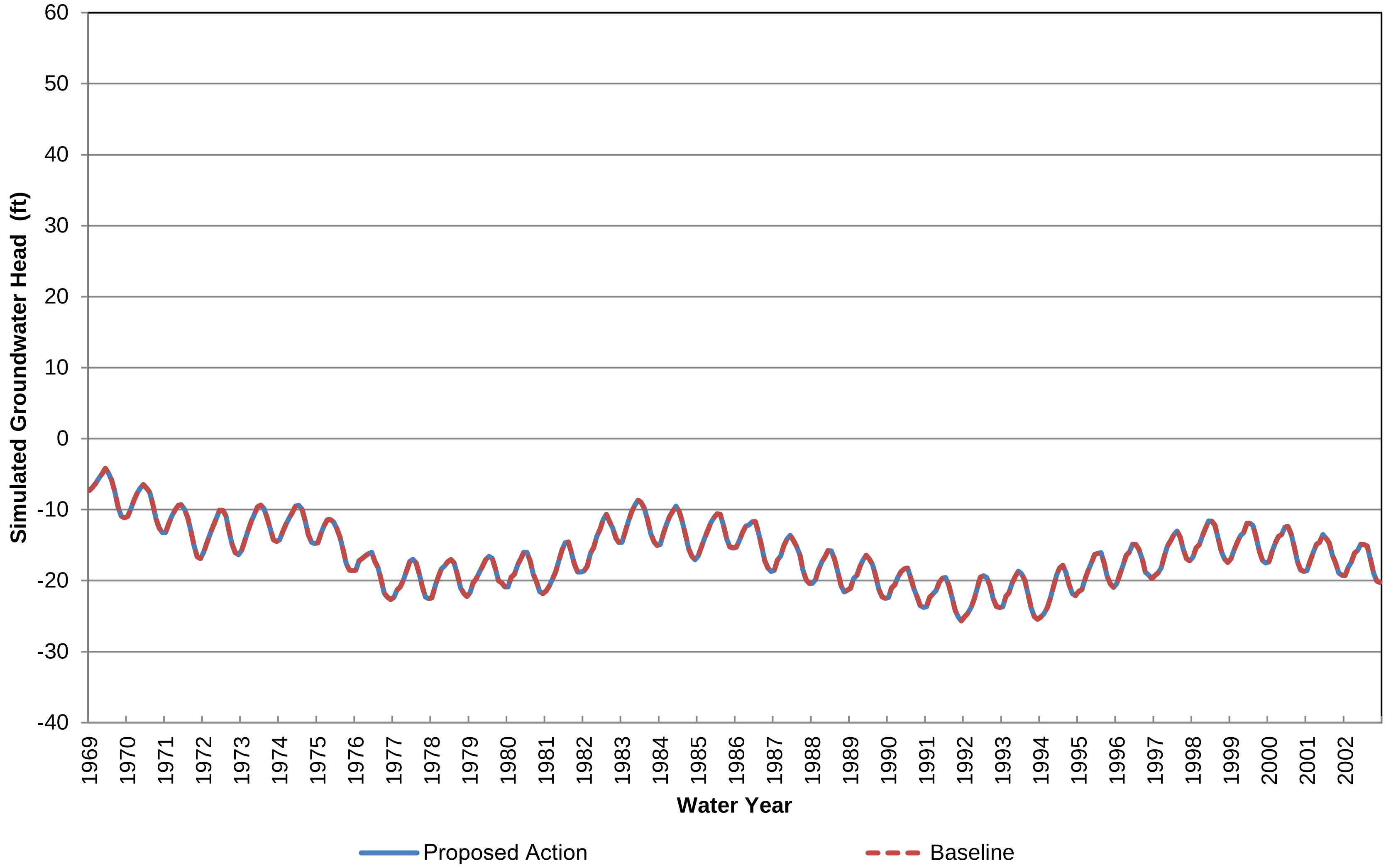


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 33 (Approximately 410-570 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

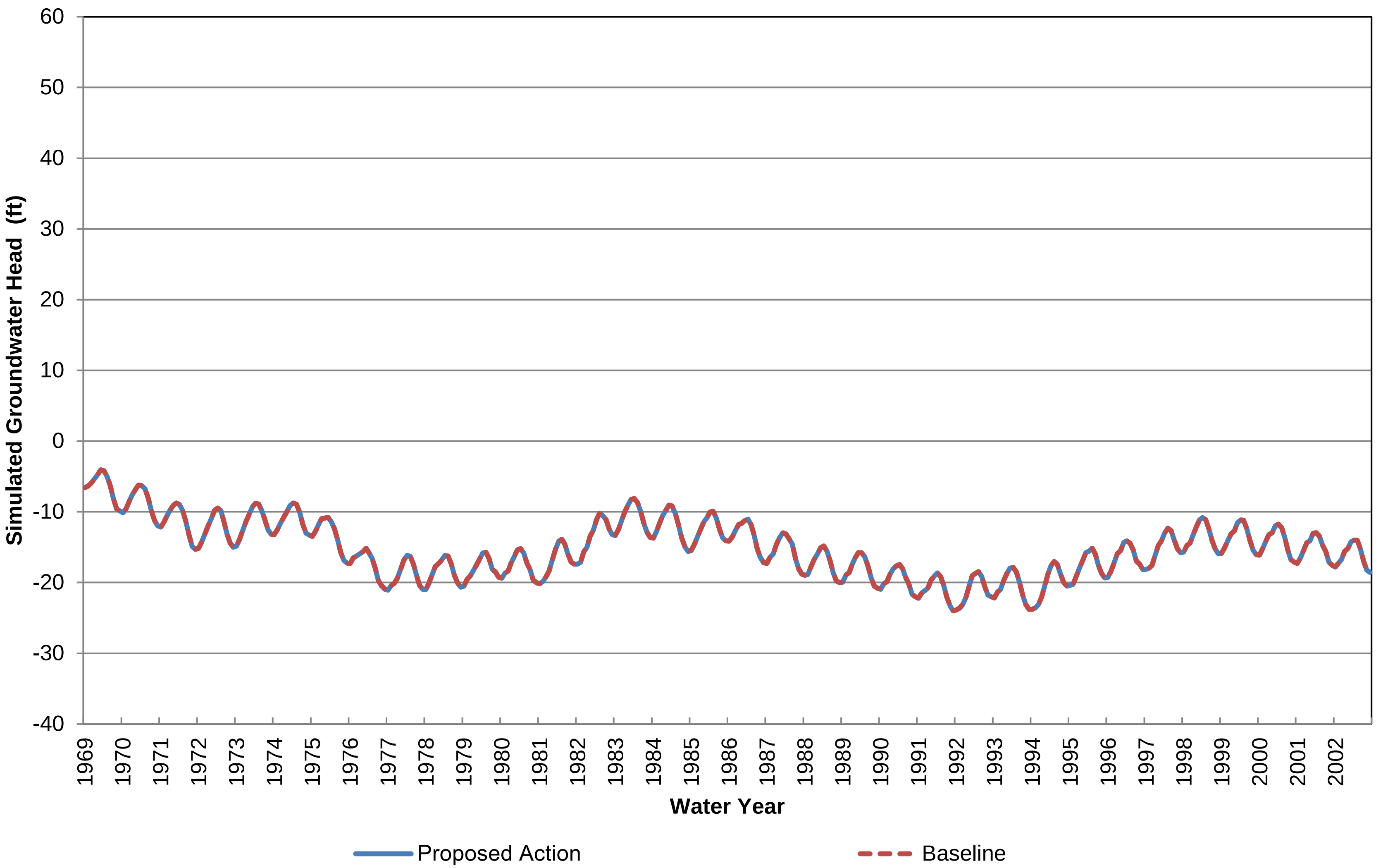


2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 33 (Approximately 570-840 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Water Year
Proposed Action
Baseline

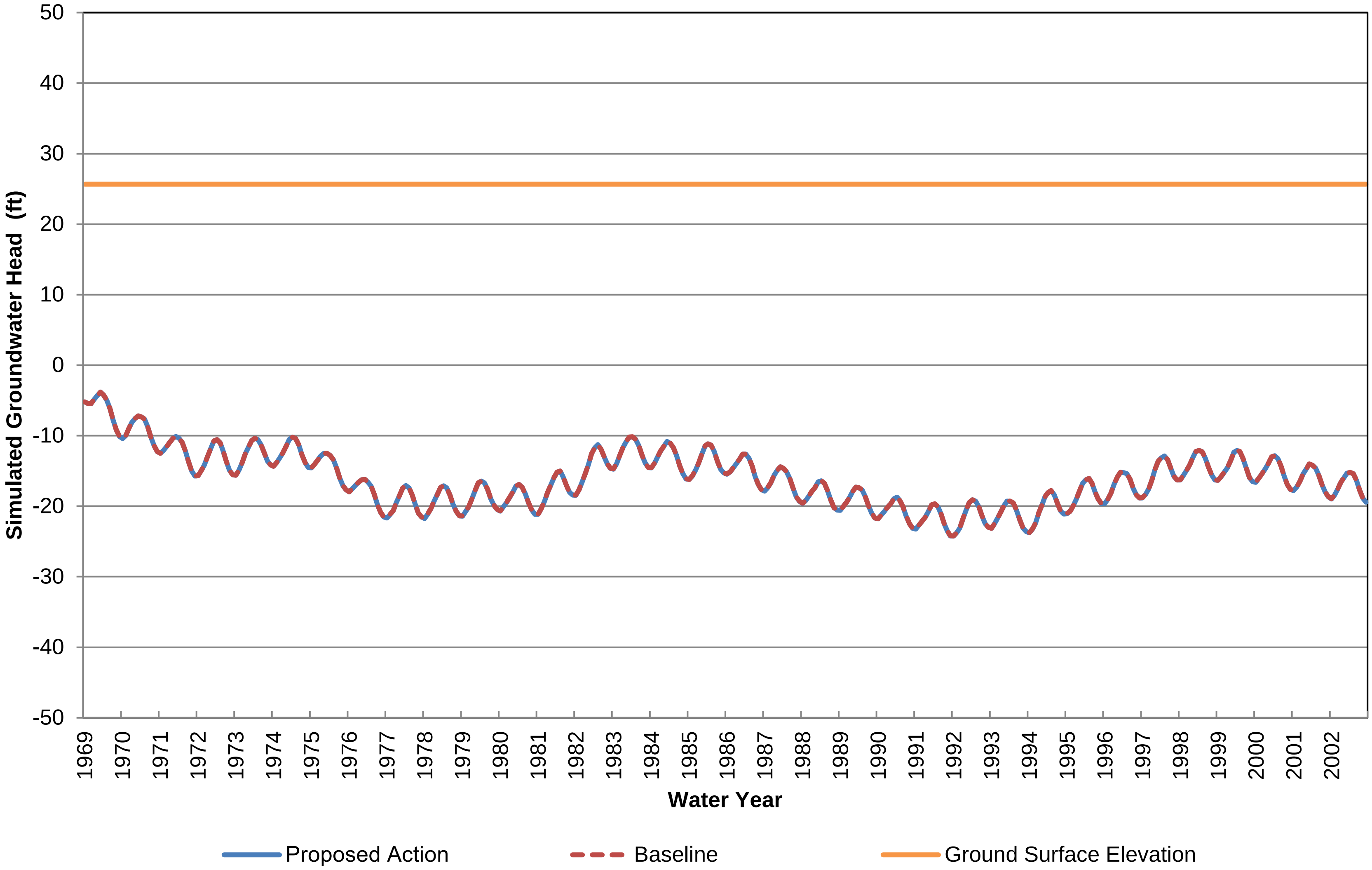
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 33 (Approximately 840-1120 ft bgs)



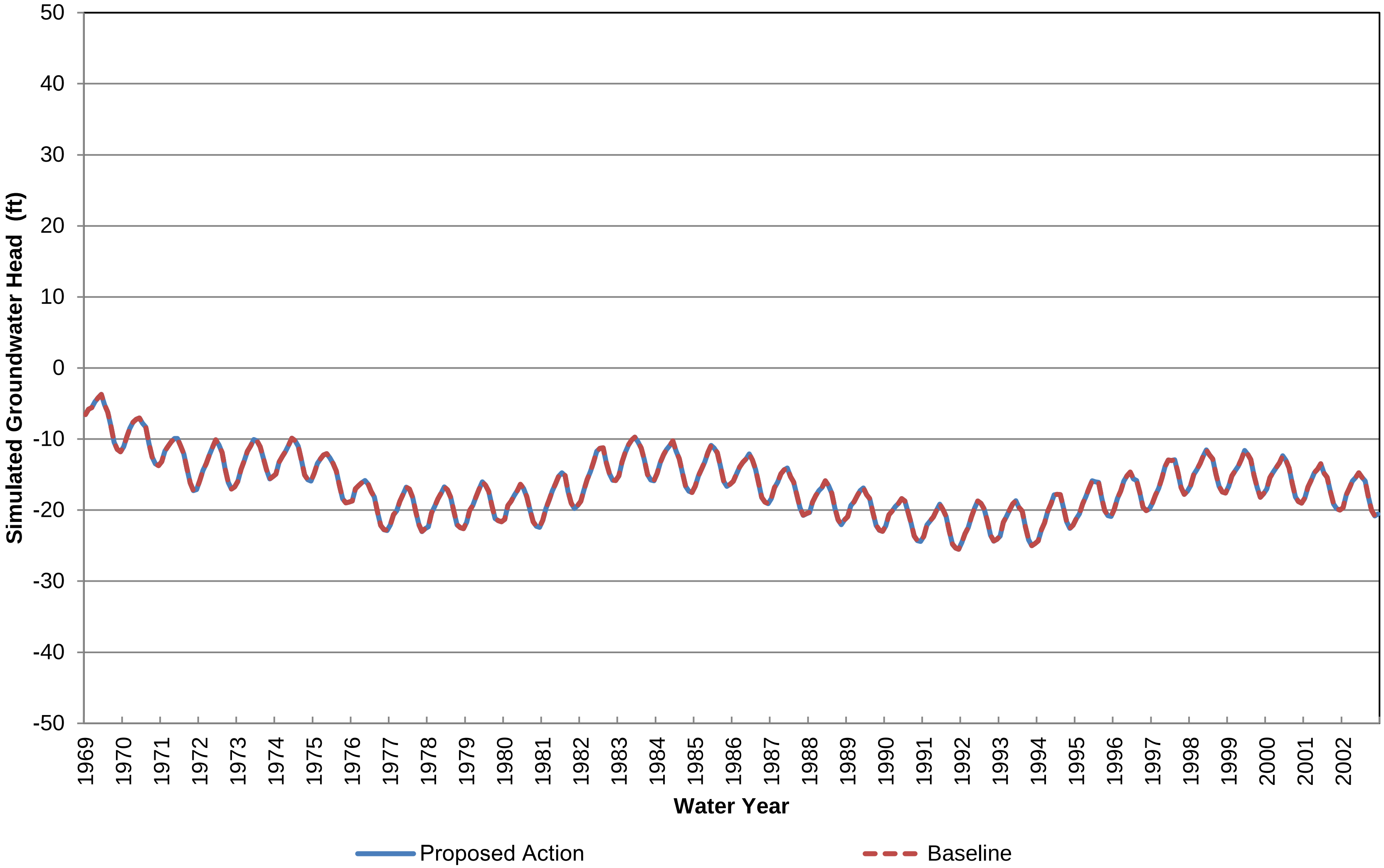
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 33 (Approximately 1120-1540 ft bgs)



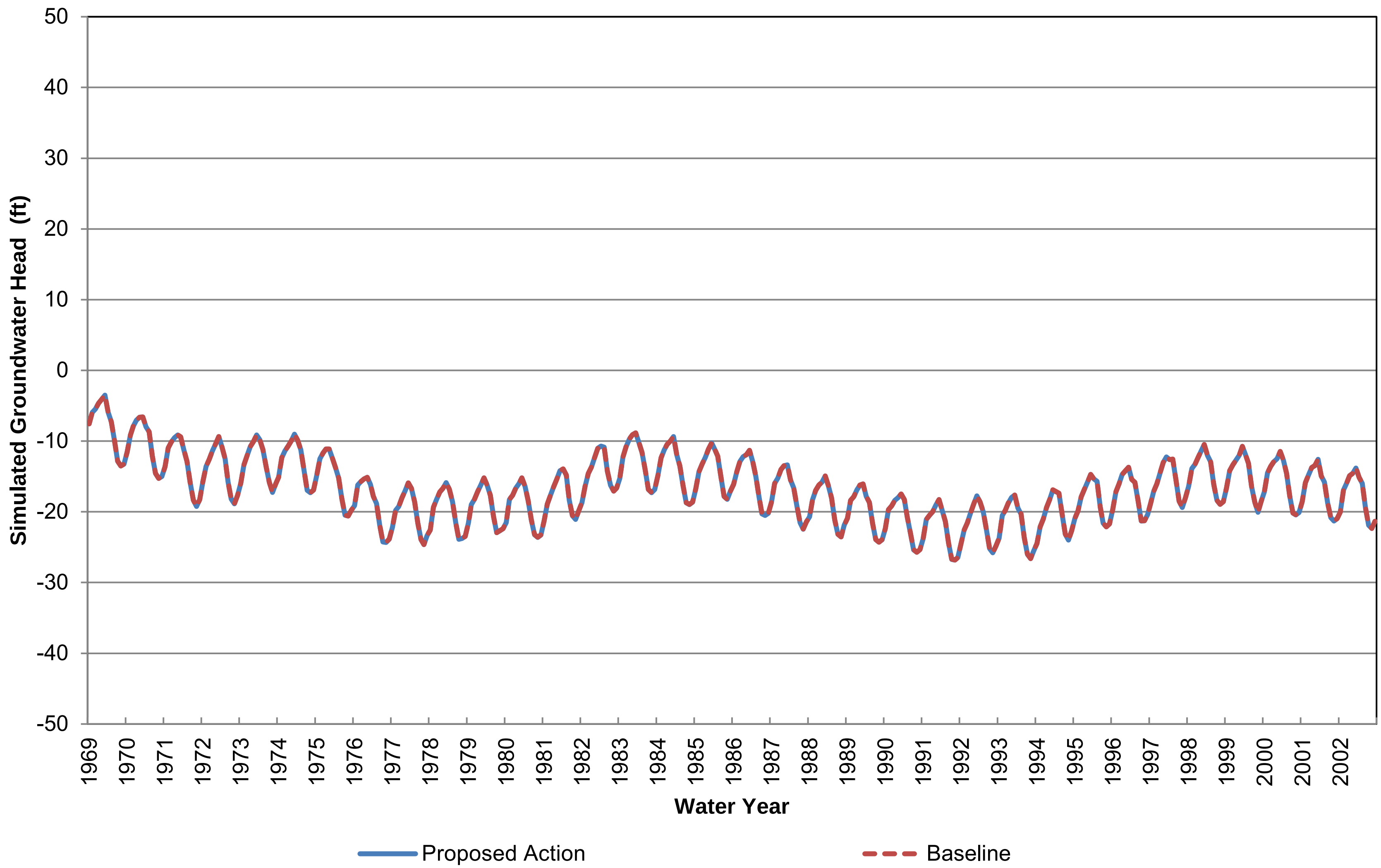
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Elevation at Location 34 (Approximately 0-70 ft bgs)



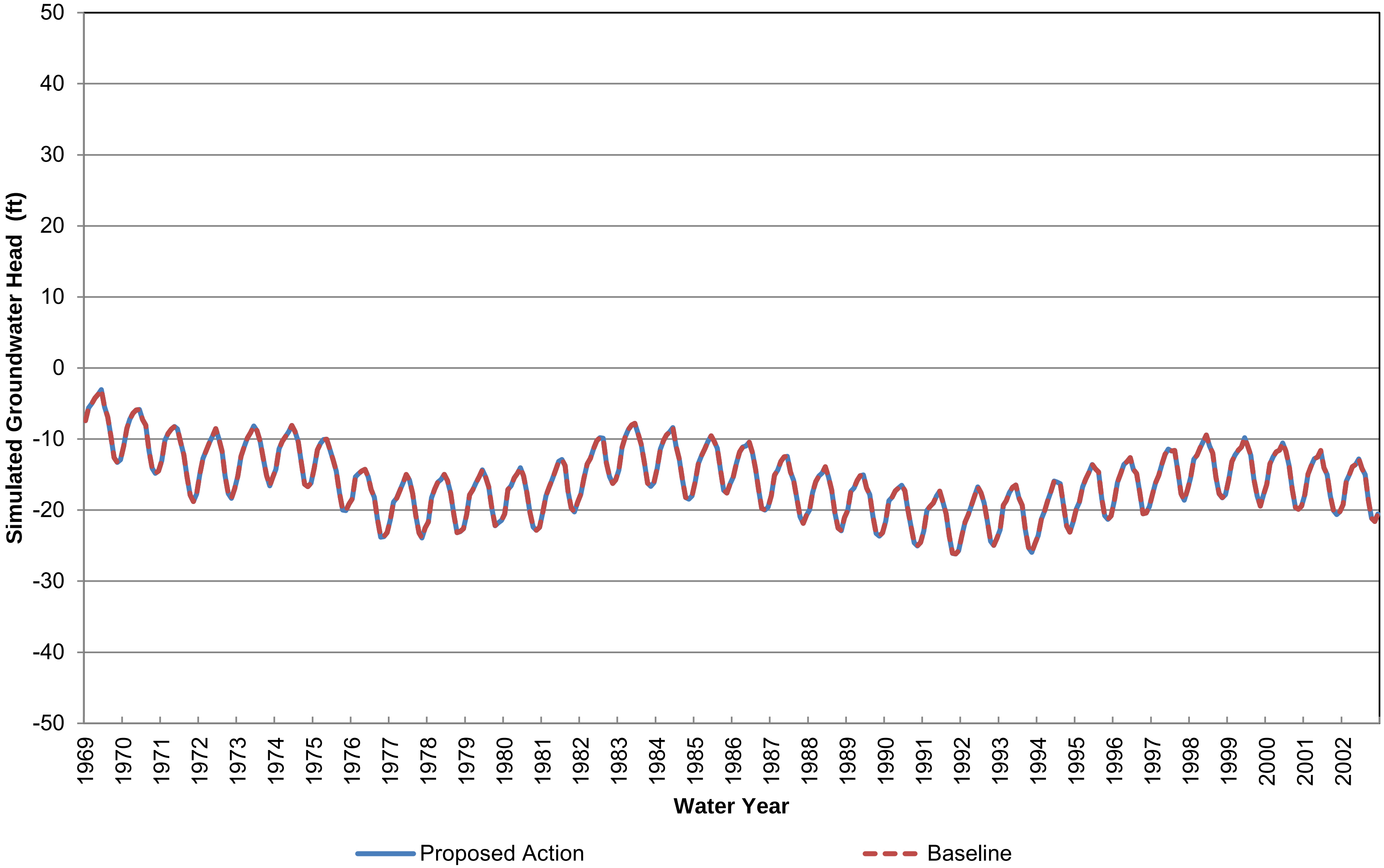
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 34 (Approximately 70-230 ft bgs)



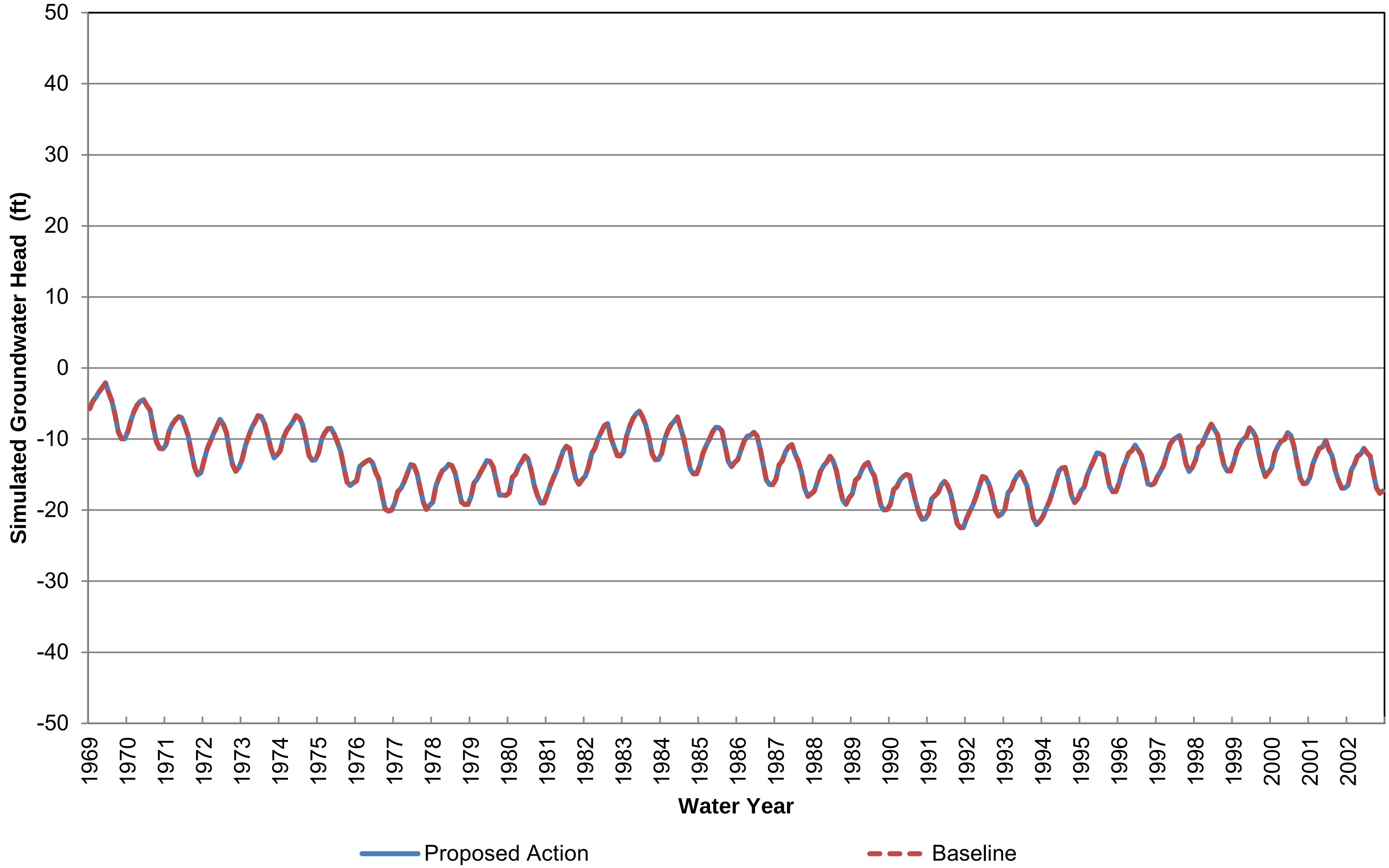
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 34 (Approximately 230-380 ft bgs)



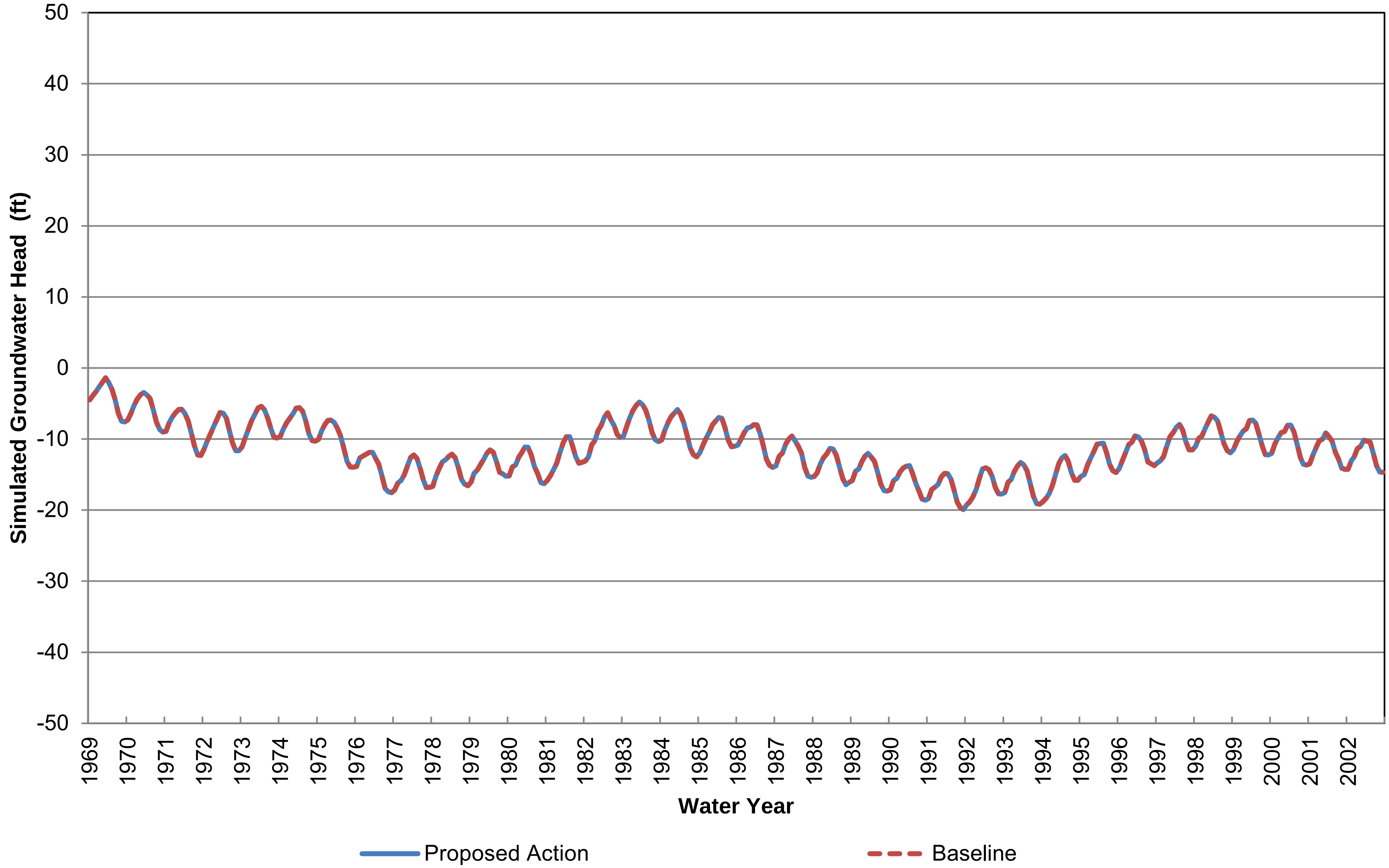
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 34 (Approximately 380-540 ft bgs)



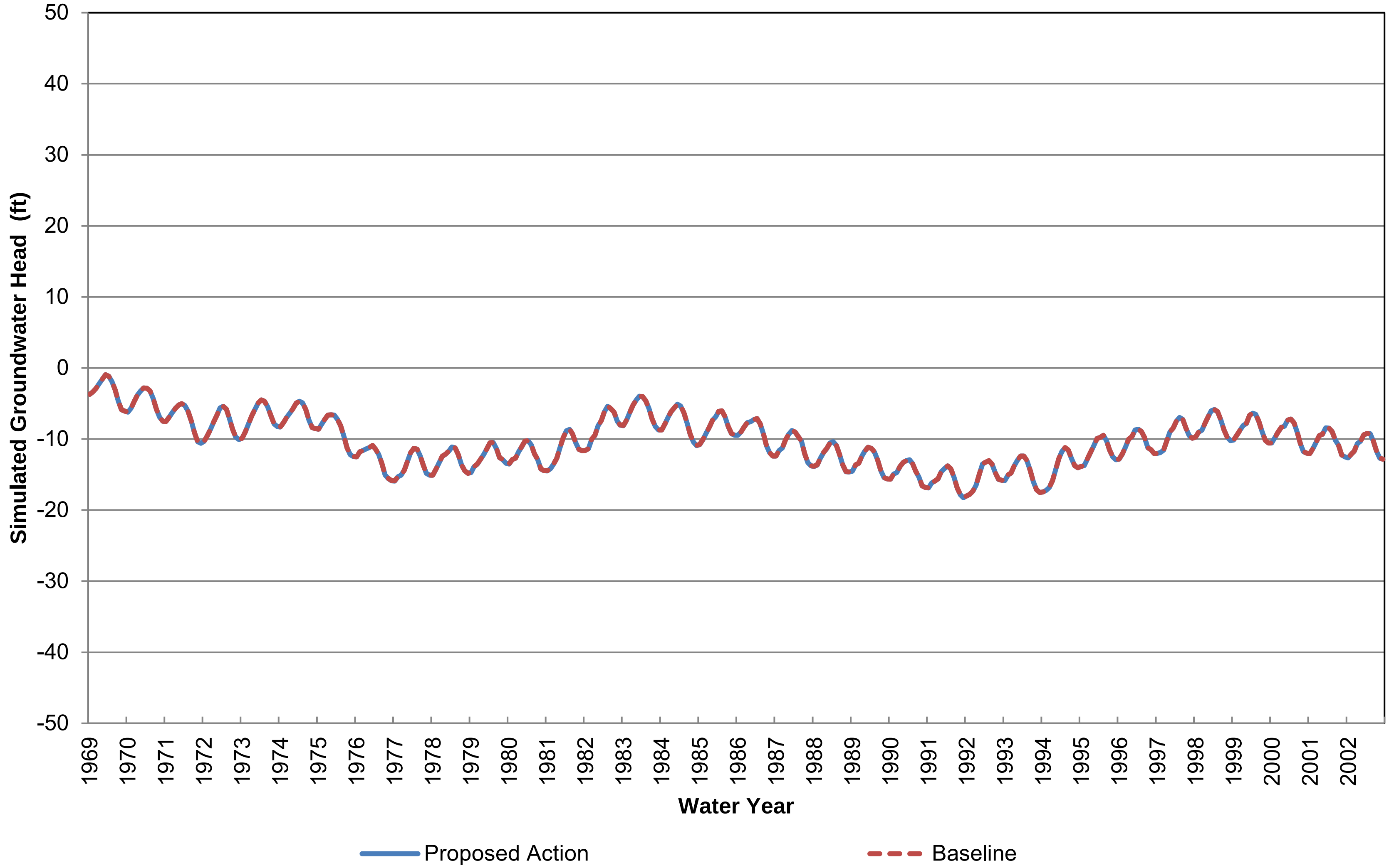
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 34 (Approximately 540-780 ft bgs)



2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 34 (Approximately 780-1040 ft bgs)



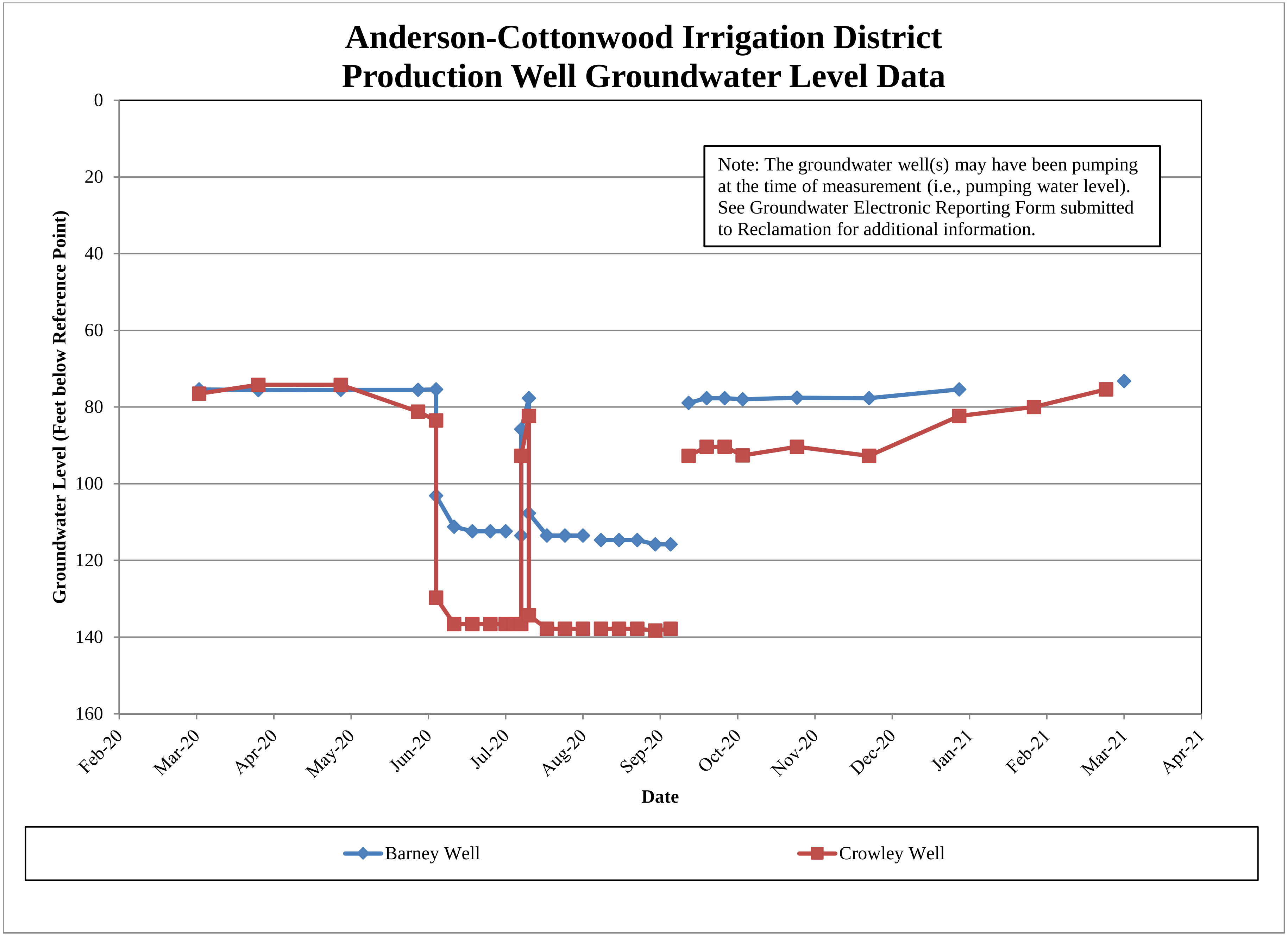
2023 Tehama-Colusa Canal Authority Water Transfers IS/EA
Simulated Groundwater Head at Location 34 (Approximately 1040-1430 ft bgs)

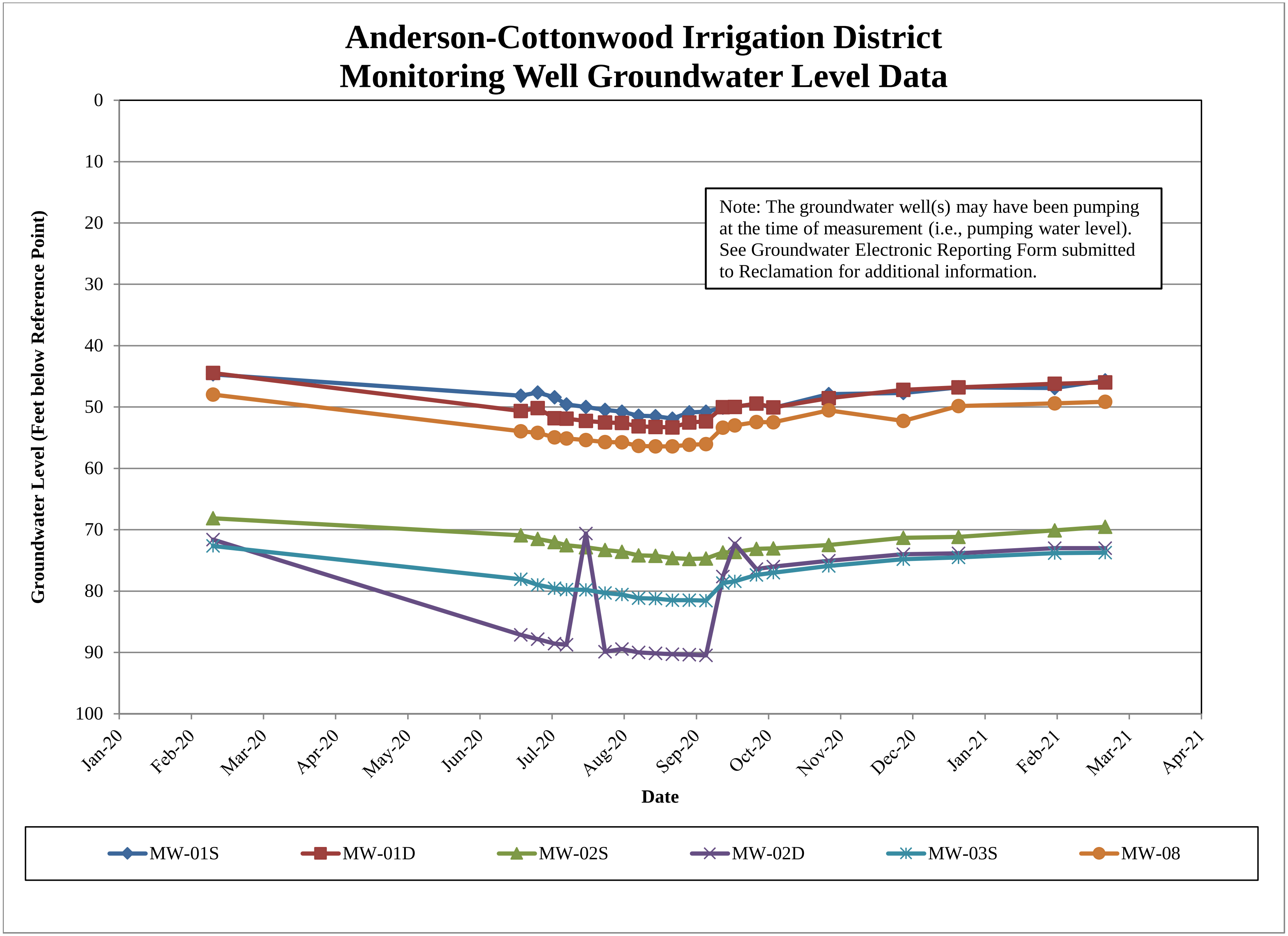


Appendix I1

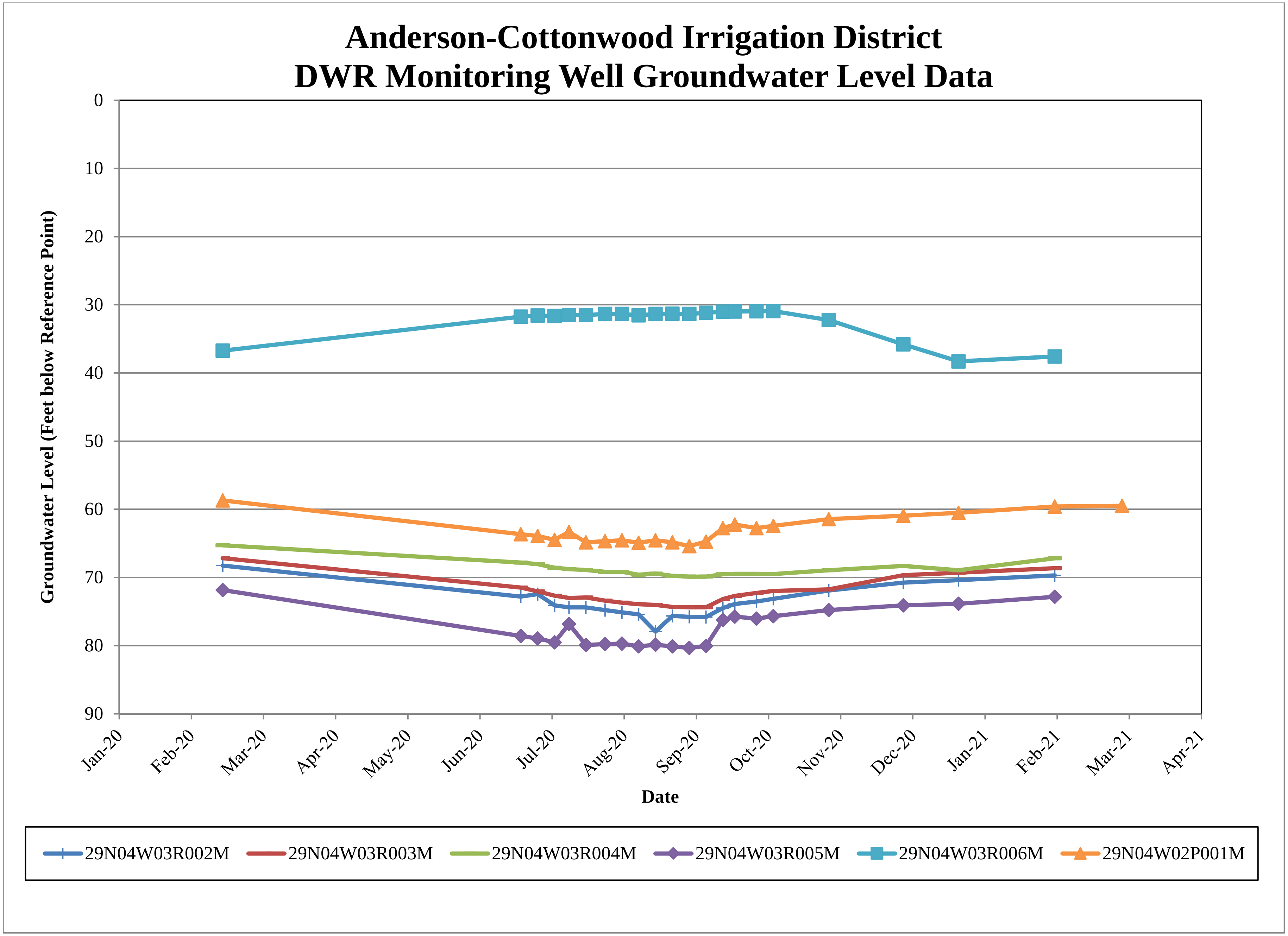
2020 Water Transfers

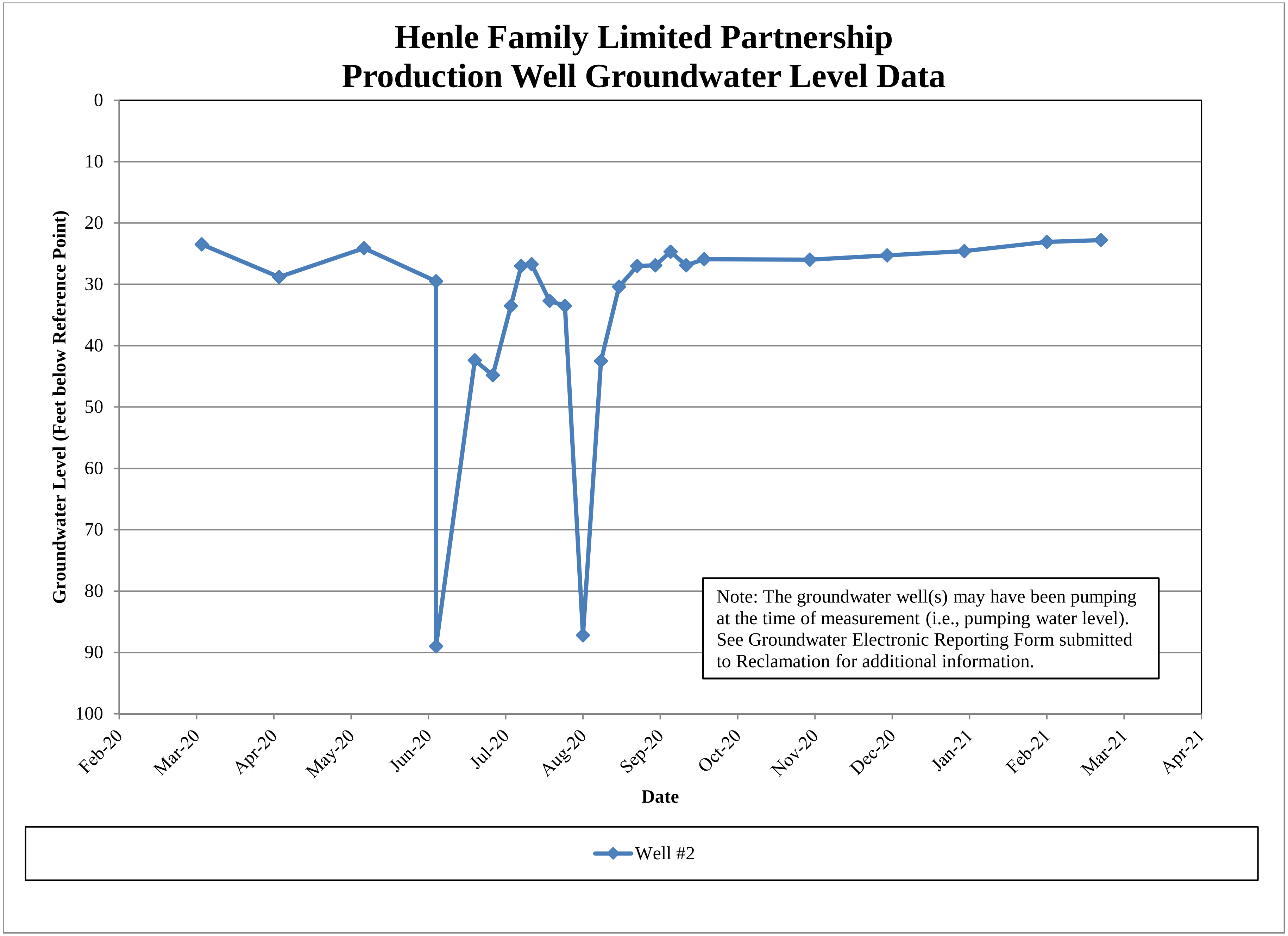
Data Reports

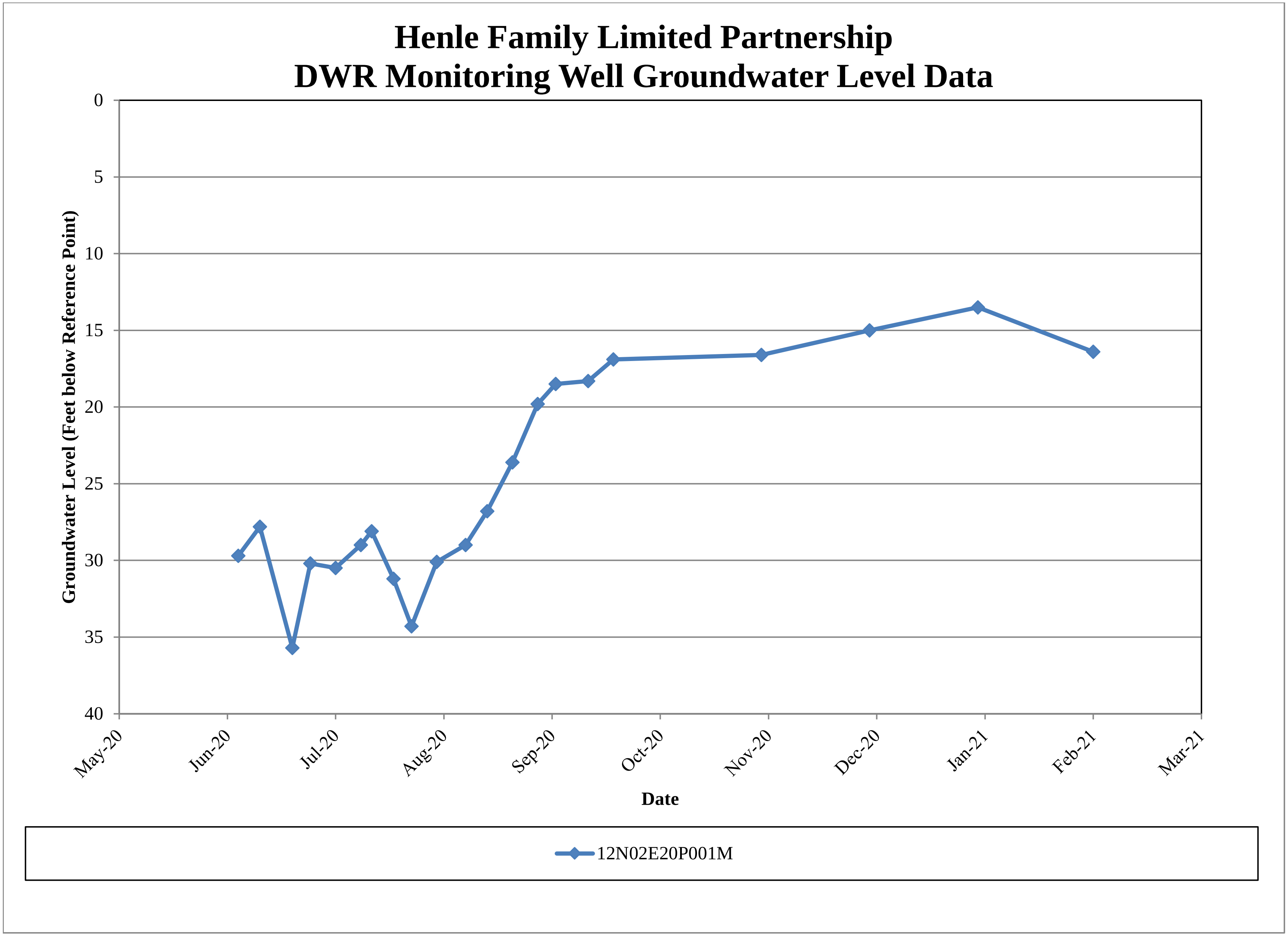

Anderson-Cottonwood Irrigation District
Production Well Groundwater Level Data
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Barney Well
Crowley Well

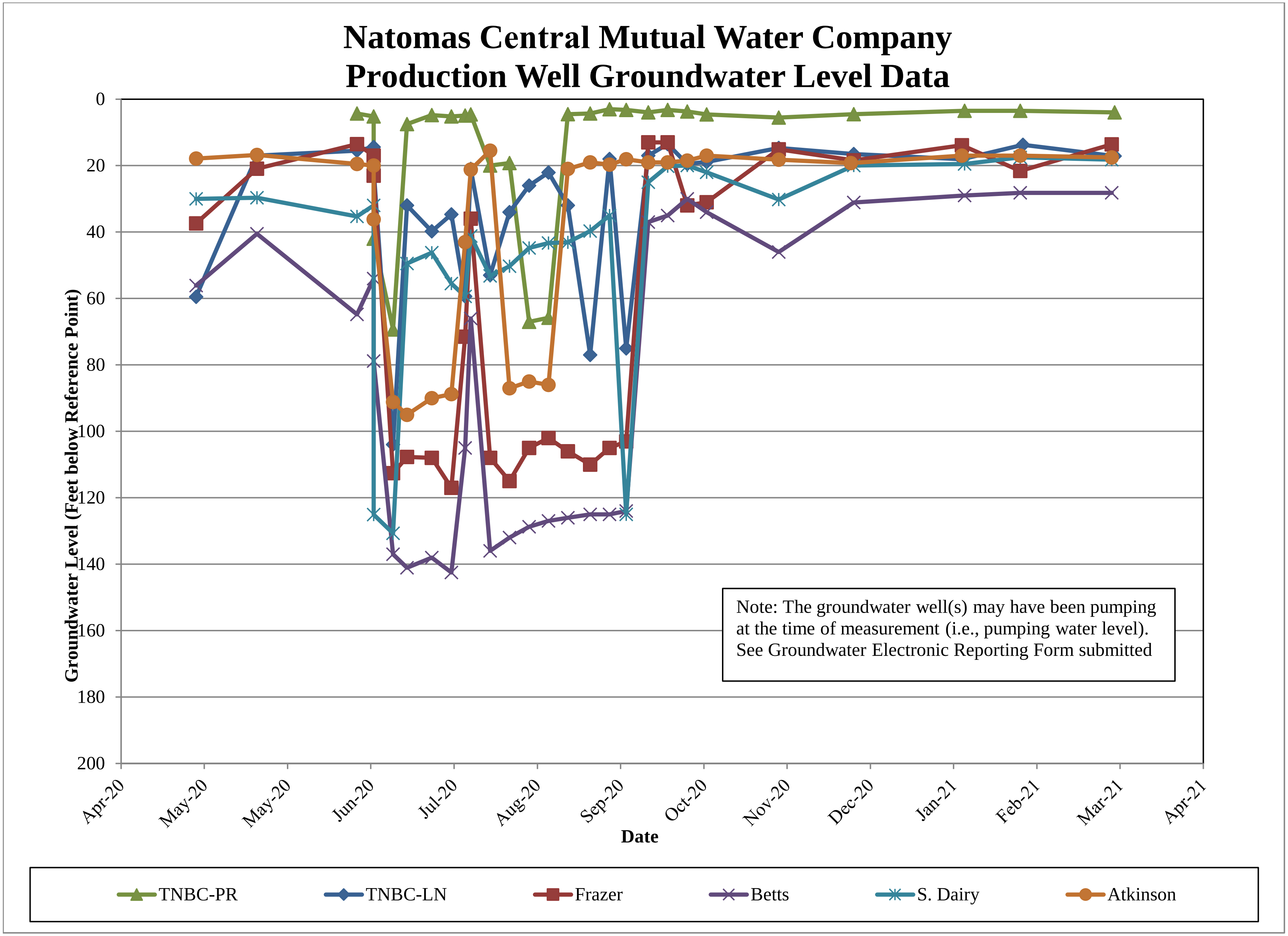


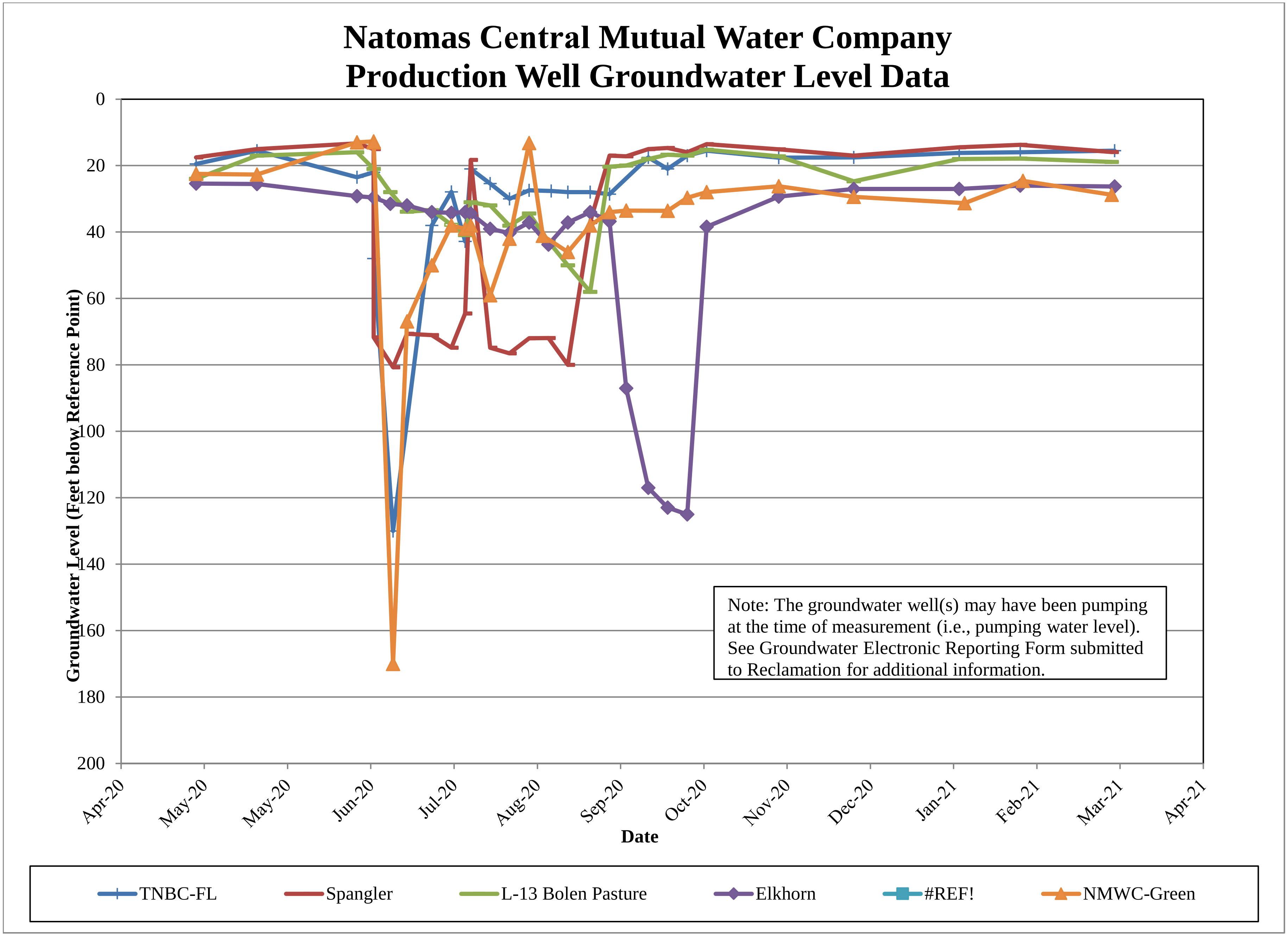
Anderson-Cottonwood Irrigation District
Monitoring Well Groundwater Level Data
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
100
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
MW-01S
MW-01D
MW-02S
MW-02D
MW-03S
MW-08


Anderson-Cottonwood Irrigation District
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
29N04W03R002M
29N04W03R003M
29N04W03R004M
29N04W03R005M
29N04W03R006M
29N04W02P001M

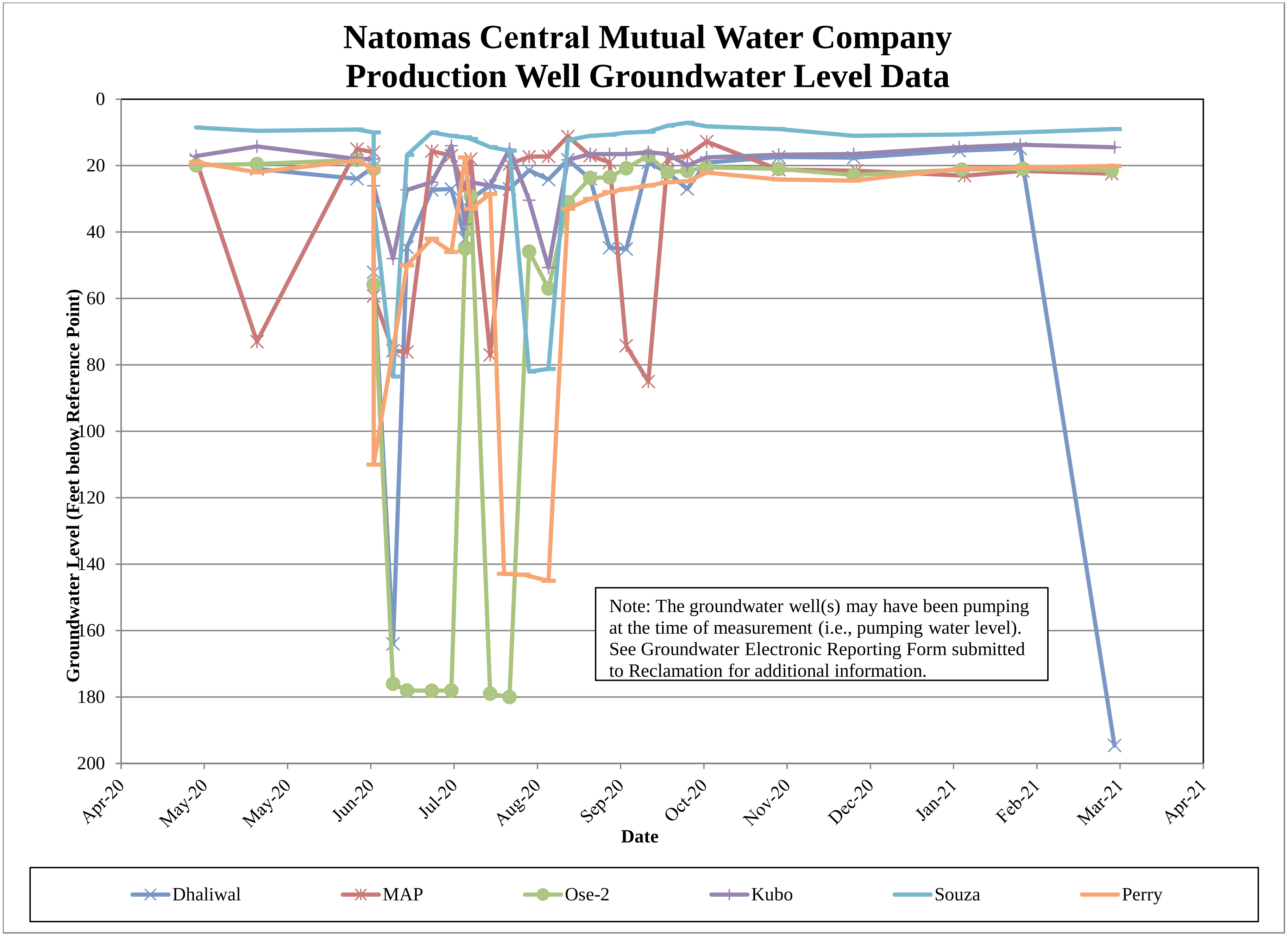

Henle Family Limited Partnership
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
100
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Well #2


Henle Family Limited Partnership
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
5
10
15
20
25
30
35
40
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Date
12N02E20P001M

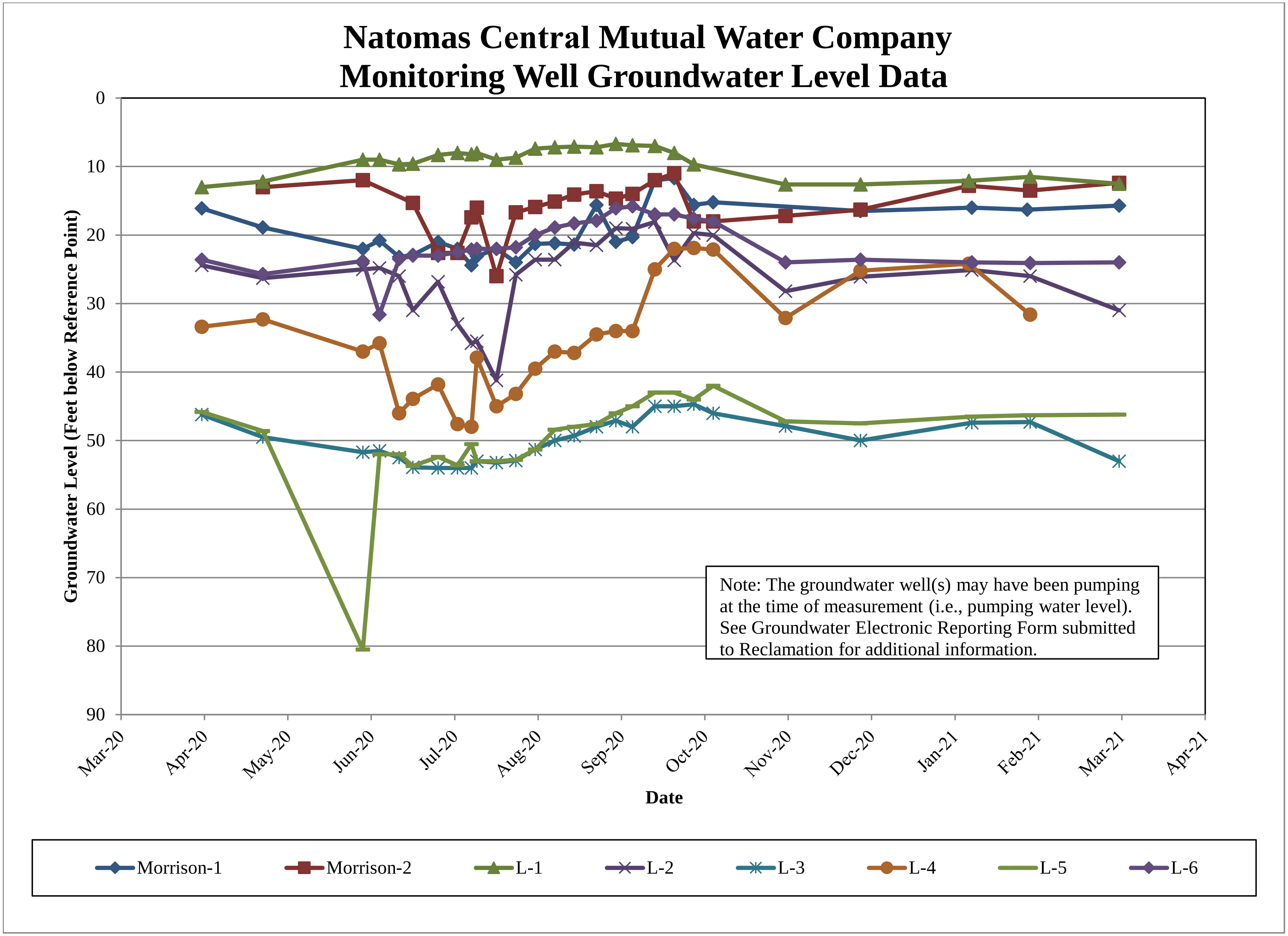

Natomas Central Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
200
Apr-20
May-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted
TNBC-PR
TNBC-LN
Frazer
Betts
S. Dairy
Atkinson

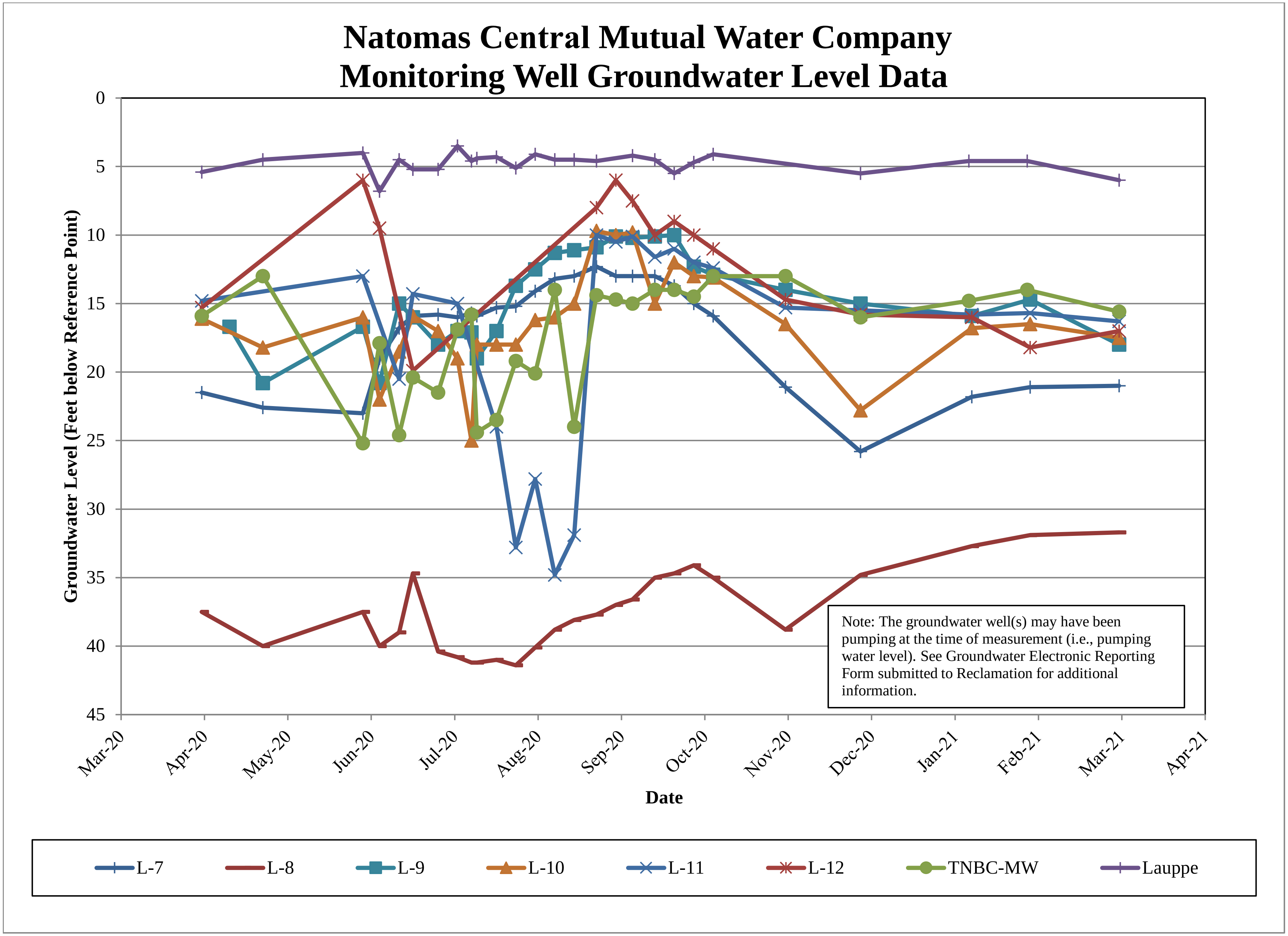


Natomas Central Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
200
Apr-20
May-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
TNBC-FL
Spangler
L-13 Bolen Pasture
Elkhorn
#REF!
NMWC-Green

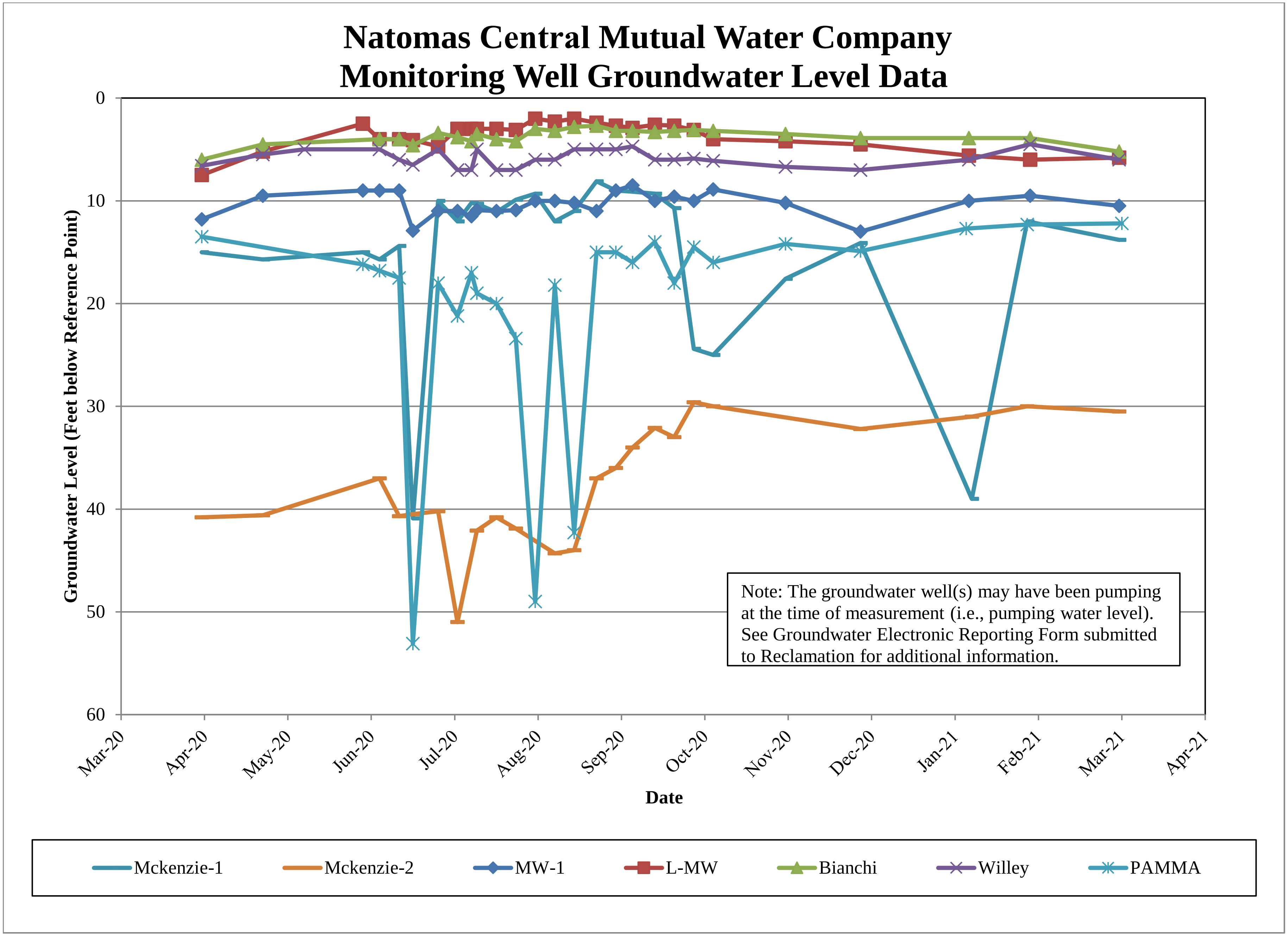


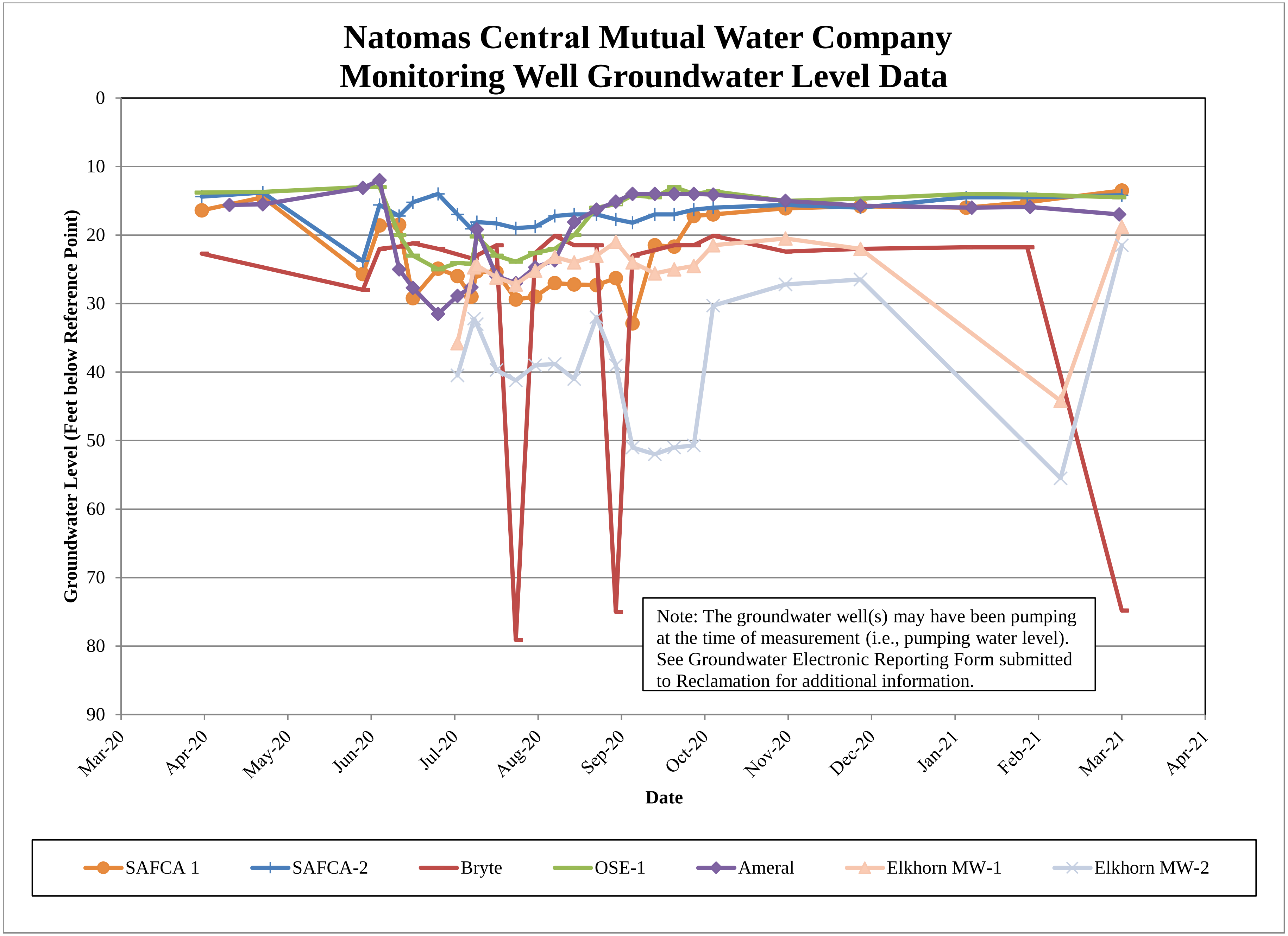
Natomas Central Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
200
Apr-20
May-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Dhaliwal
MAP
Ose-2
Kubo
Souza
Perry

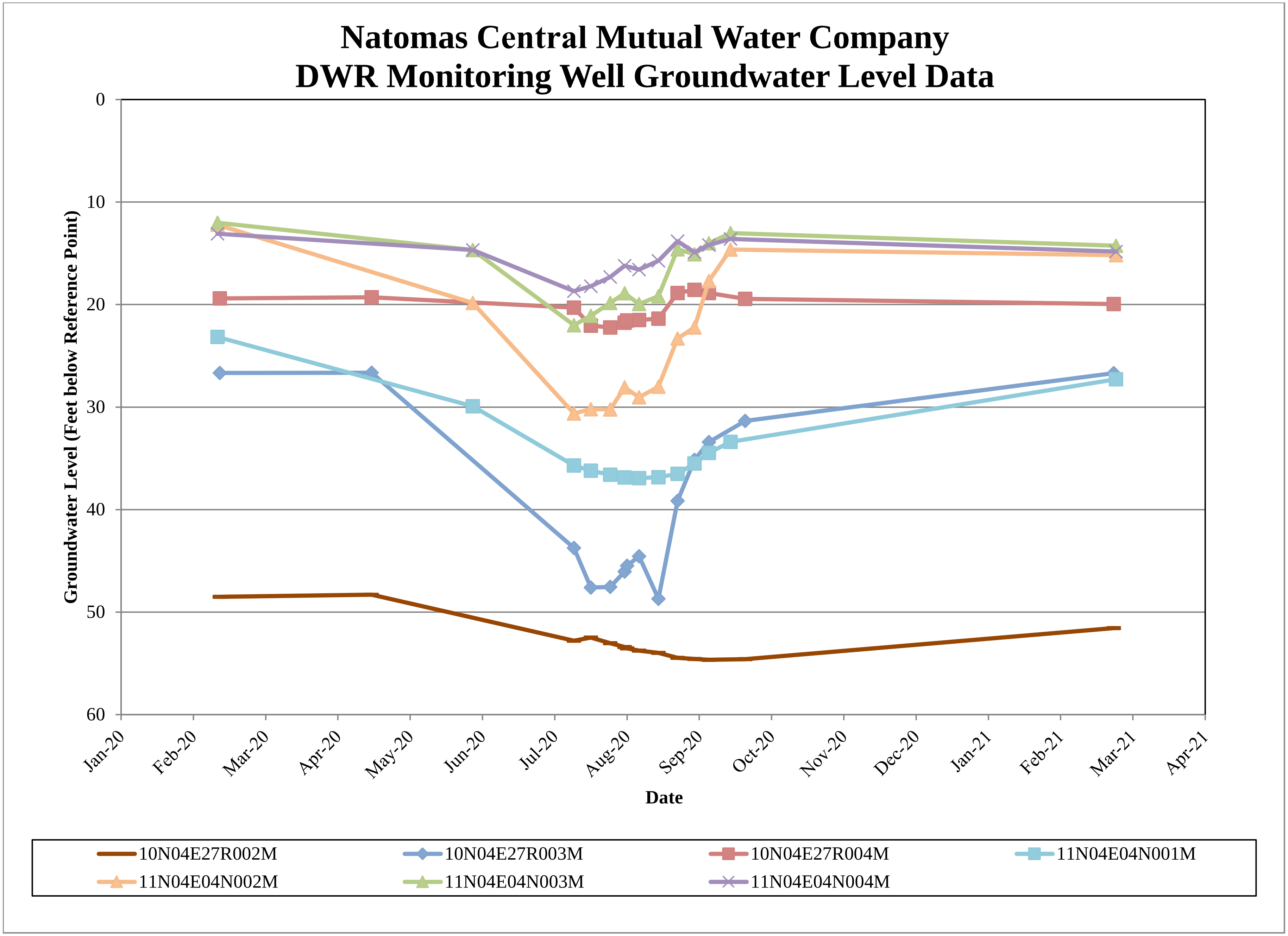

Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Morrison-1
Morrison-2
L-1
L-2
L-3
L-4
L-5
L-6

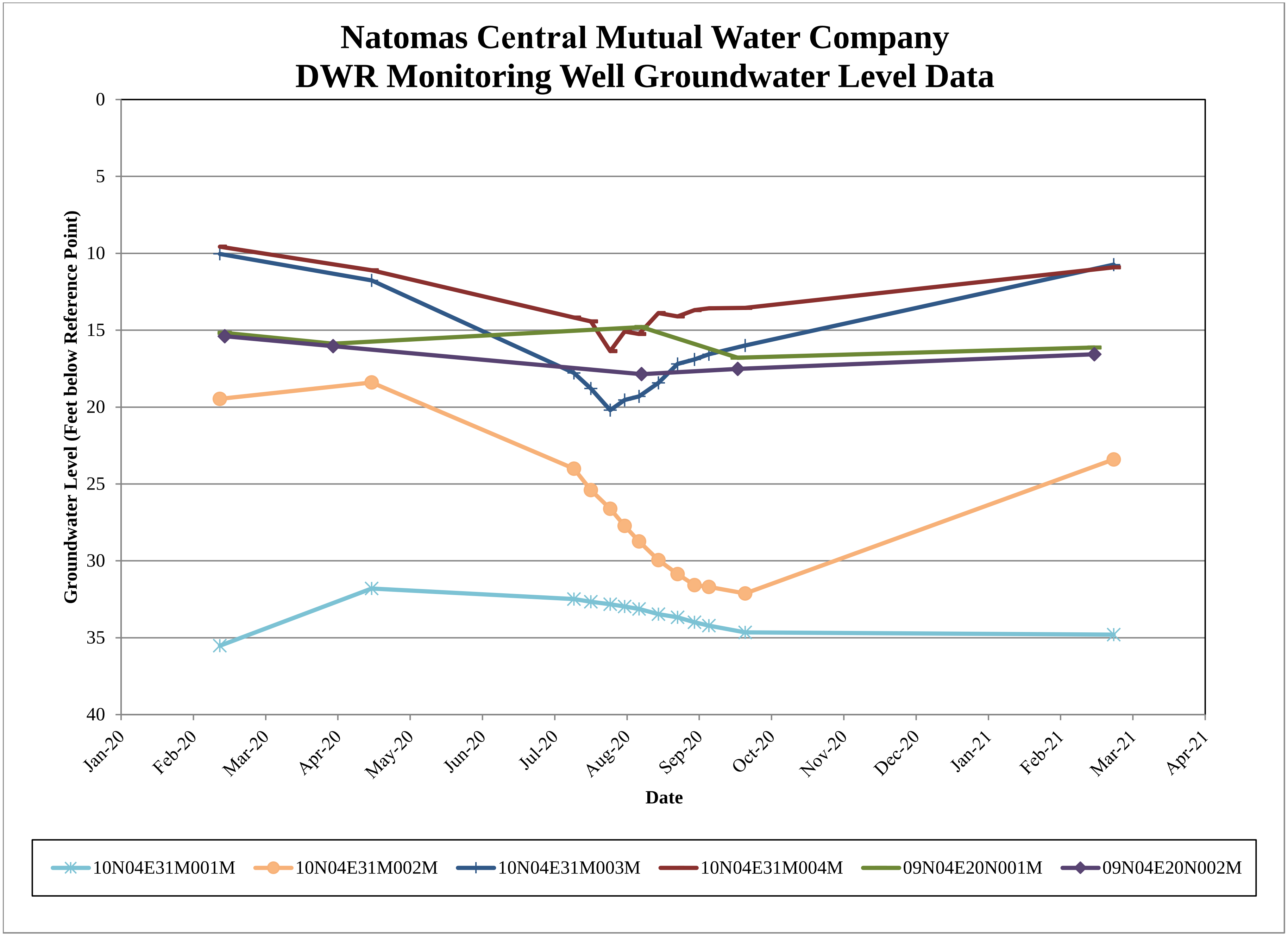


Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
5
10
15
20
25
30
35
40
45
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
L-7
L-8
L-9
L-10
L-11
L-12
TNBC-MW
Lauppe

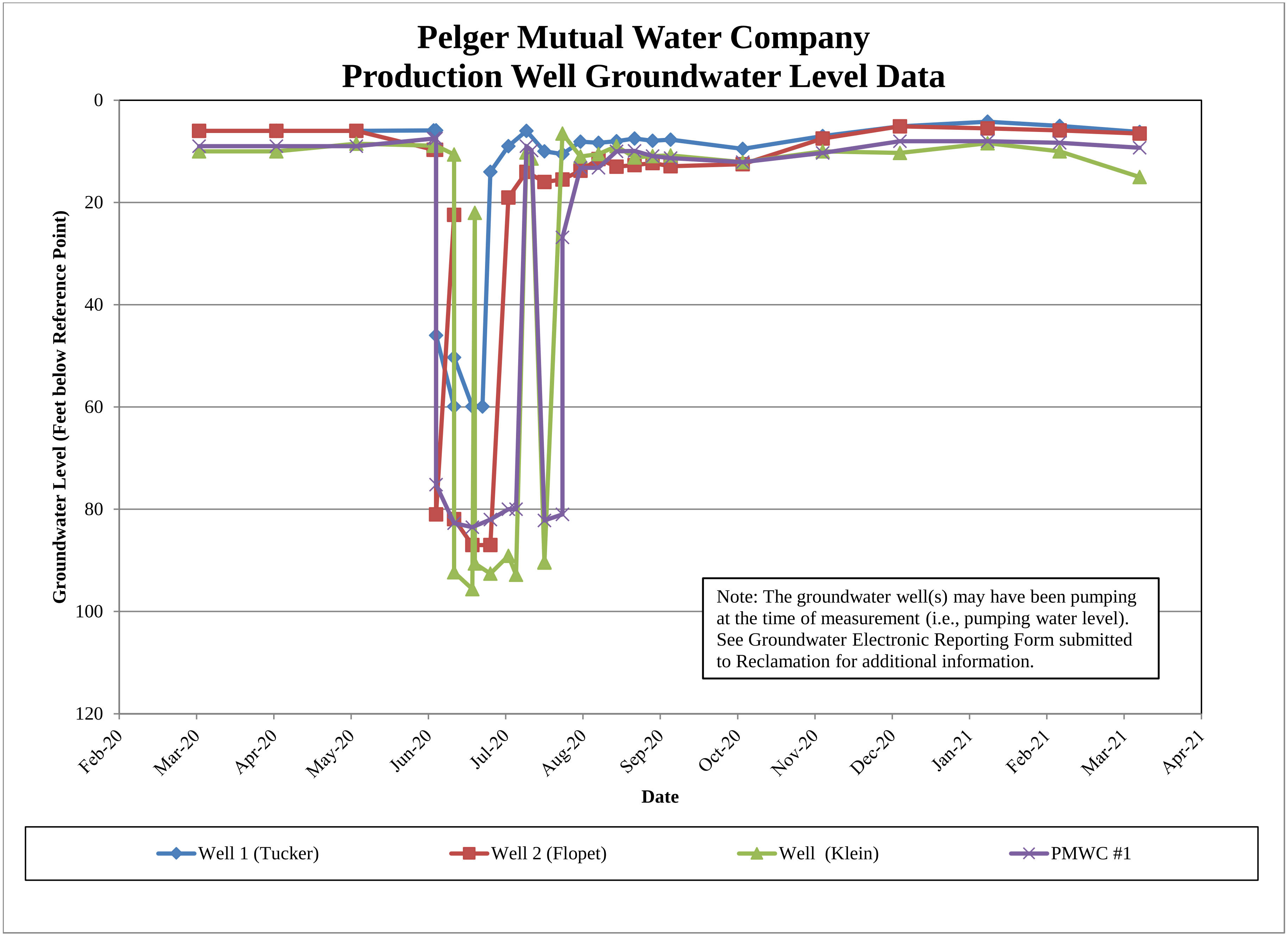

Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Mckenzie-1
Mckenzie-2
MW-1
L-MW
Bianchi
Willey
PAMMA

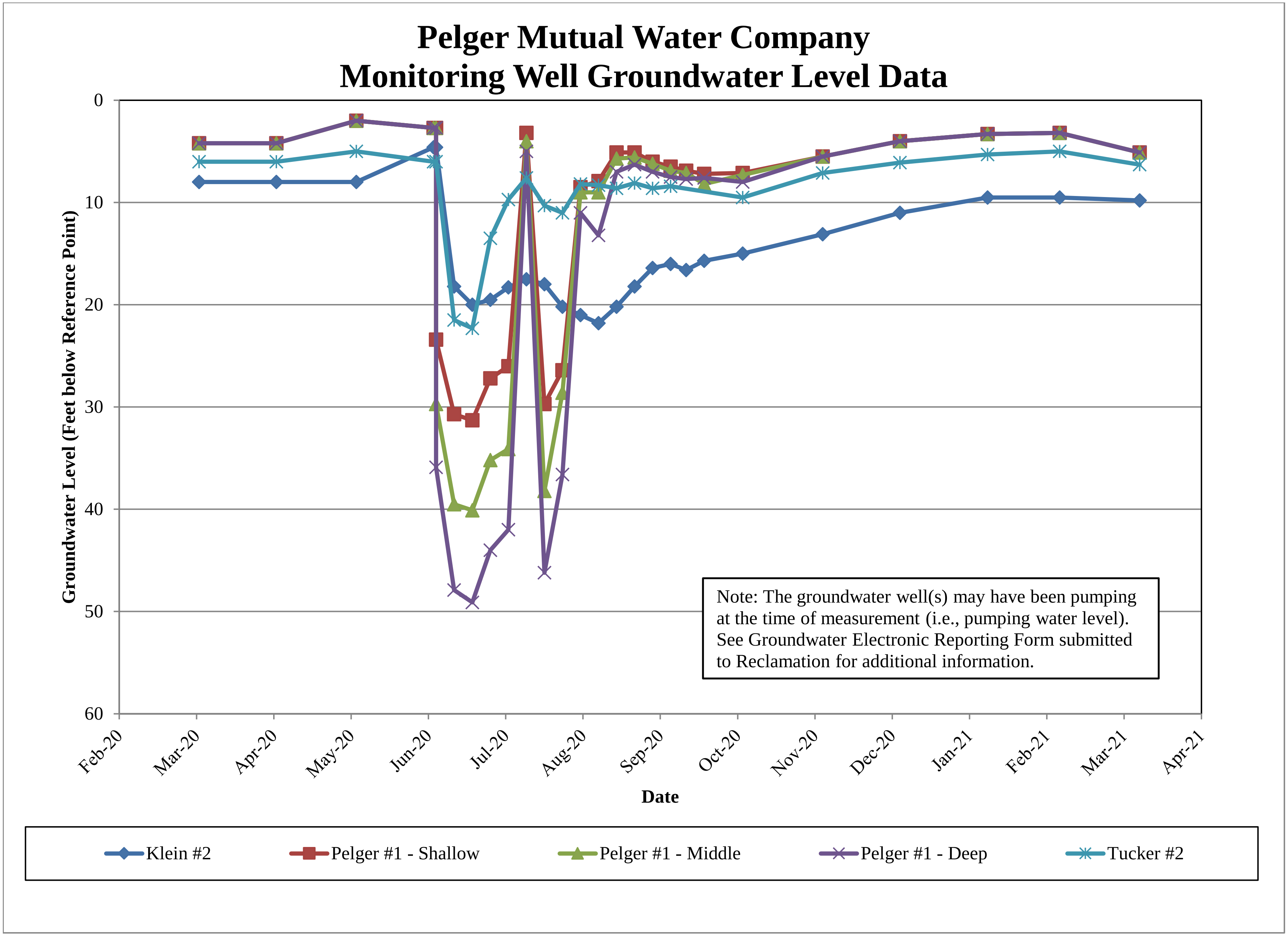

Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
SAFCA 1
SAFCA-2
Bryte
OSE-1
Ameral
Elkhorn MW-1
Elkhorn MW-2

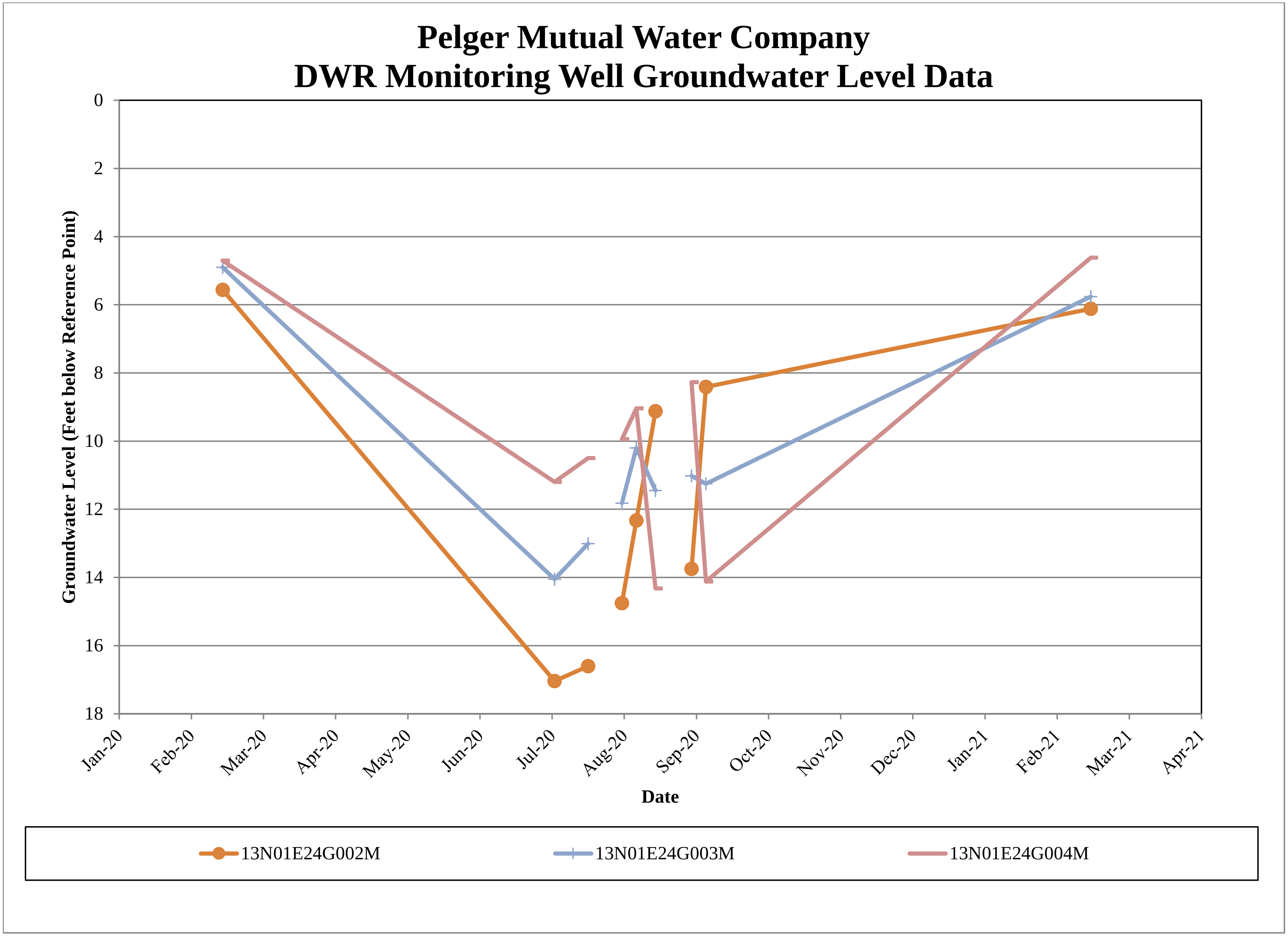

Natomas Central Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
10N04E27R002M
10N04E27R003M
10N04E27R004M
11N04E04N001M
11N04E04N002M
11N04E04N003M
11N04E04N004M



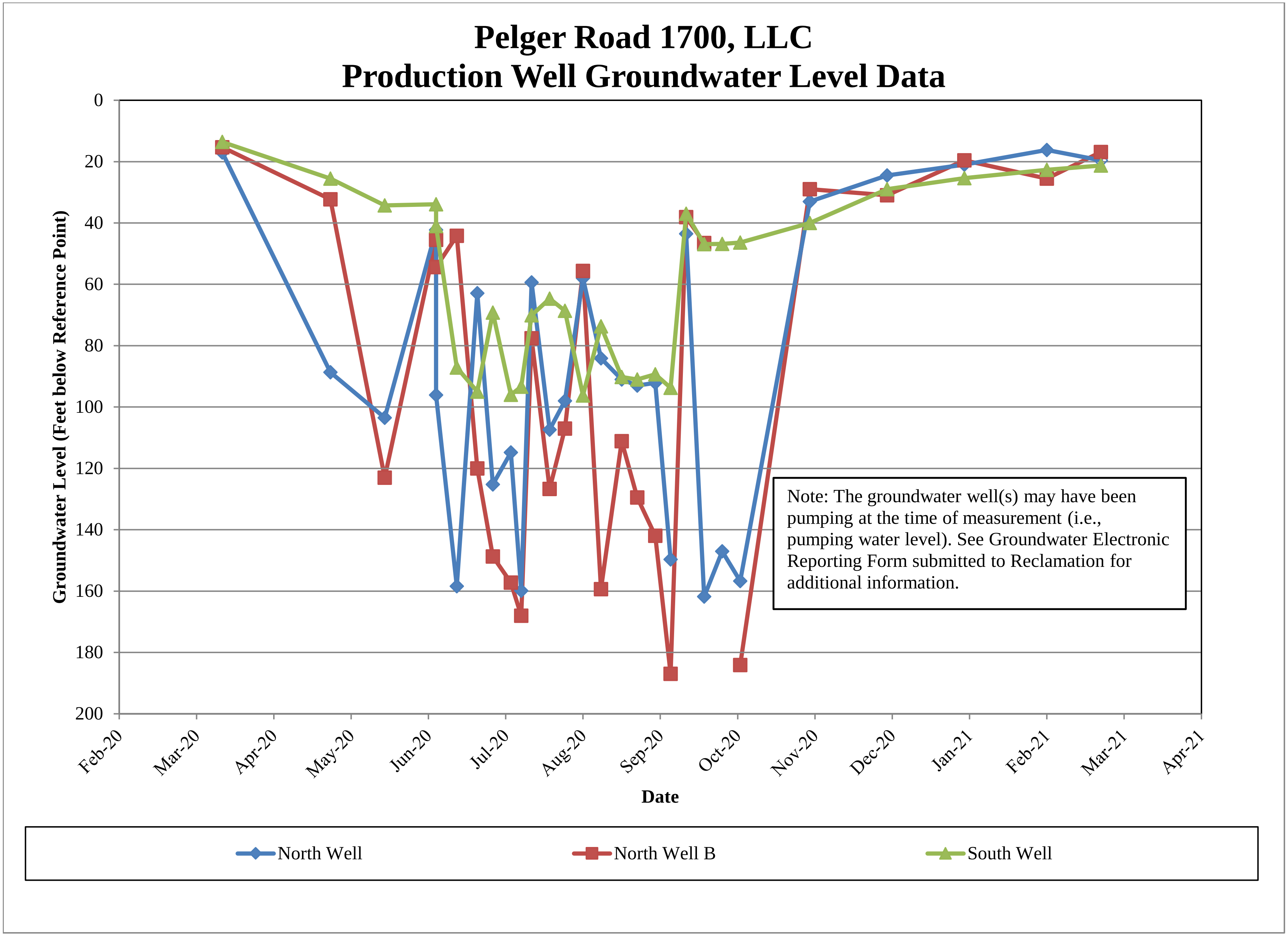
Natomas Central Mutual Water Company
DWR Monitoring Well Groundwater Level Data
0
5
10
15
20
25
30
35
40
Groundwater Level (Feet below Reference Point)
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
10N04E31M001M
10N04E31M002M
10N04E31M003M
10N04E31M004M
09N04E20N001M
09N04E20N002M

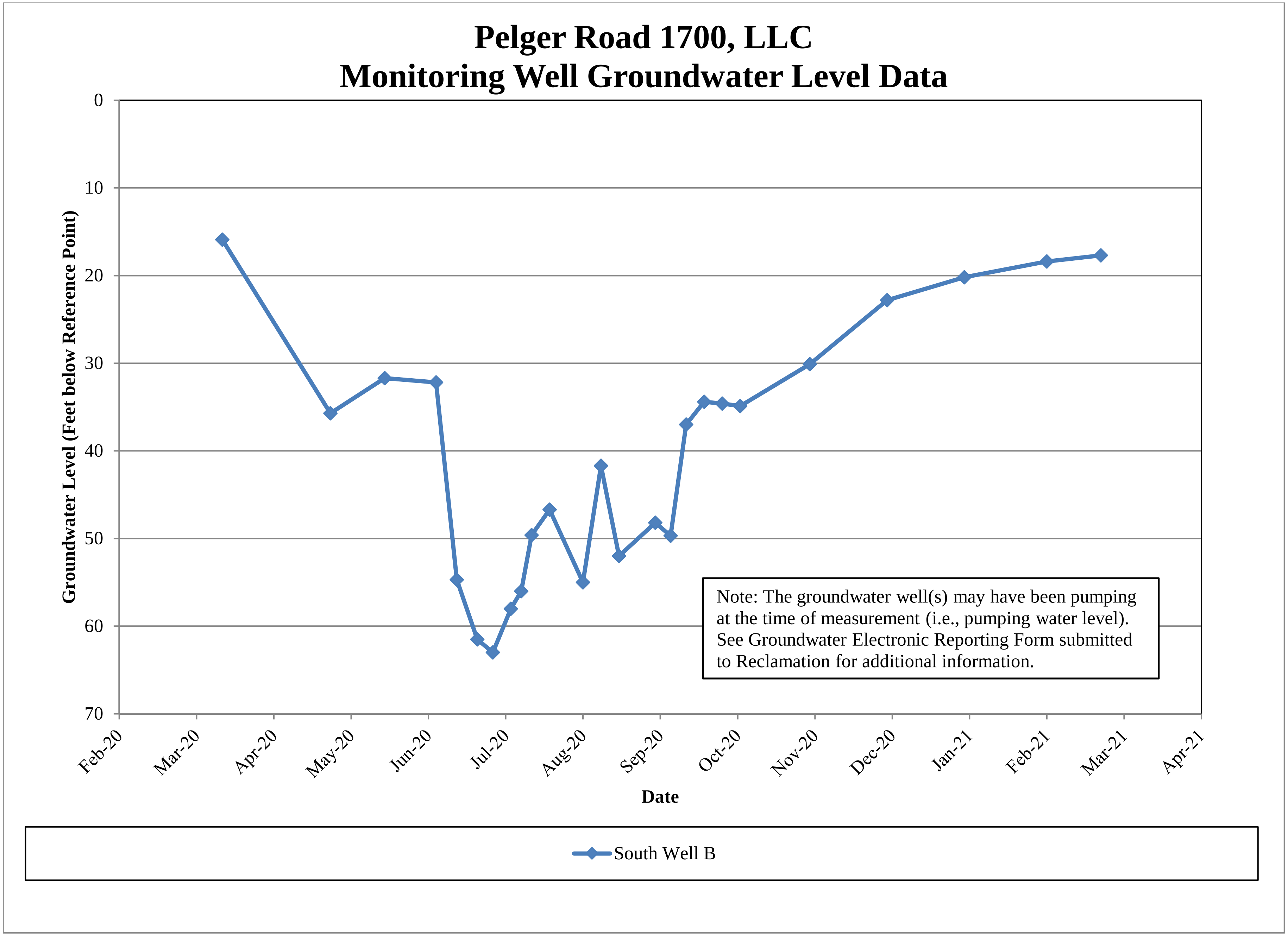

Pelger Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Well 1 (Tucker)
Well 2 (Flopet)
Well (Klein)
PMWC #1


Pelger Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Klein #2
Pelger #1 - Shallow
Pelger #1 - Middle
Pelger #1 - Deep
Tucker #2

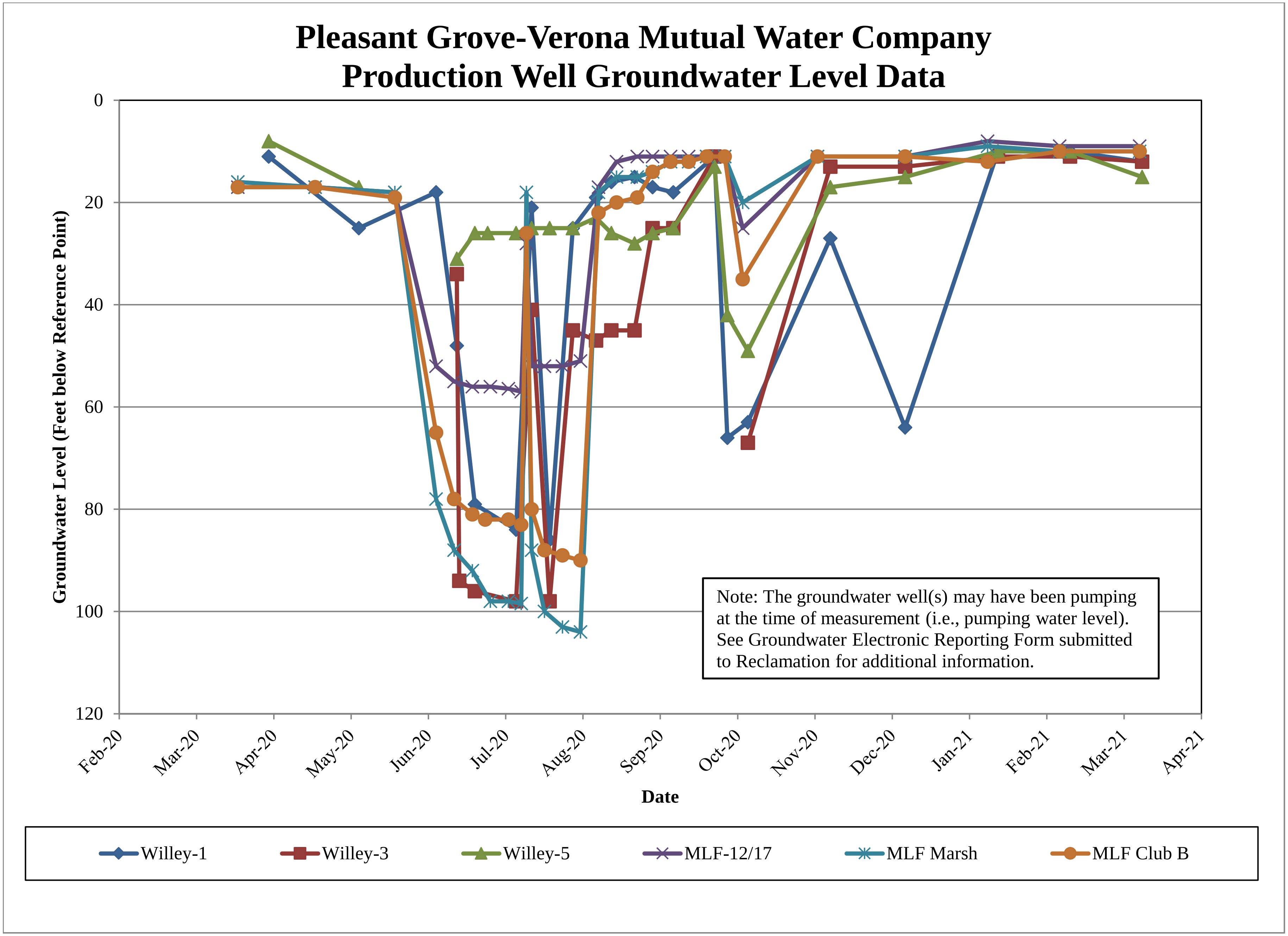


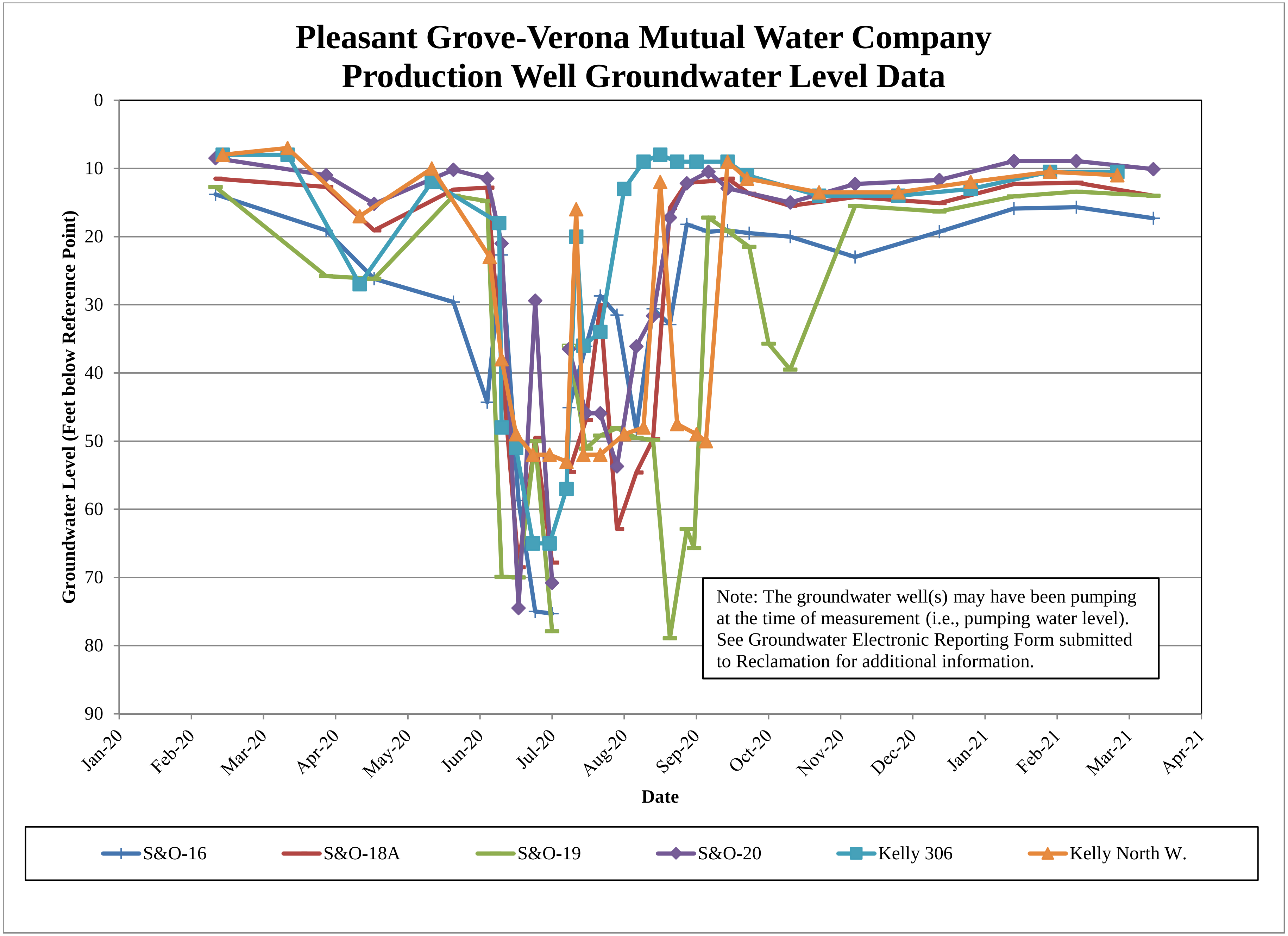
Pelger Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
2
4
6
8
10
12
14
16
18
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
13N01E24G002M
13N01E24G003M
13N01E24G004M


Pelger Road 1700, LLC
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
200
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
North Well
North Well B
South Well

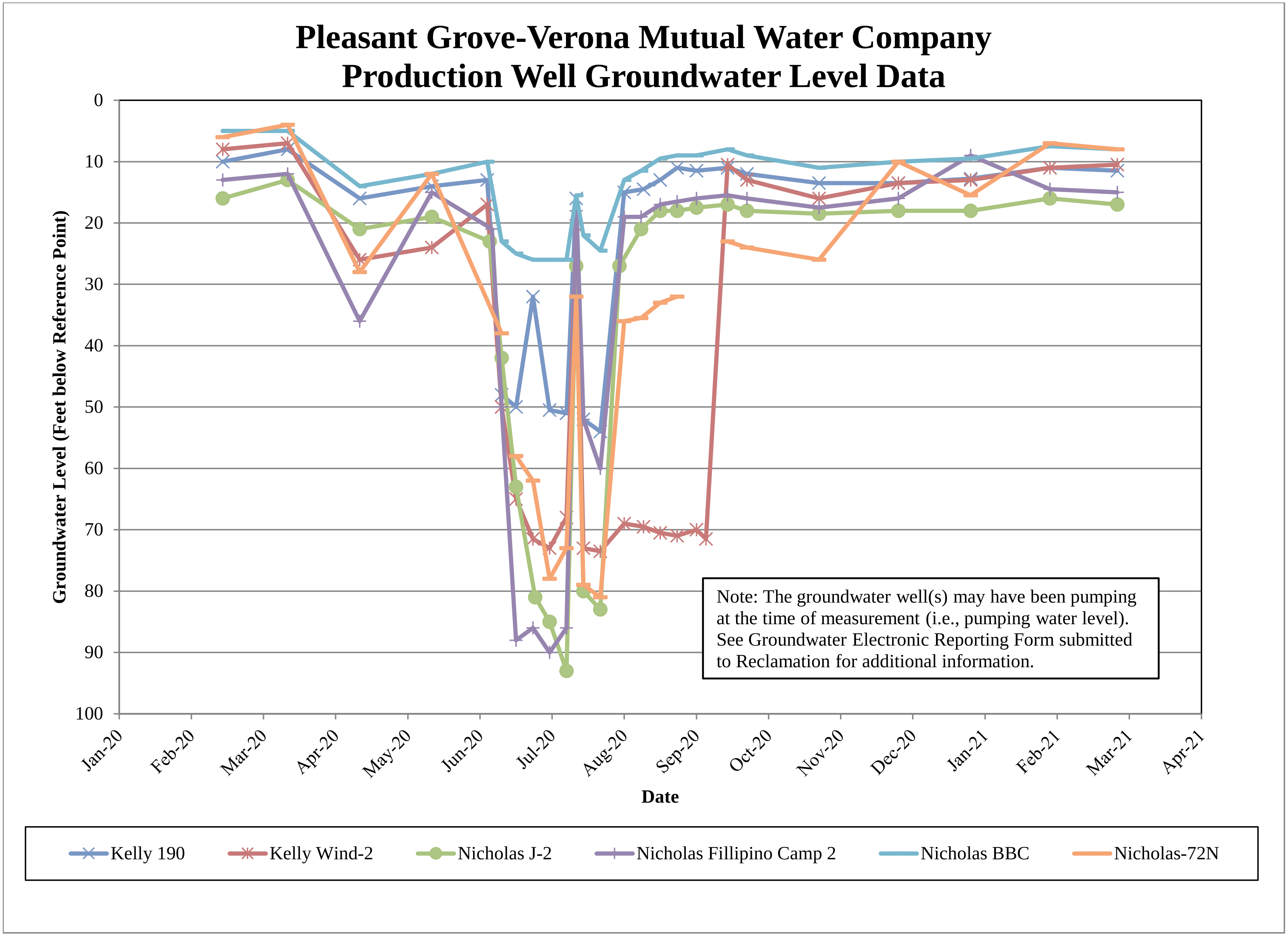


Pelger Road 1700, LLC
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
South Well B

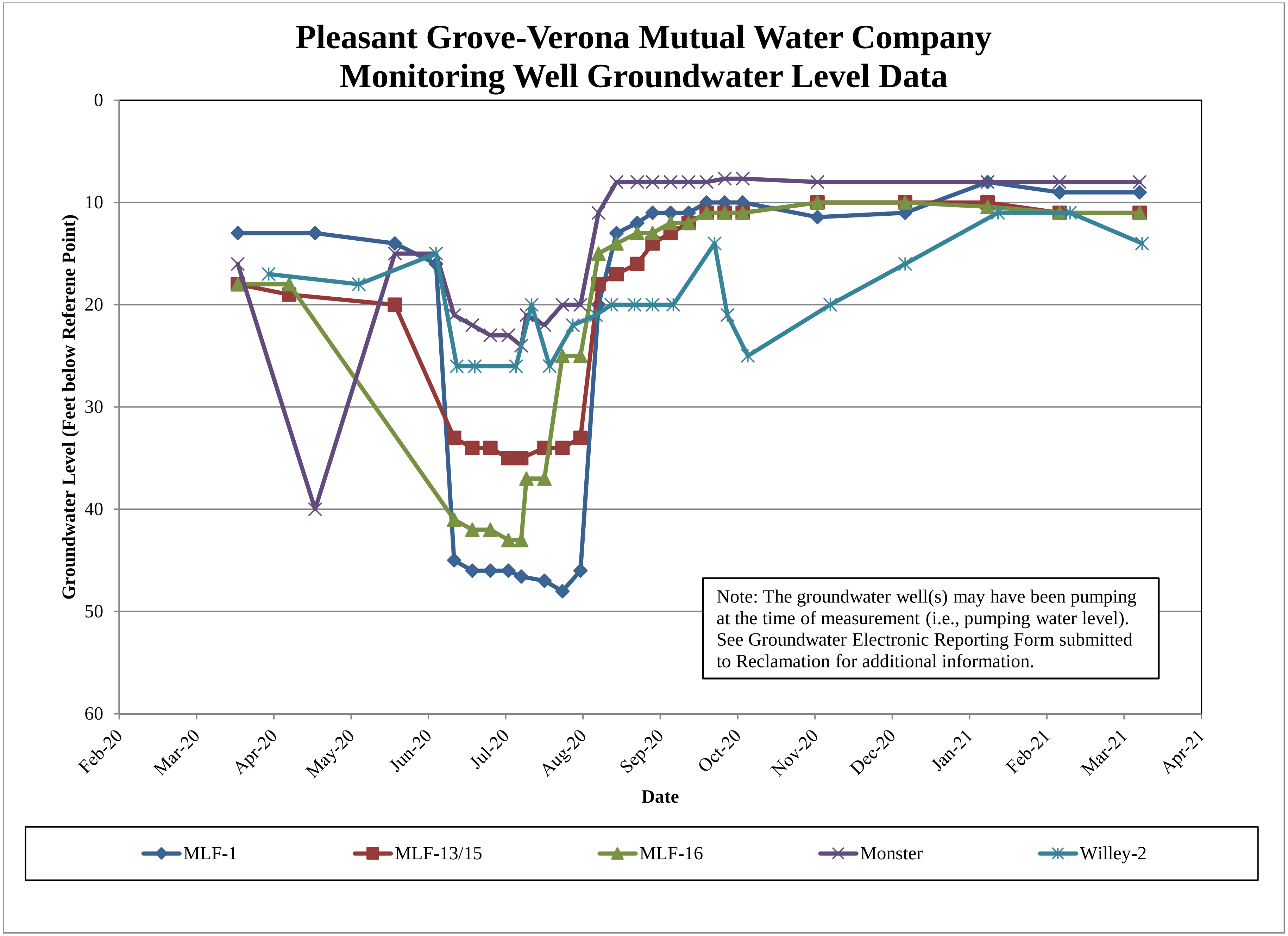

Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Willey-1
Willey-3
Willey-5
MLF-12/17
MLF Marsh
MLF Club B

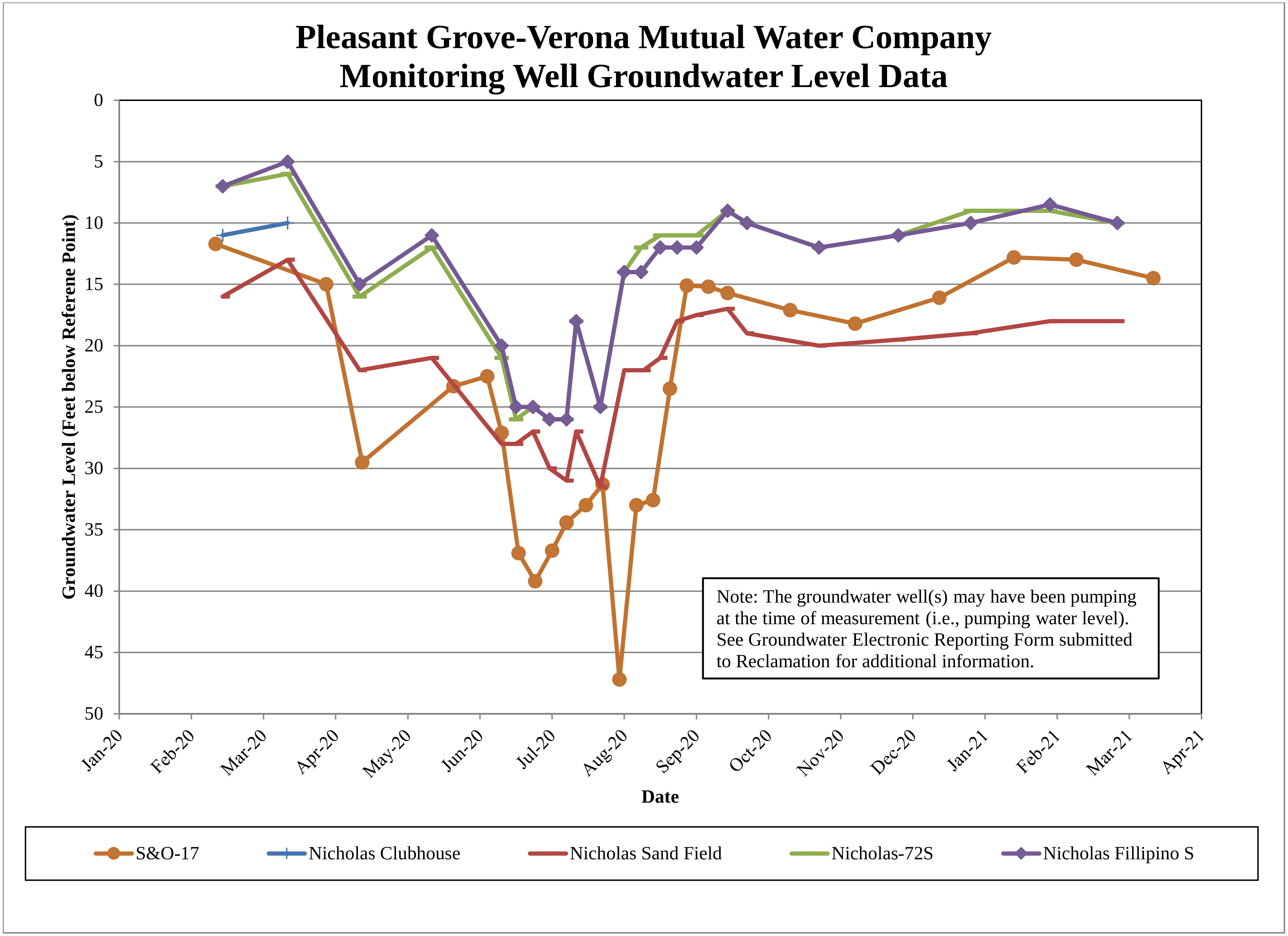


Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
S&O-16
S&O-18A
S&O-19
S&O-20
Kelly 306
Kelly North W.

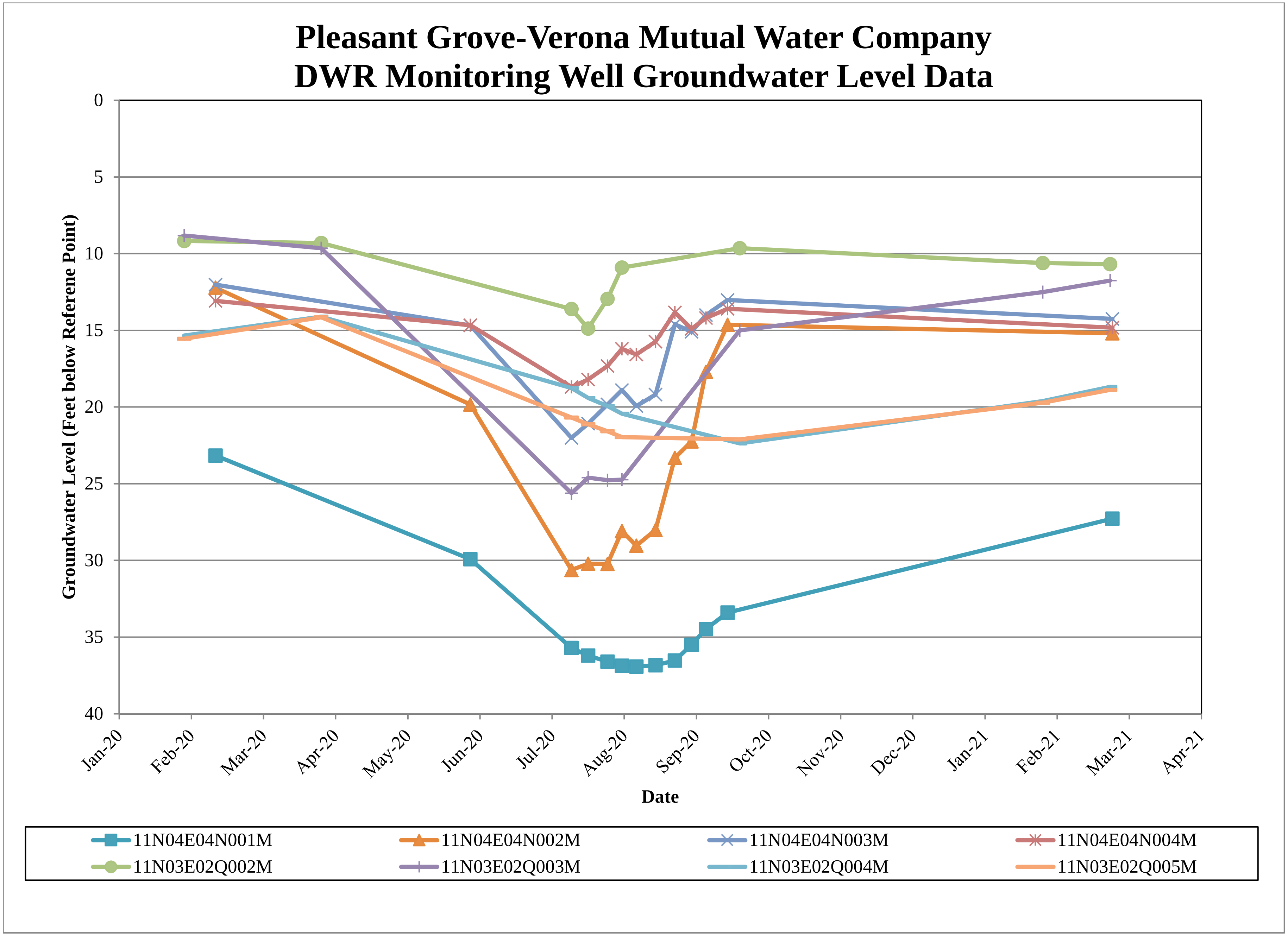


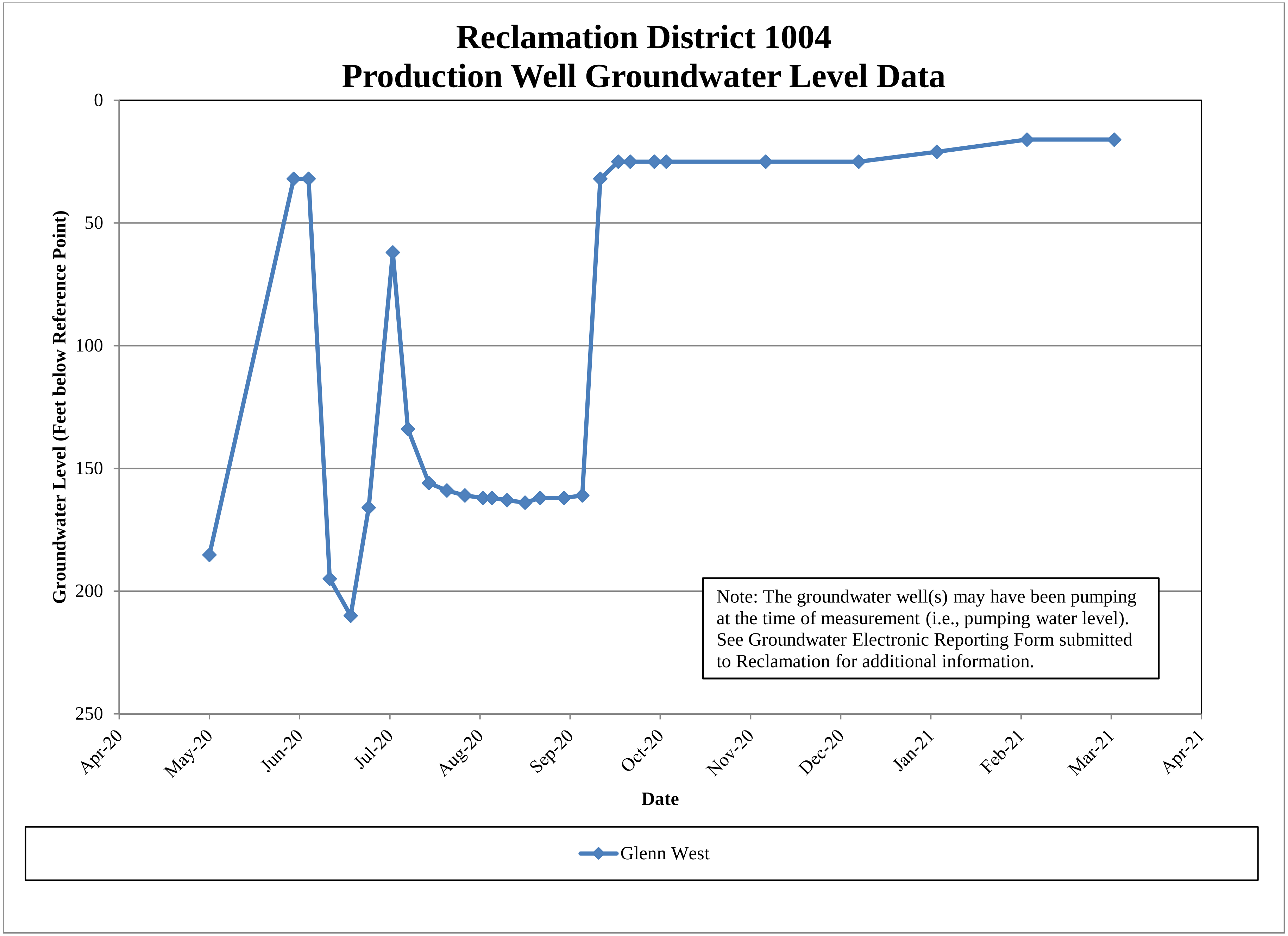
Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
100
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Kelly 190
Kelly Wind-2
Nicholas J-2
Nicholas Fillipino Camp 2
Nicholas BBC
Nicholas-72N

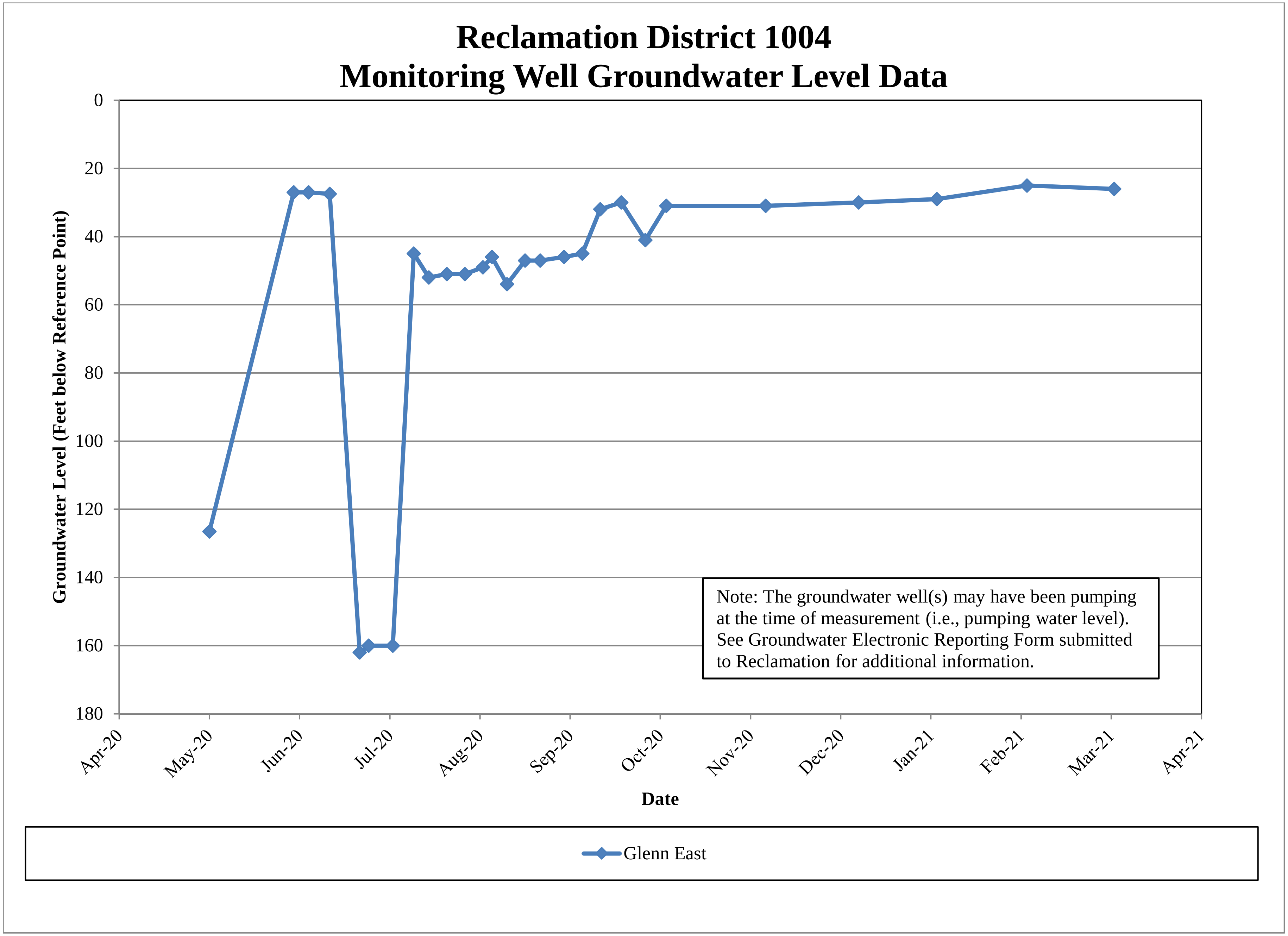

Pleasant Grove-Verona Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Referene Point)
0
10
20
30
40
50
60
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
MLF-1
MLF-13/15
MLF-16
Monster
Willey-2



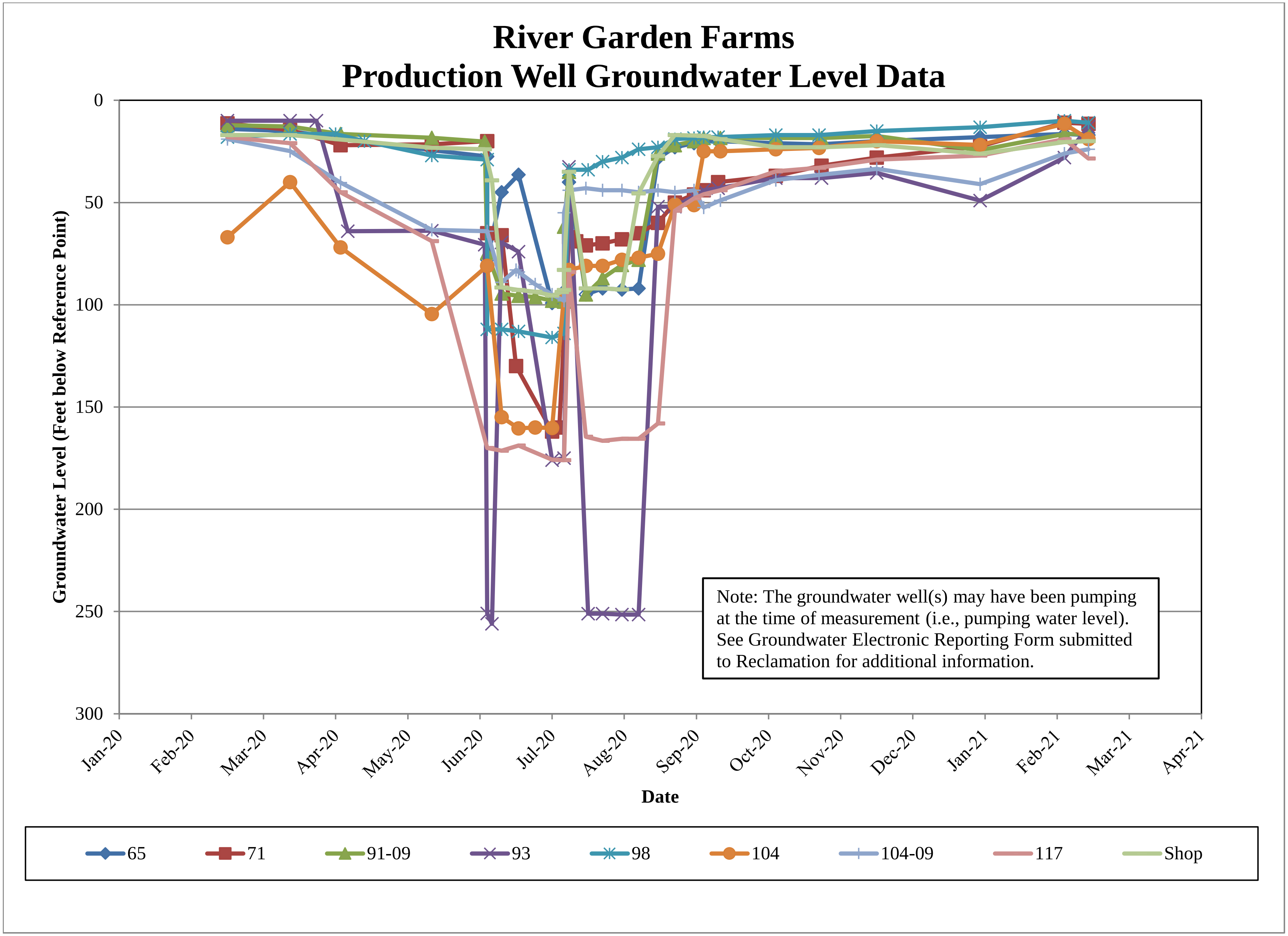
Pleasant Grove-Verona Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Referene Point)
0
5
10
15
20
25
30
35
40
45
50
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
S&O-17
Nicholas Clubhouse
Nicholas Sand Field
Nicholas-72S
Nicholas Fillipino S

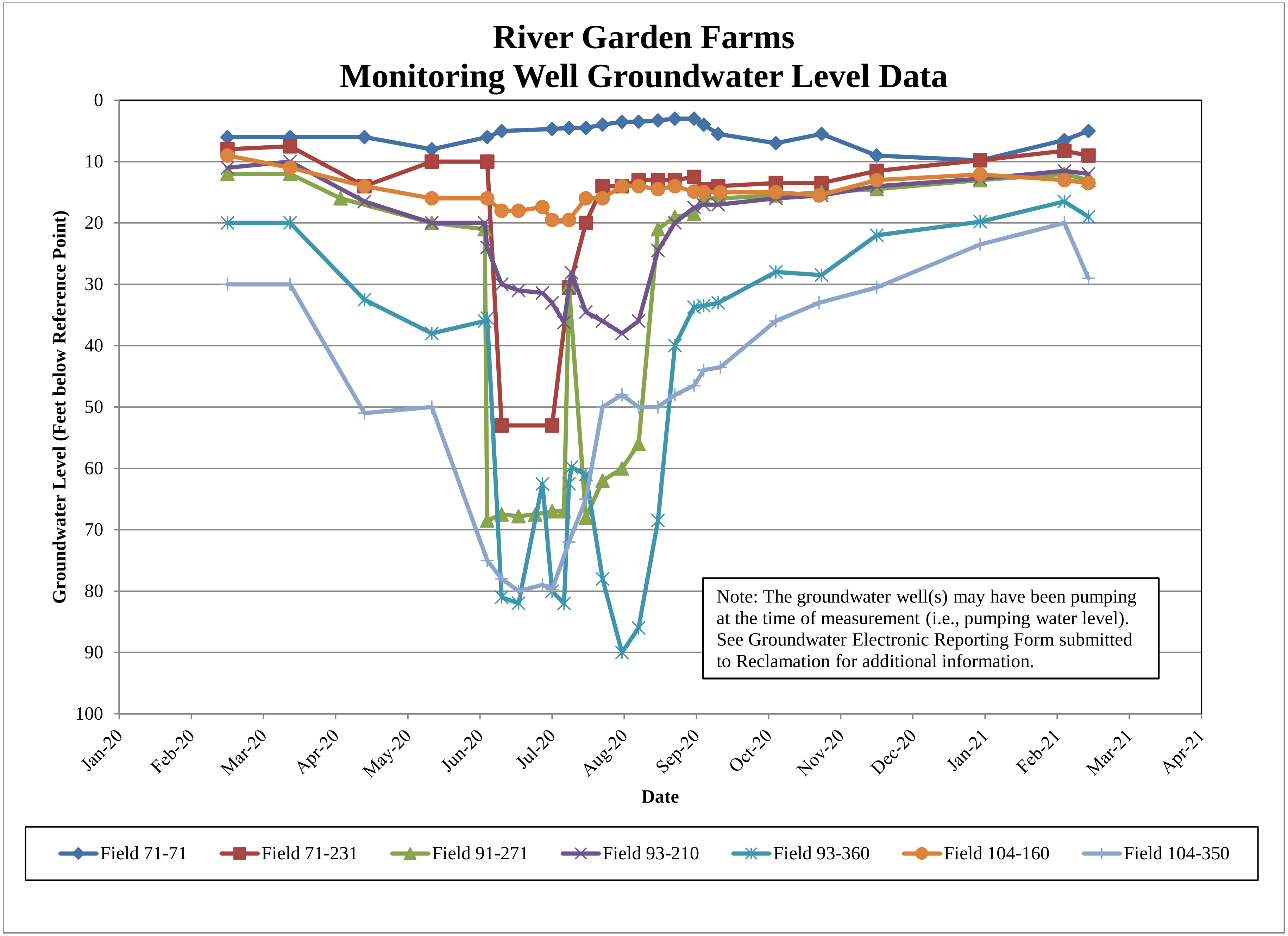

Pleasant Grove-Verona Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Referene Point)
0
5
10
15
20
25
30
35
40
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
11N04E04N001M
11N04E04N002M
11N04E04N003M
11N04E04N004M
11N03E02Q002M
11N03E02Q003M
11N03E02Q004M
11N03E02Q005M

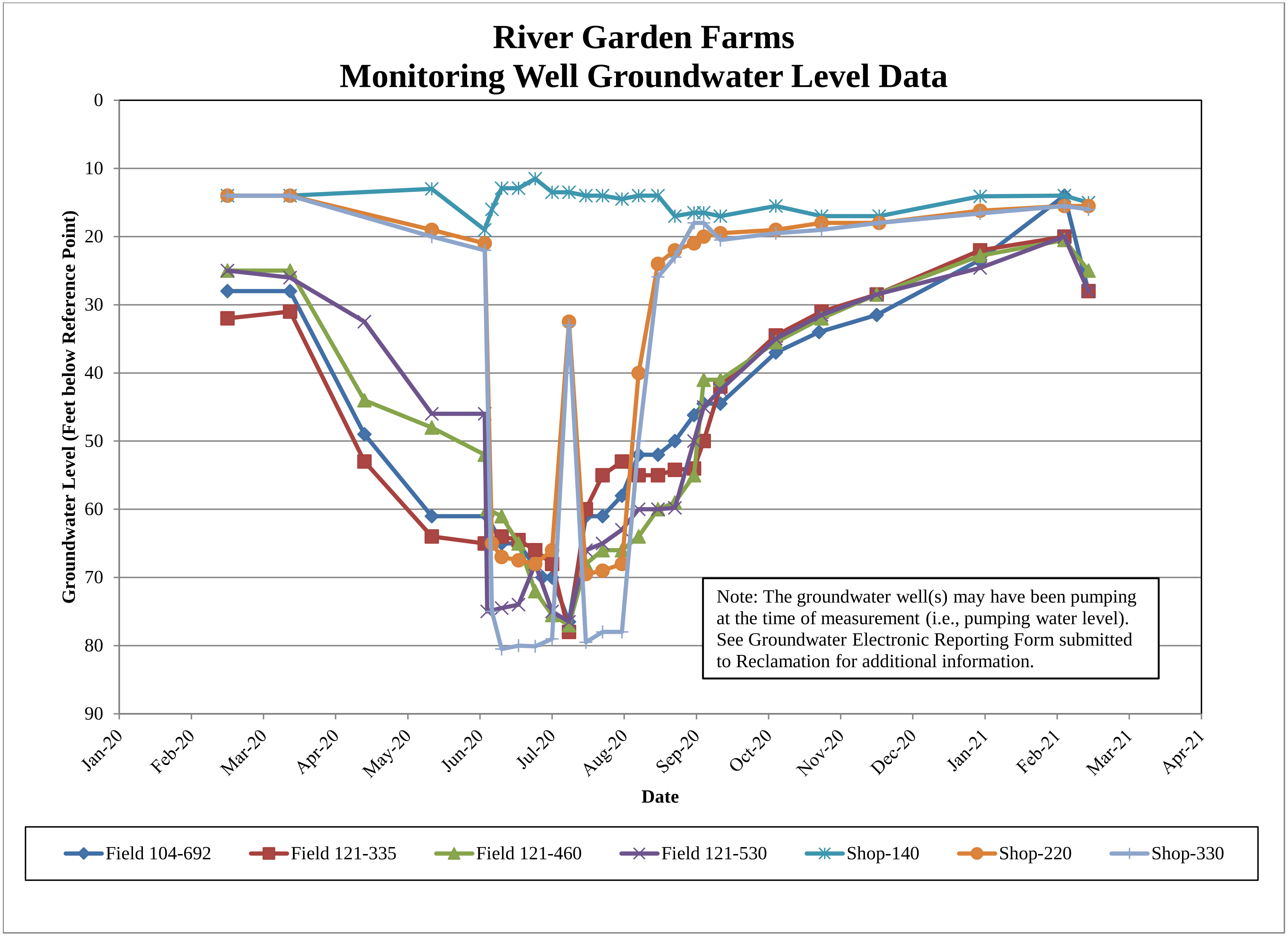

Reclamation District 1004
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Glenn West



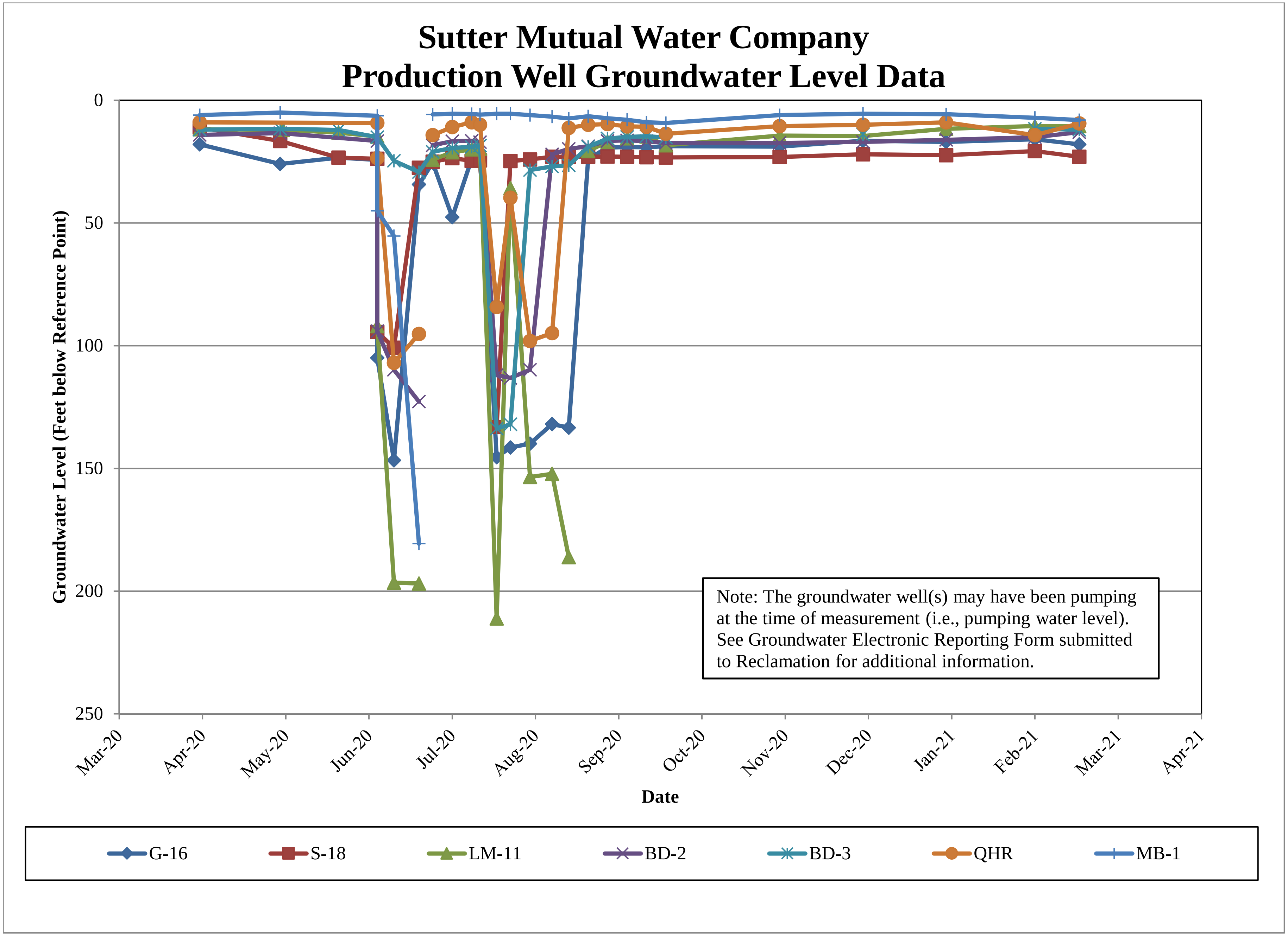
Reclamation District 1004
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Glenn East

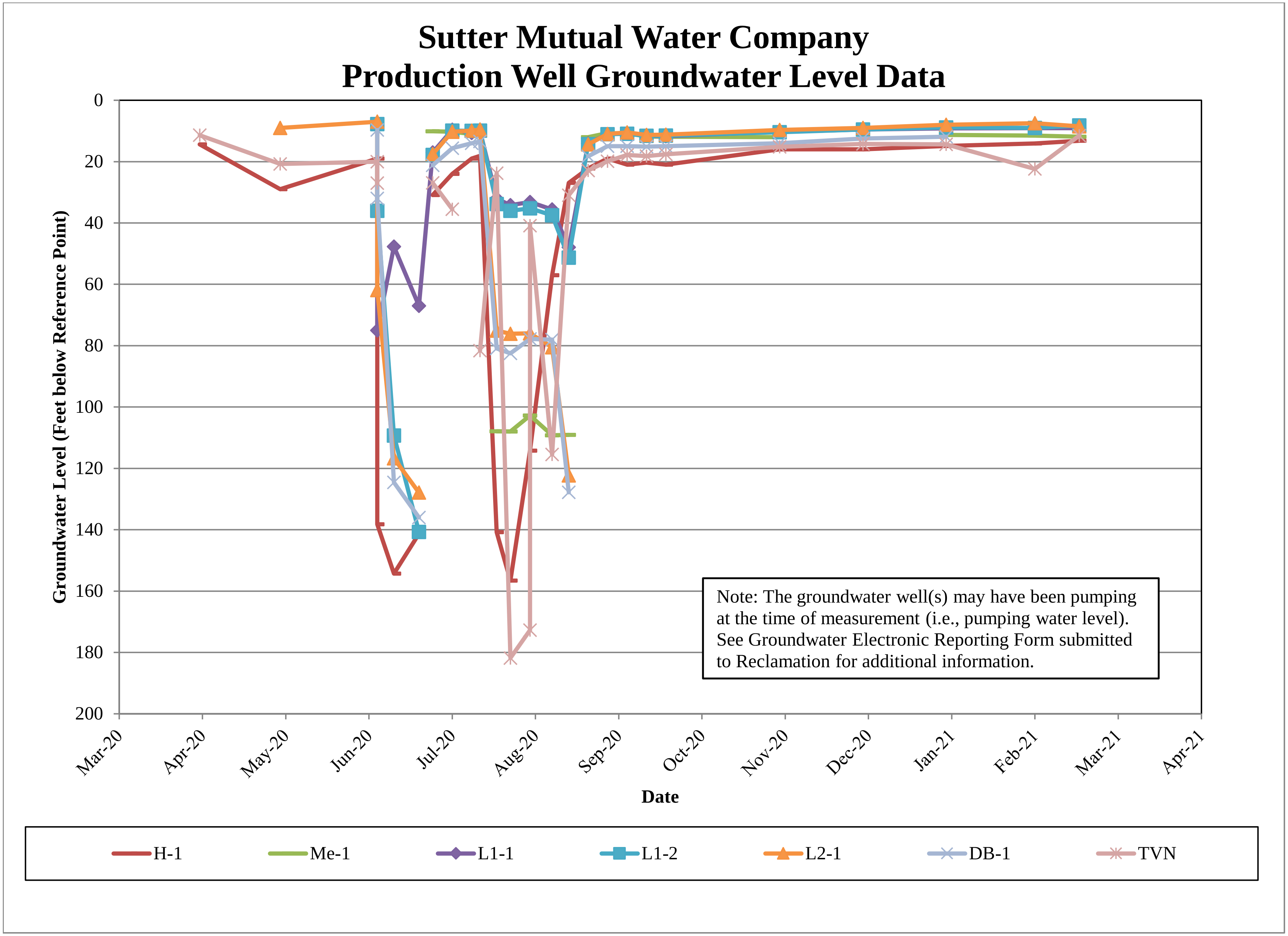

River Garden Farms
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
300
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
65
71
91-09
93
98
104
104-09
117
Shop

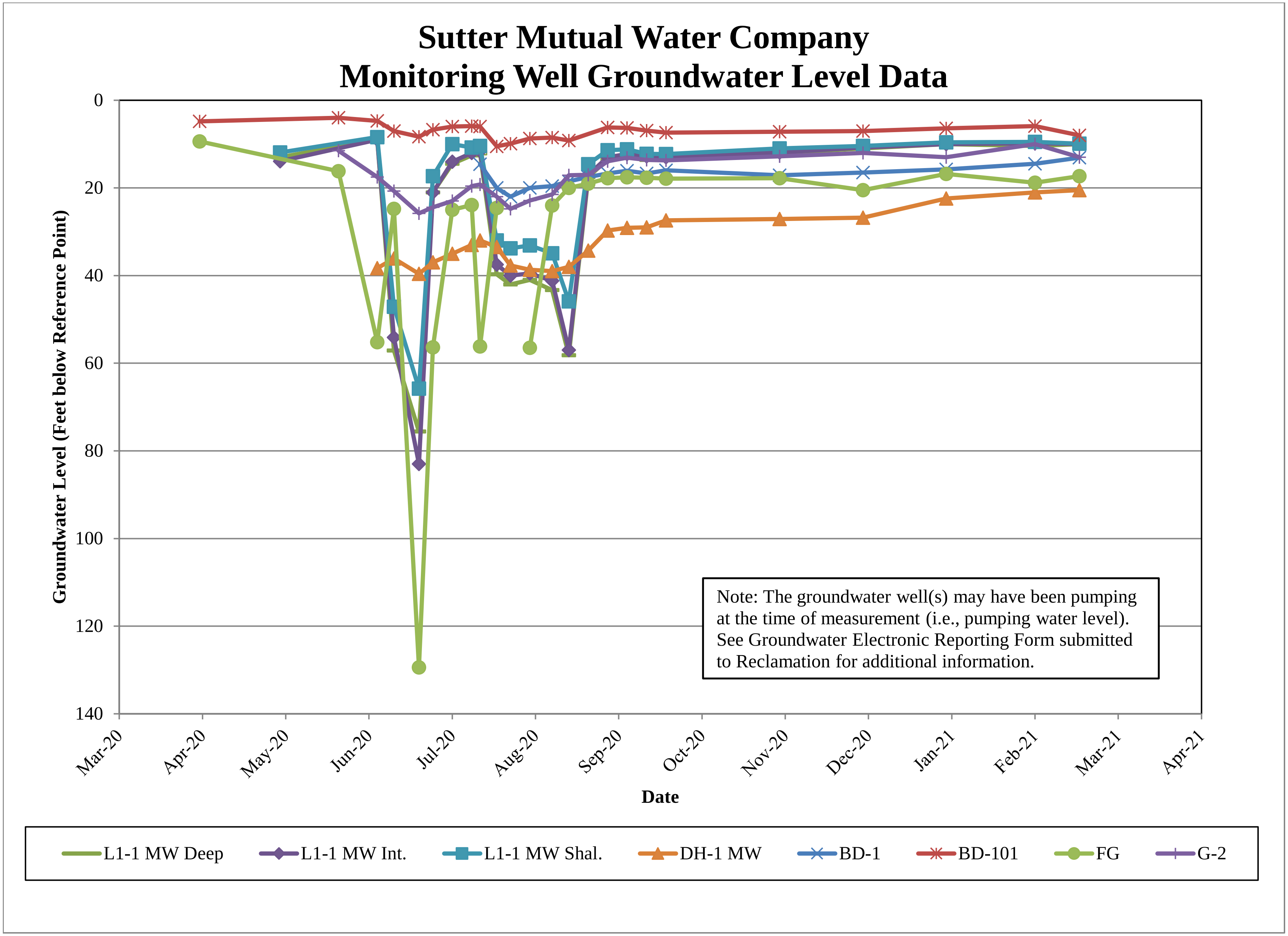

River Garden Farms
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
100
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Field 71-71
Field 71-231
Field 91-271
Field 93-210
Field 93-360
Field 104-160
Field 104-350

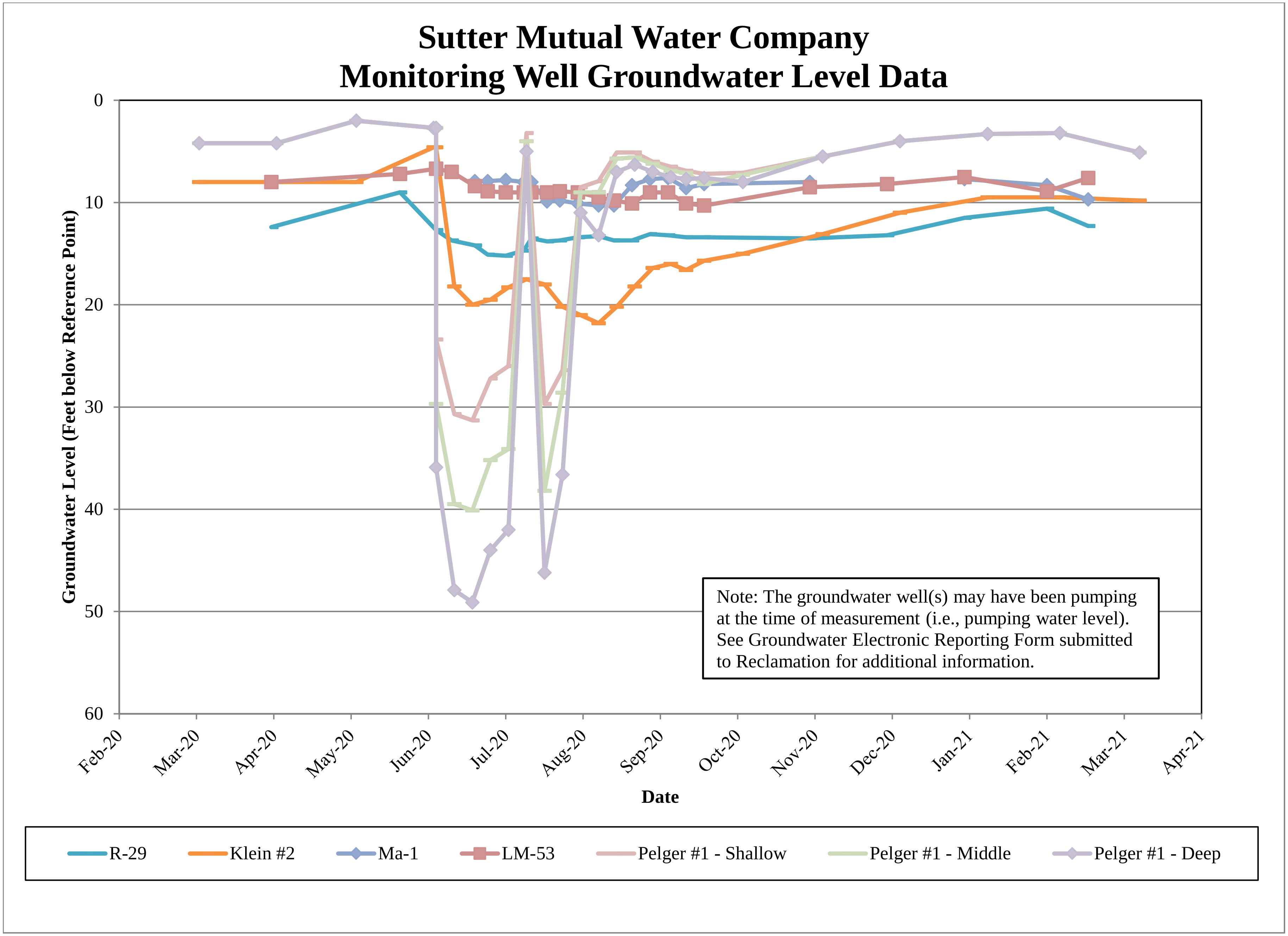


River Garden Farms
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
Field 104-692
Field 121-335
Field 121-460
Field 121-530
Shop-140
Shop-220
Shop-330

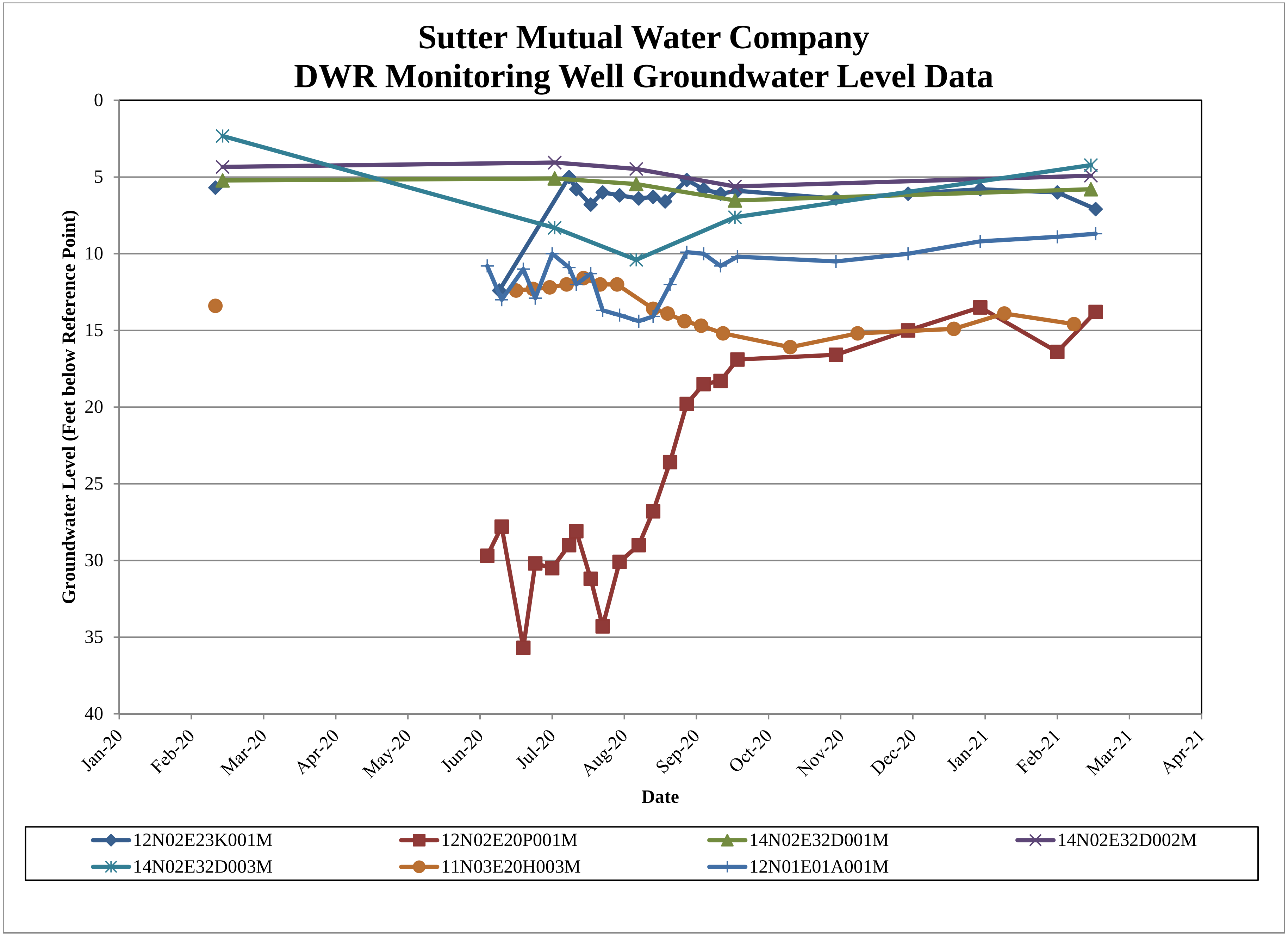

Sutter Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
G-16
S-18
LM-11
BD-2
BD-3
QHR
MB-1


Sutter Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
200
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
H-1
Me-1
L1-1
L1-2
L2-1
DB-1
TVN

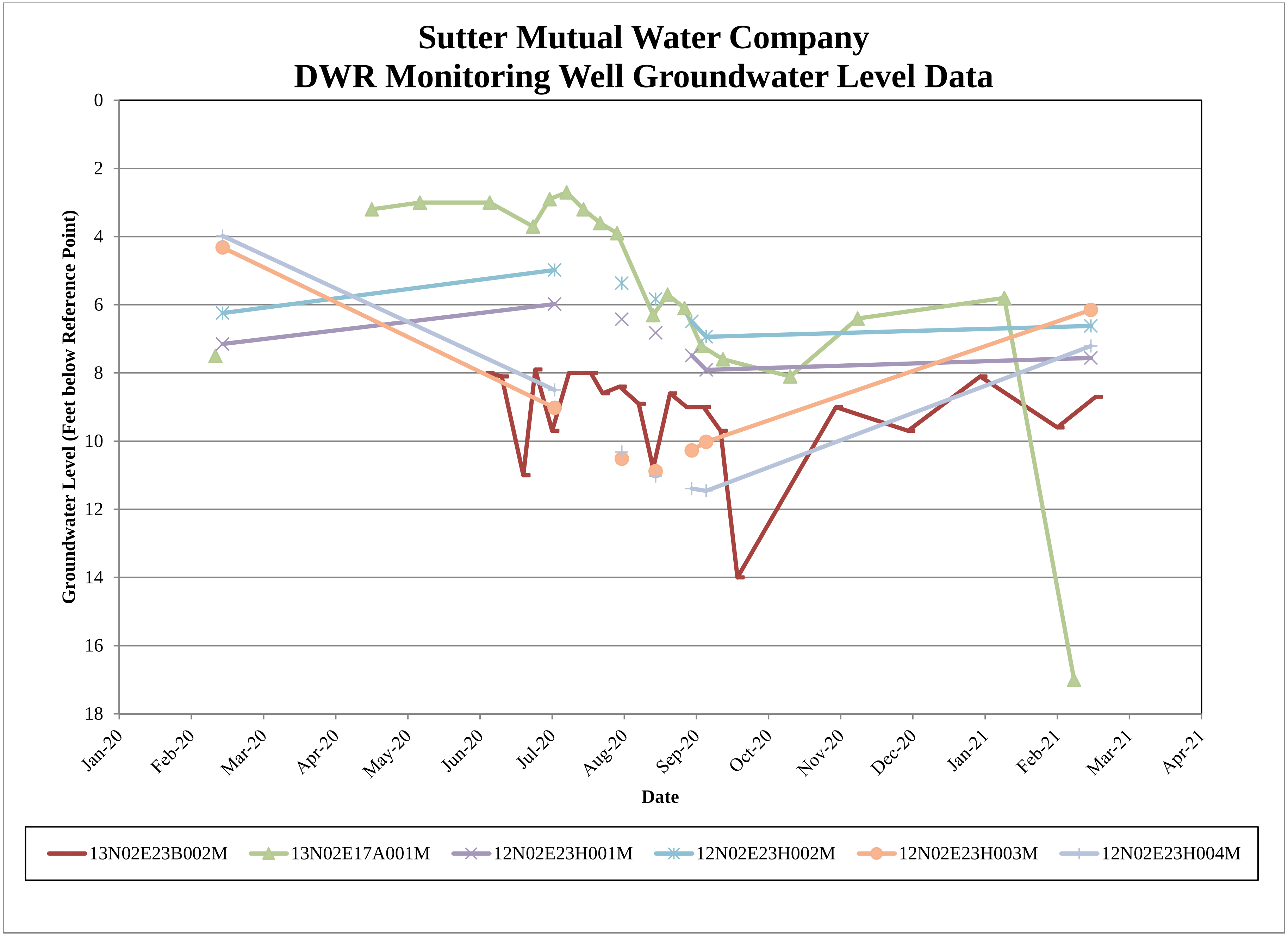

Sutter Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
L1-1 MW Deep
L1-1 MW Int.
L1-1 MW Shal.
DH-1 MW
BD-1
BD-101
FG
G-2



Sutter Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
R-29
Klein #2
Ma-1
LM-53
Pelger #1 - Shallow
Pelger #1 - Middle
Pelger #1 - Deep



Sutter Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
5
10
15
20
25
30
35
40
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
12N02E23K001M
12N02E20P001M
14N02E32D001M
14N02E32D002M
14N02E32D003M
11N03E20H003M
12N01E01A001M


Sutter Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
2
4
6
8
10
12
14
16
18
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
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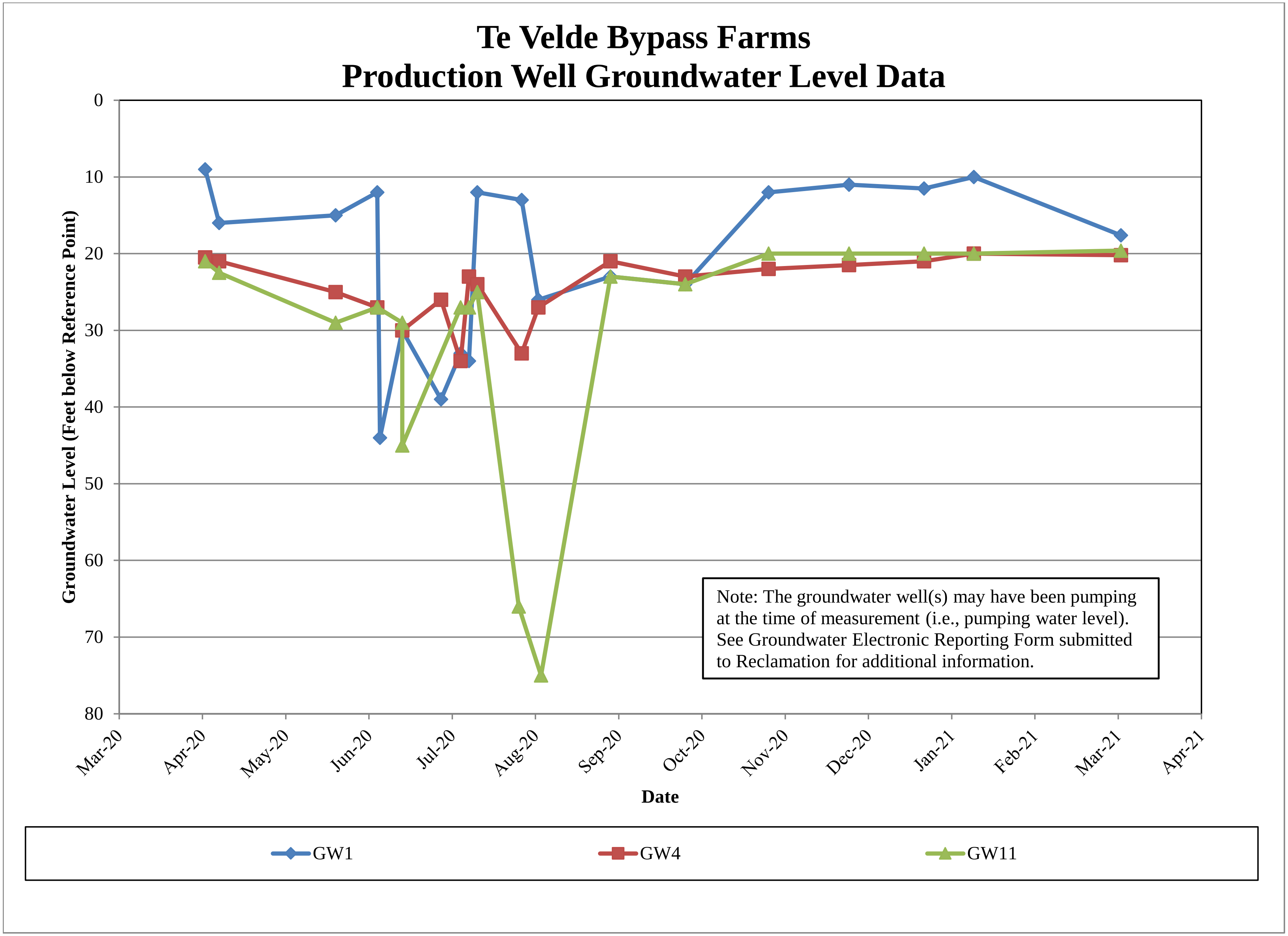
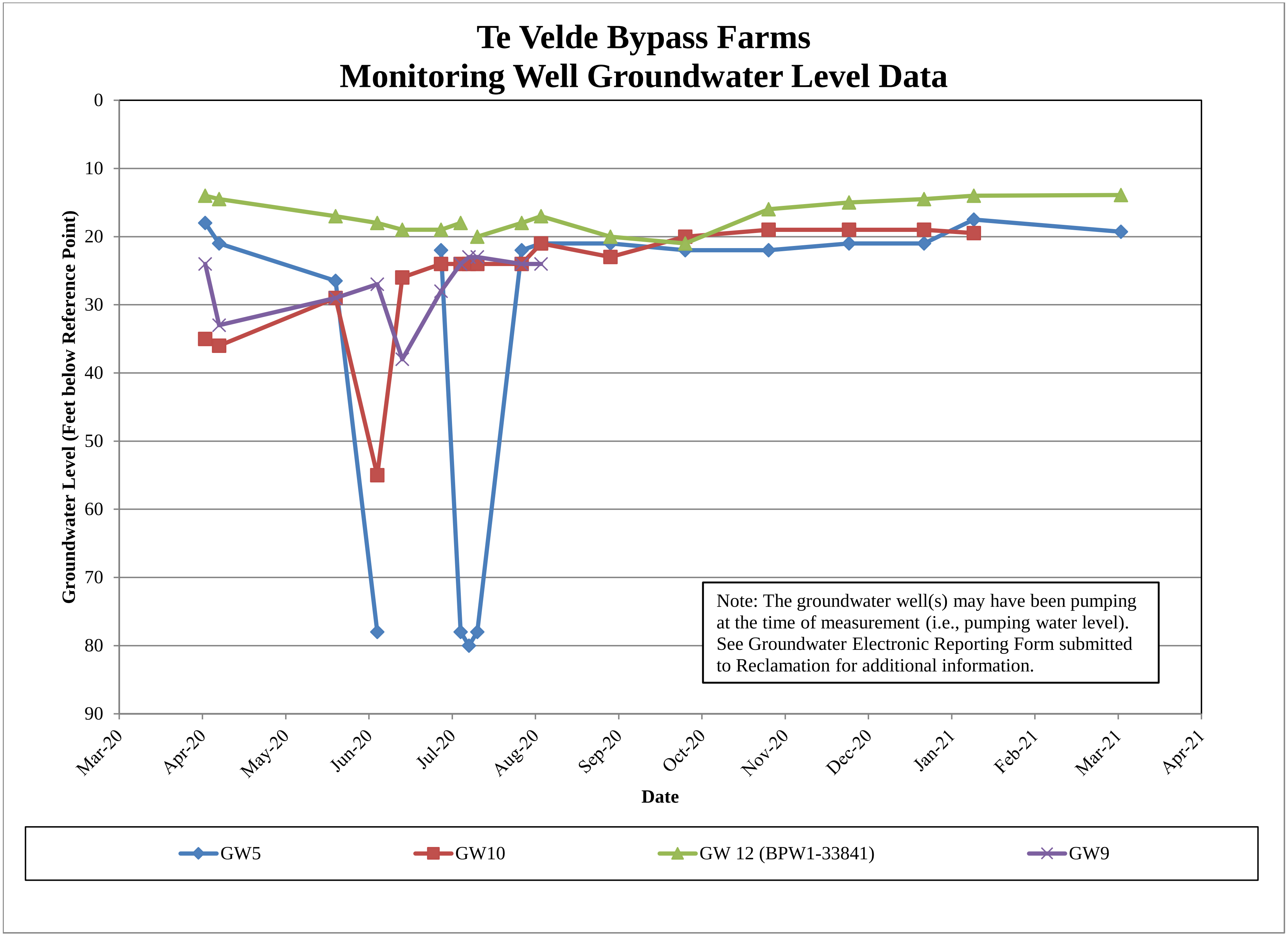
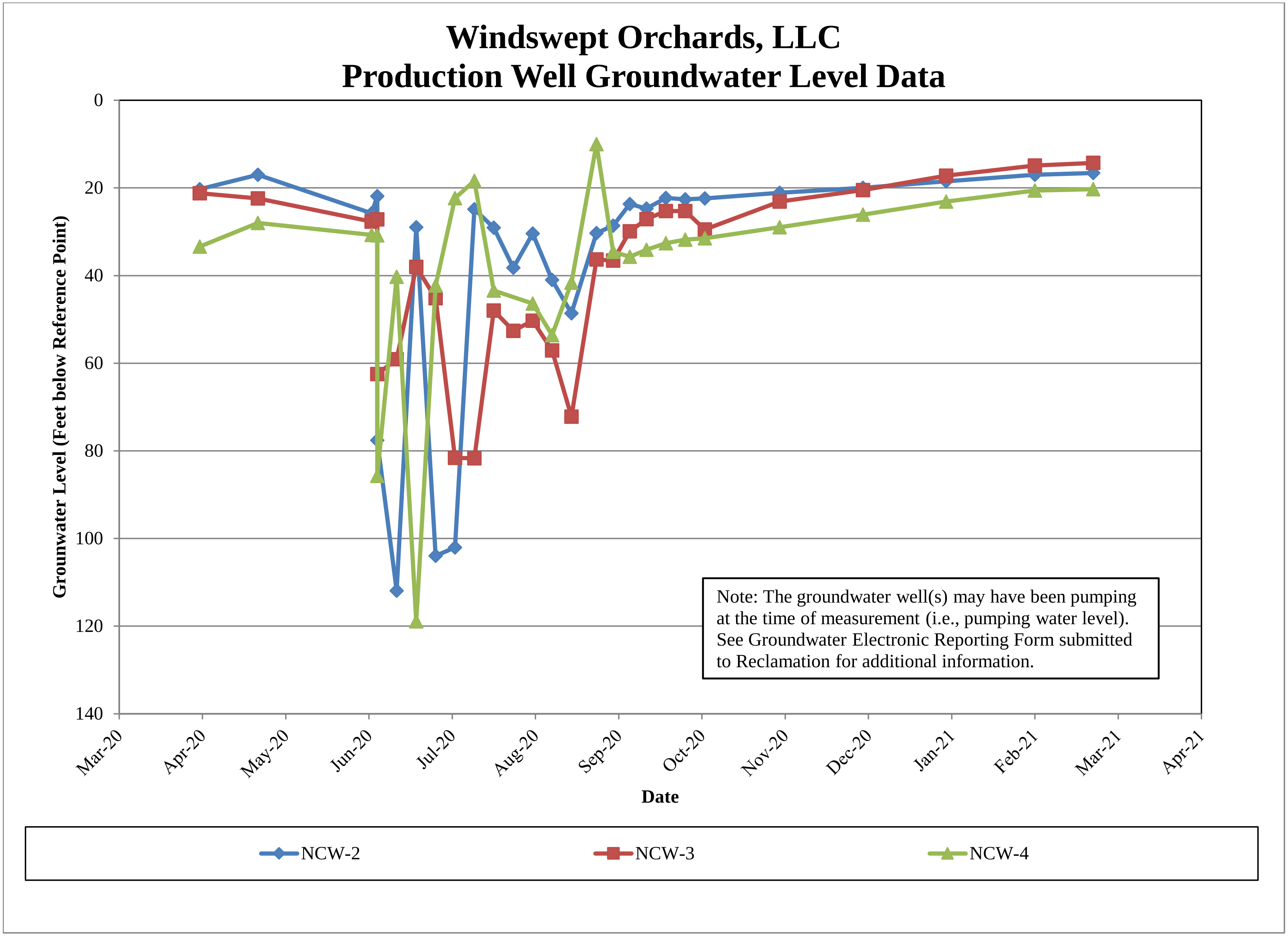
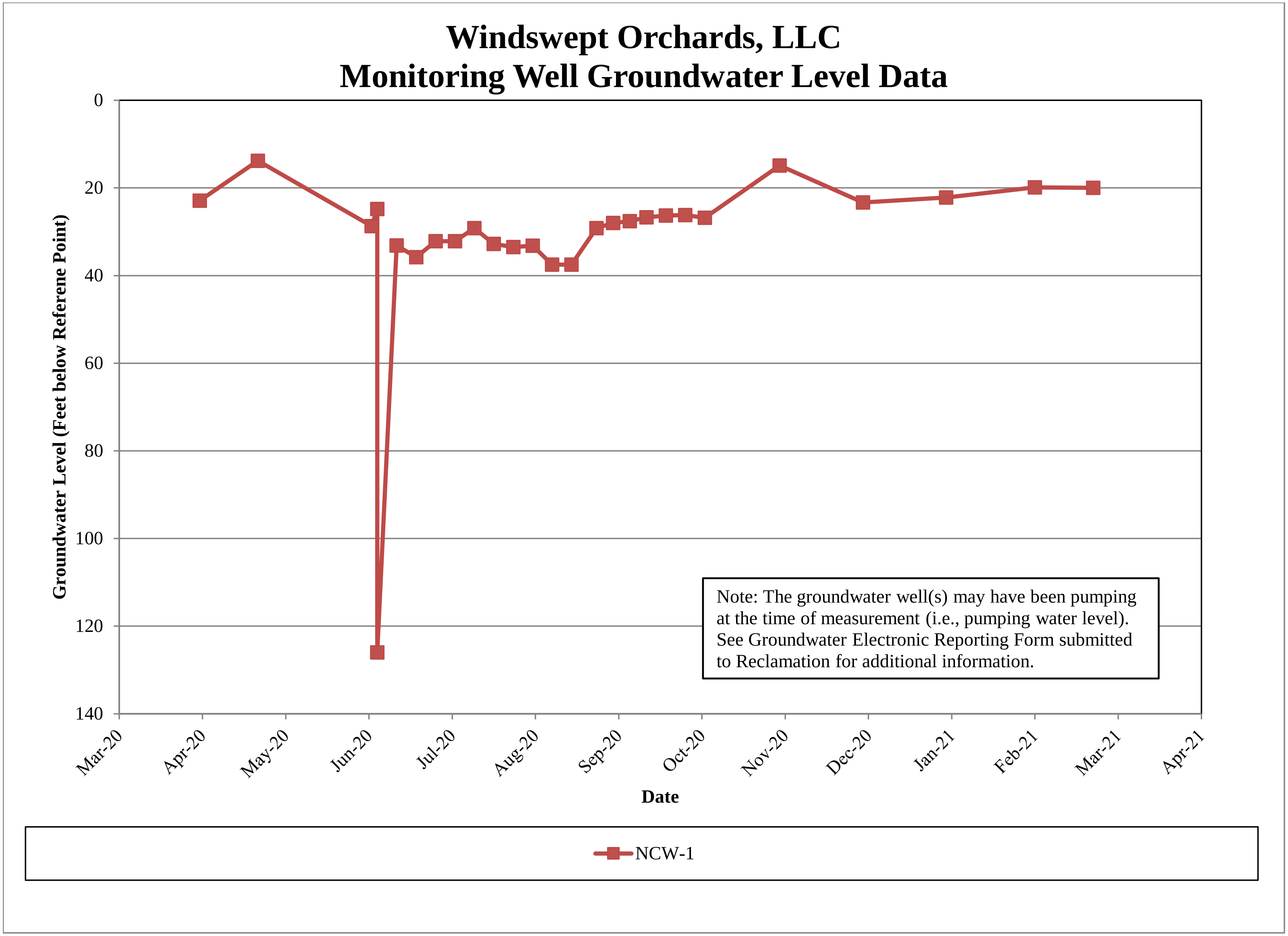
12N02E23H004M

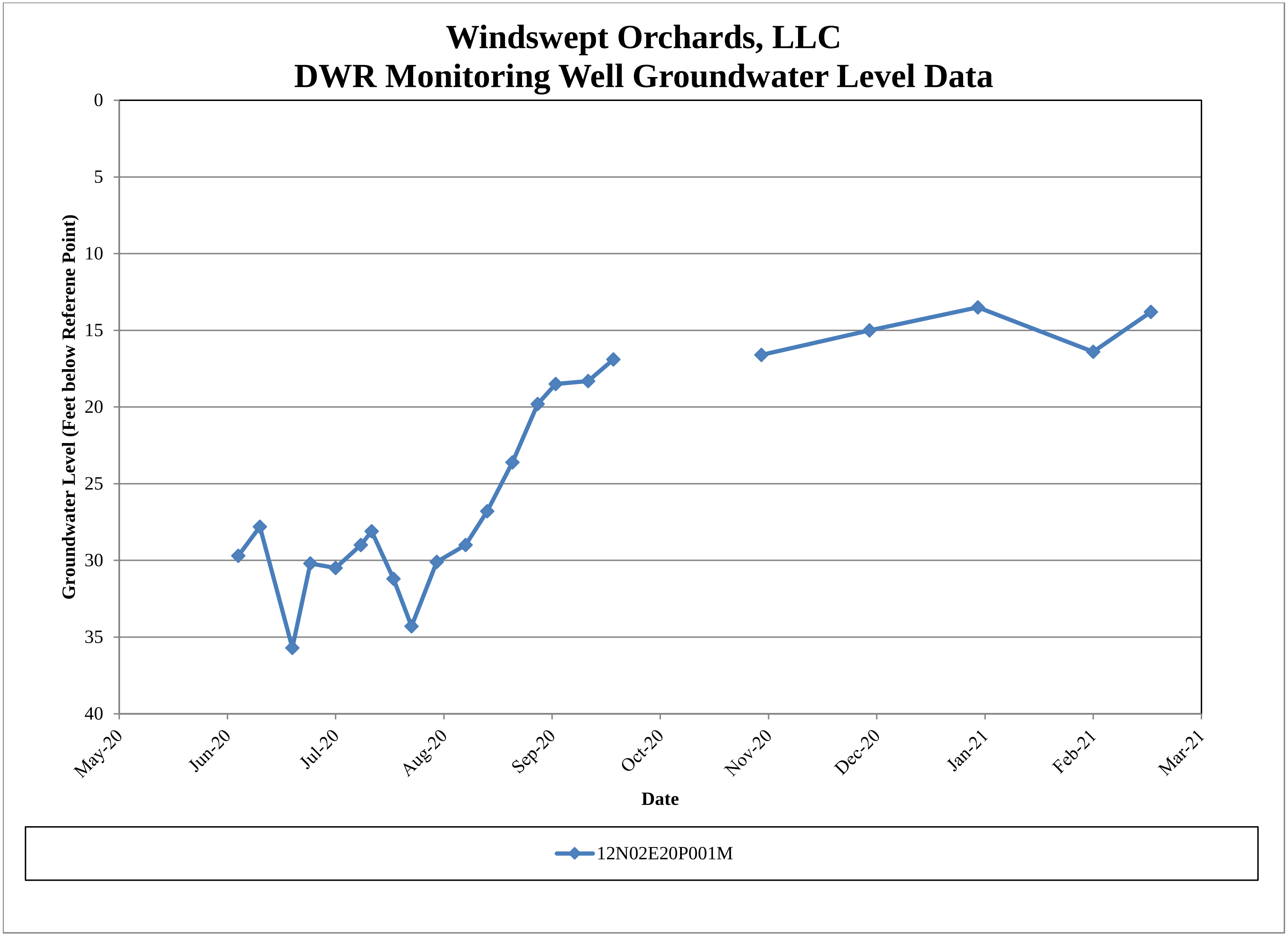

Te Velde Bypass Farms
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
GW1
GW4
GW11


Te Velde Bypass Farms
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
GW5
GW10
GW 12 (BPW1-33841)
GW9


Windswept Orchards, LLC
Production Well Groundwater Level Data
Grounwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
NCW-2
NCW-3
NCW-4



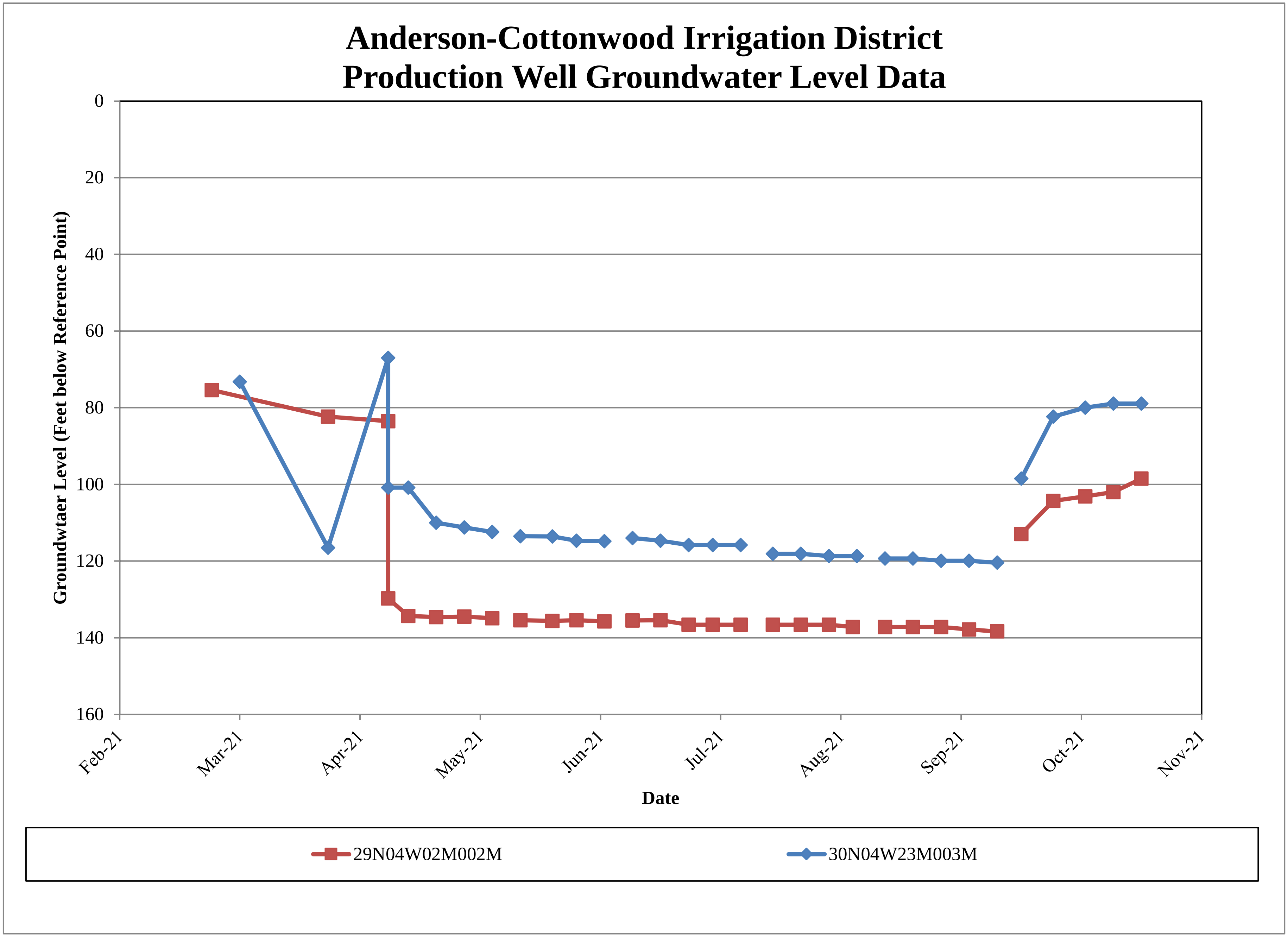
Windswept Orchards, LLC
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Referene Point)
0
20
40
60
80
100
120
140
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
Date
Note: The groundwater well(s) may have been pumping at the time of measurement (i.e., pumping water level). See Groundwater Electronic Reporting Form submitted to Reclamation for additional information.
NCW-1


Windswept Orchards, LLC
DWR Monitoring Well Groundwater Level Data
0
5
10
15
20
25
30
35
40
Groundwater Level (Feet below Referene Point)
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Date
12N02E20P001M

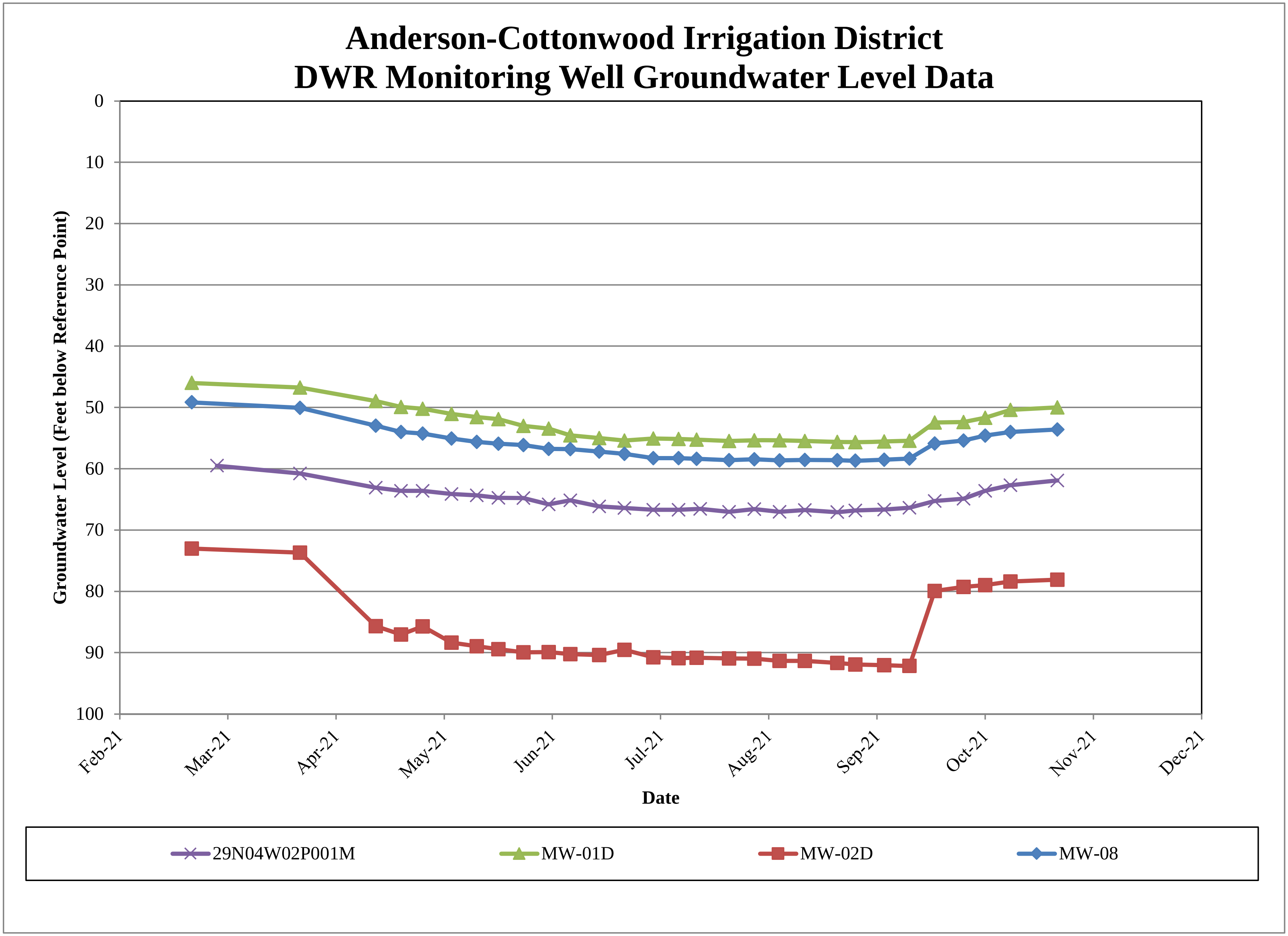
Appendix I2

2021 Water Transfers

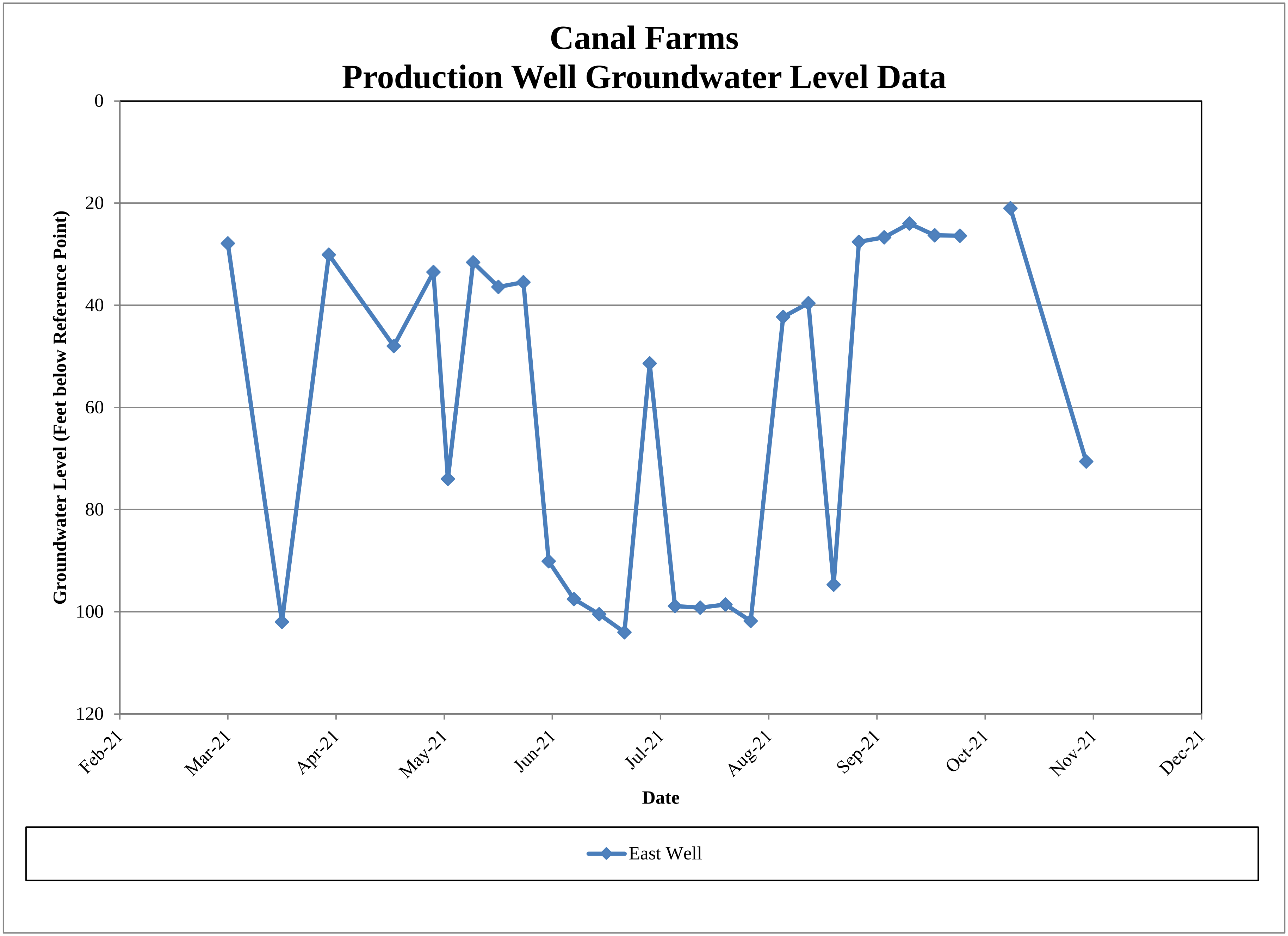
Data Reports

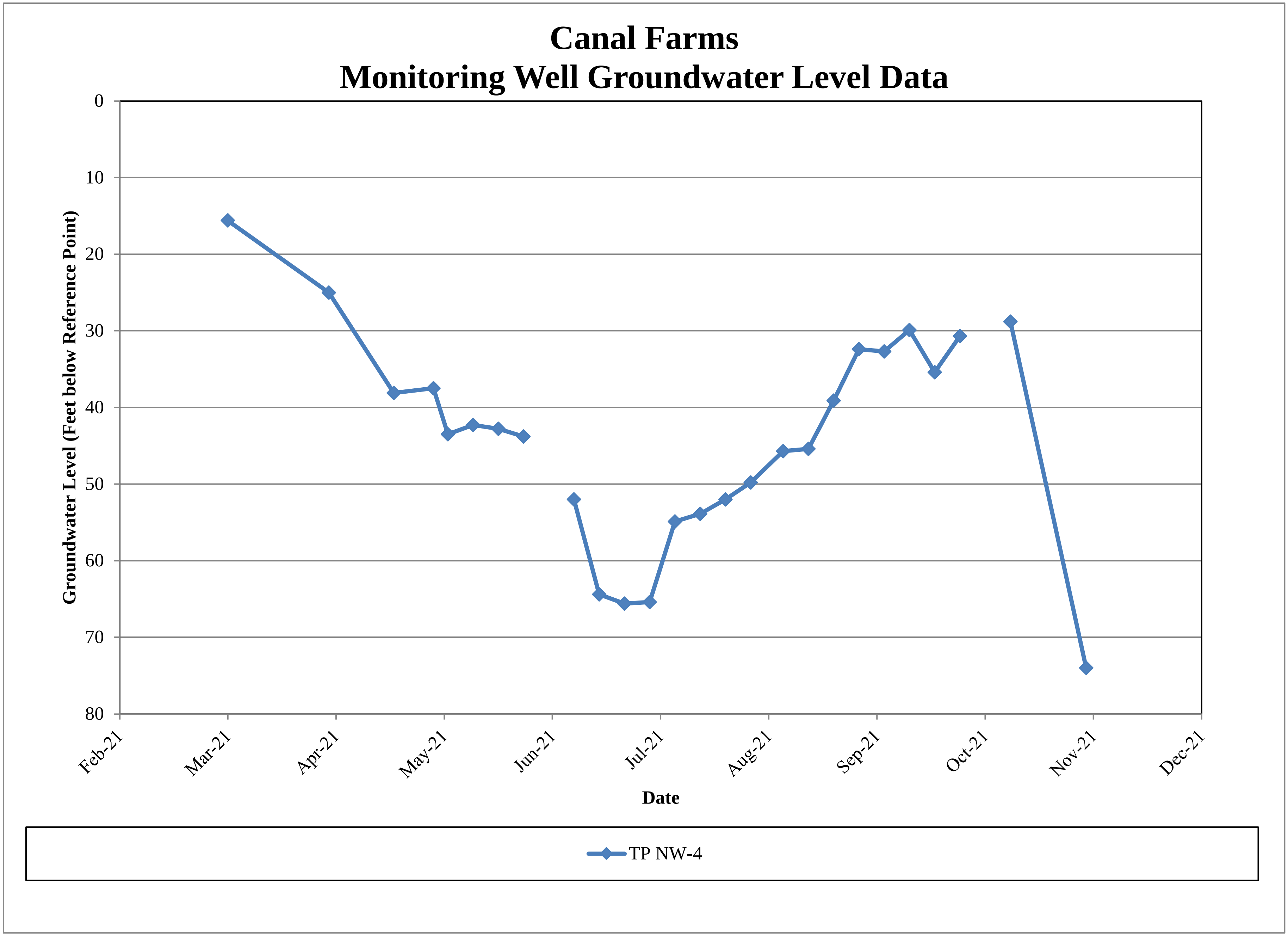


Anderson-Cottonwood Irrigation District
Production Well Groundwater Level Data
Groundwtaer Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Date
29N04W02M002M
30N04W23M003M

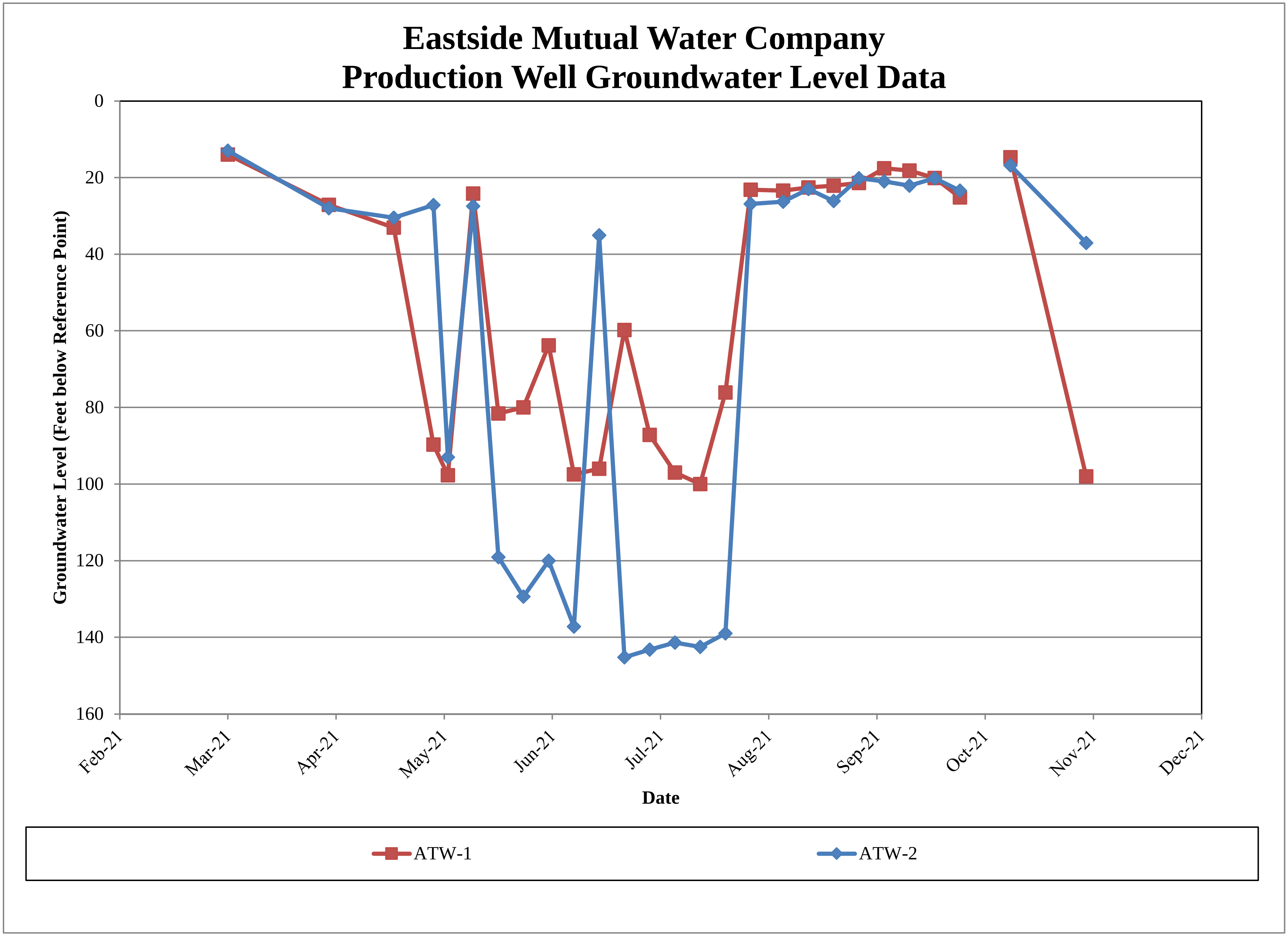


Anderson-Cottonwood Irrigation District
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
100
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
29N04W02P001M
MW-01D
MW-02D
MW-08

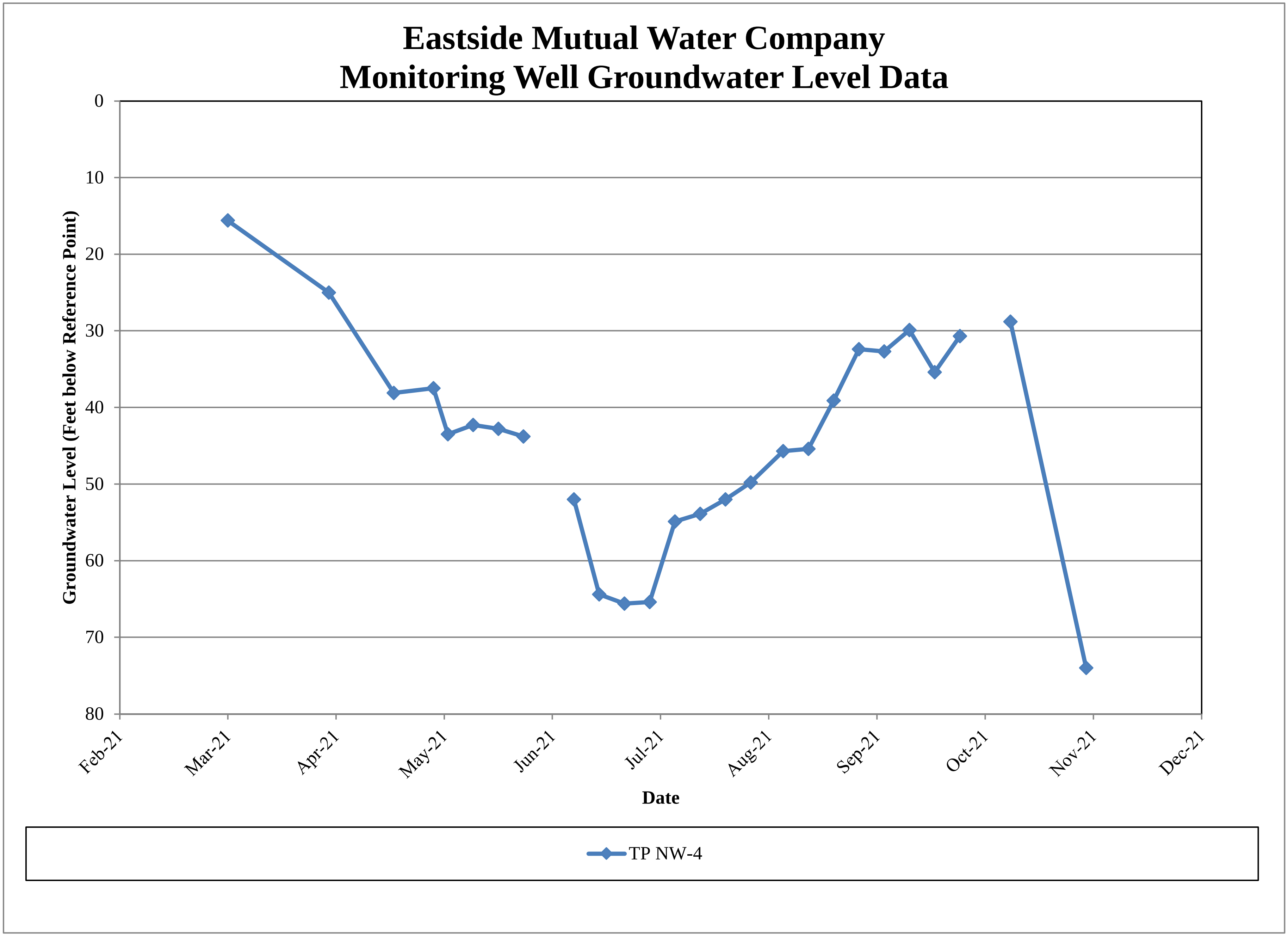

Canal Farms
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
East Well



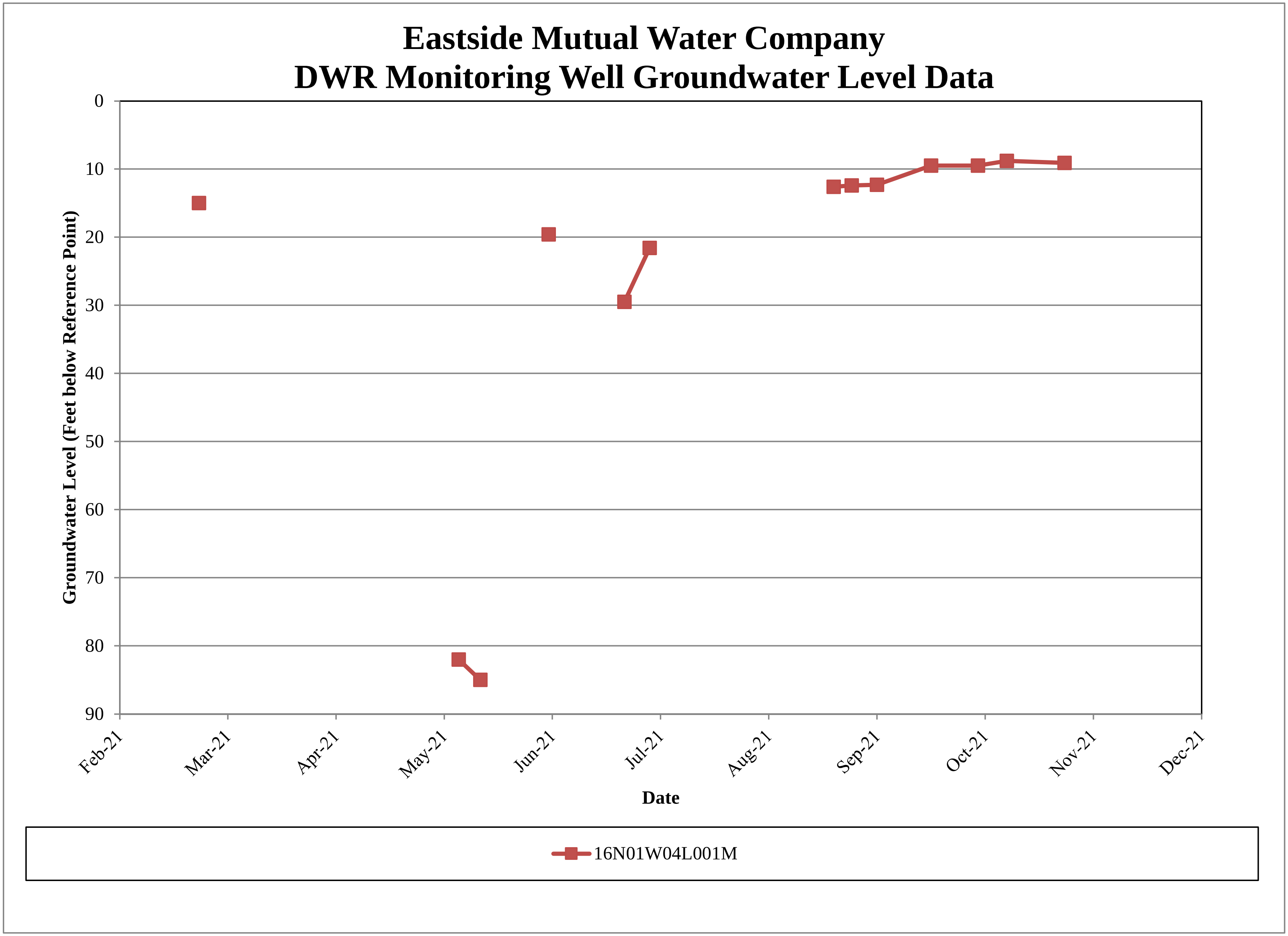
Canal Farms
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
TP NW-4



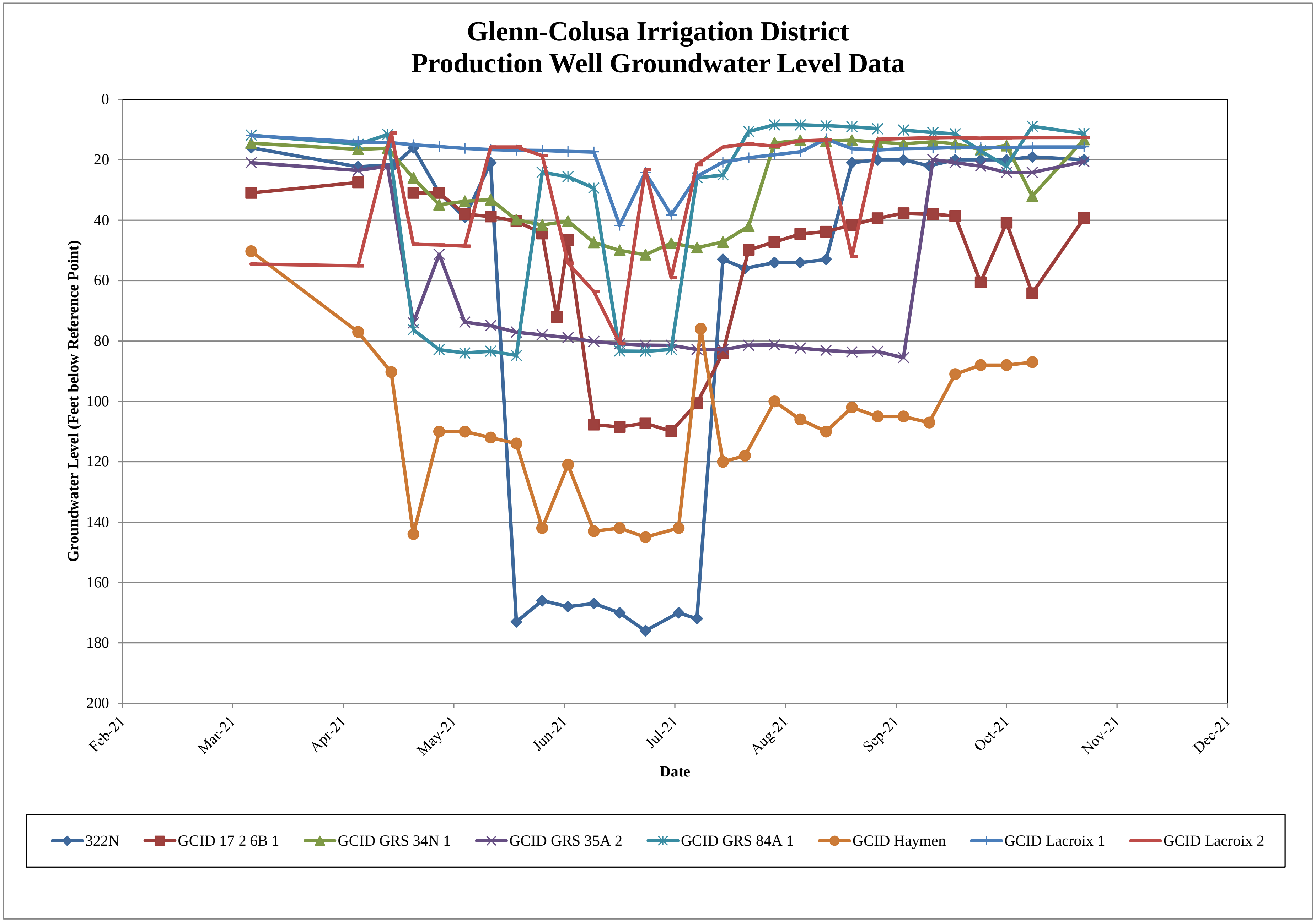
Eastside Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
ATW-1
ATW-2

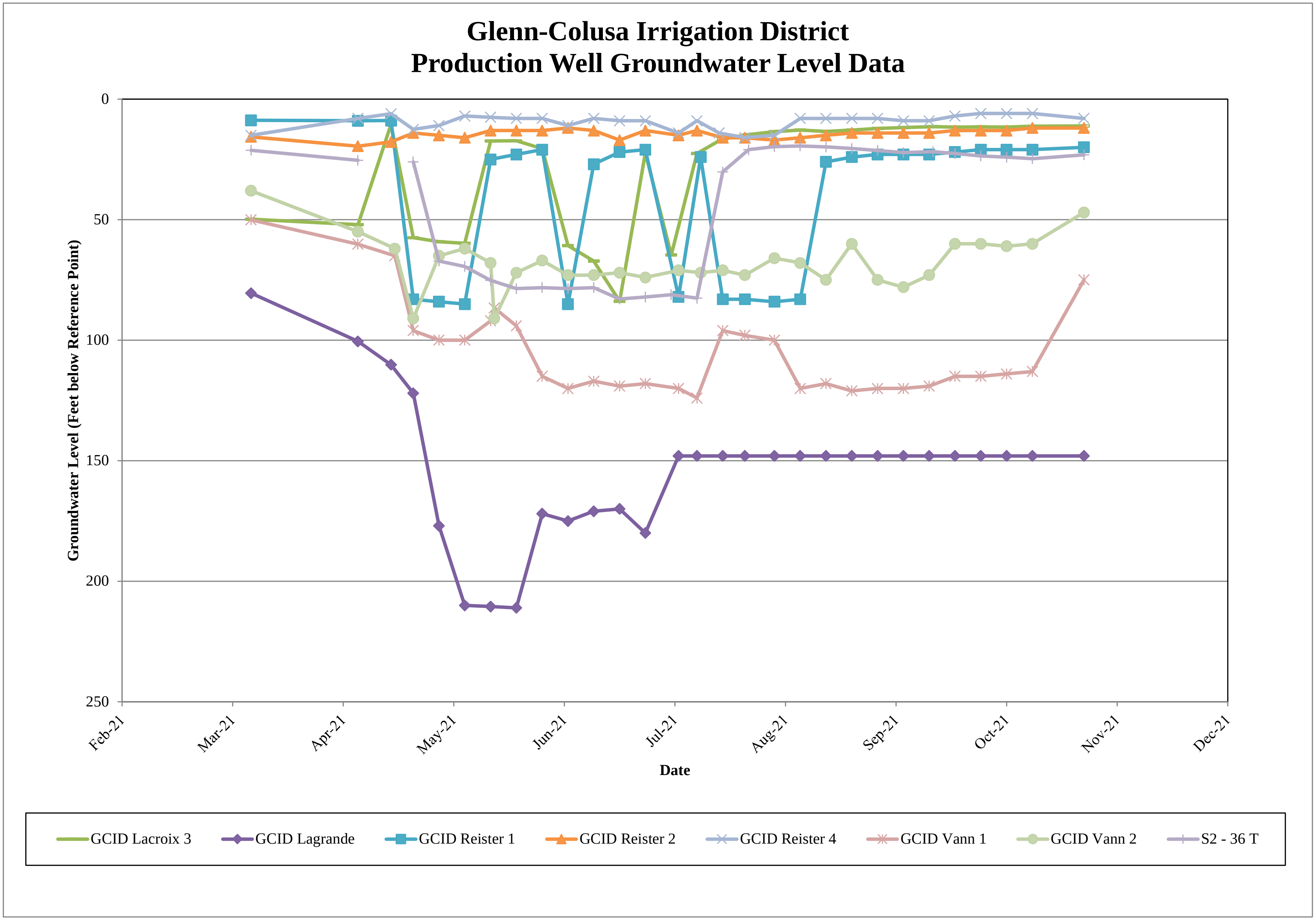


Eastside Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
TP NW-4

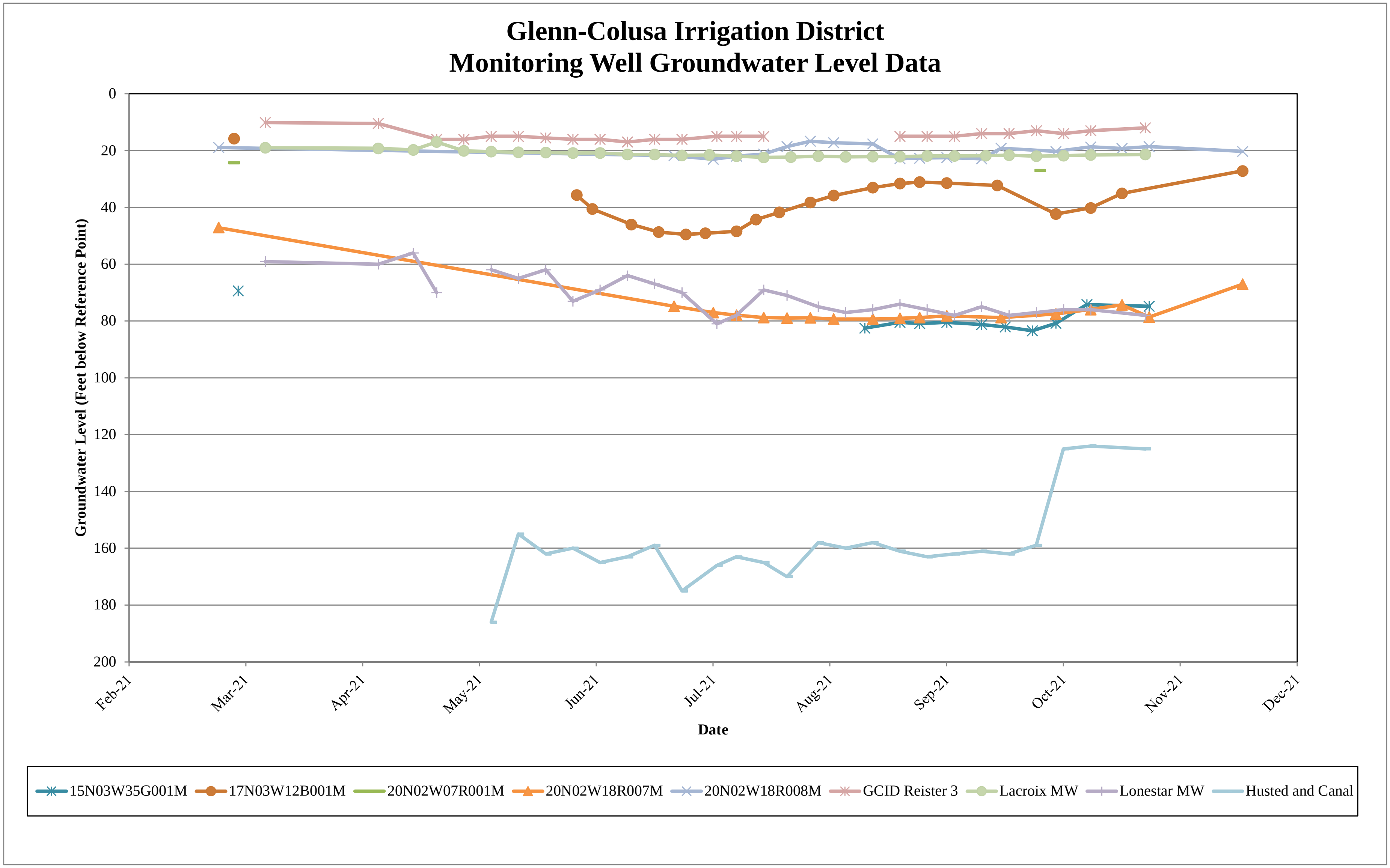


Eastside Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
16N01W04L001M

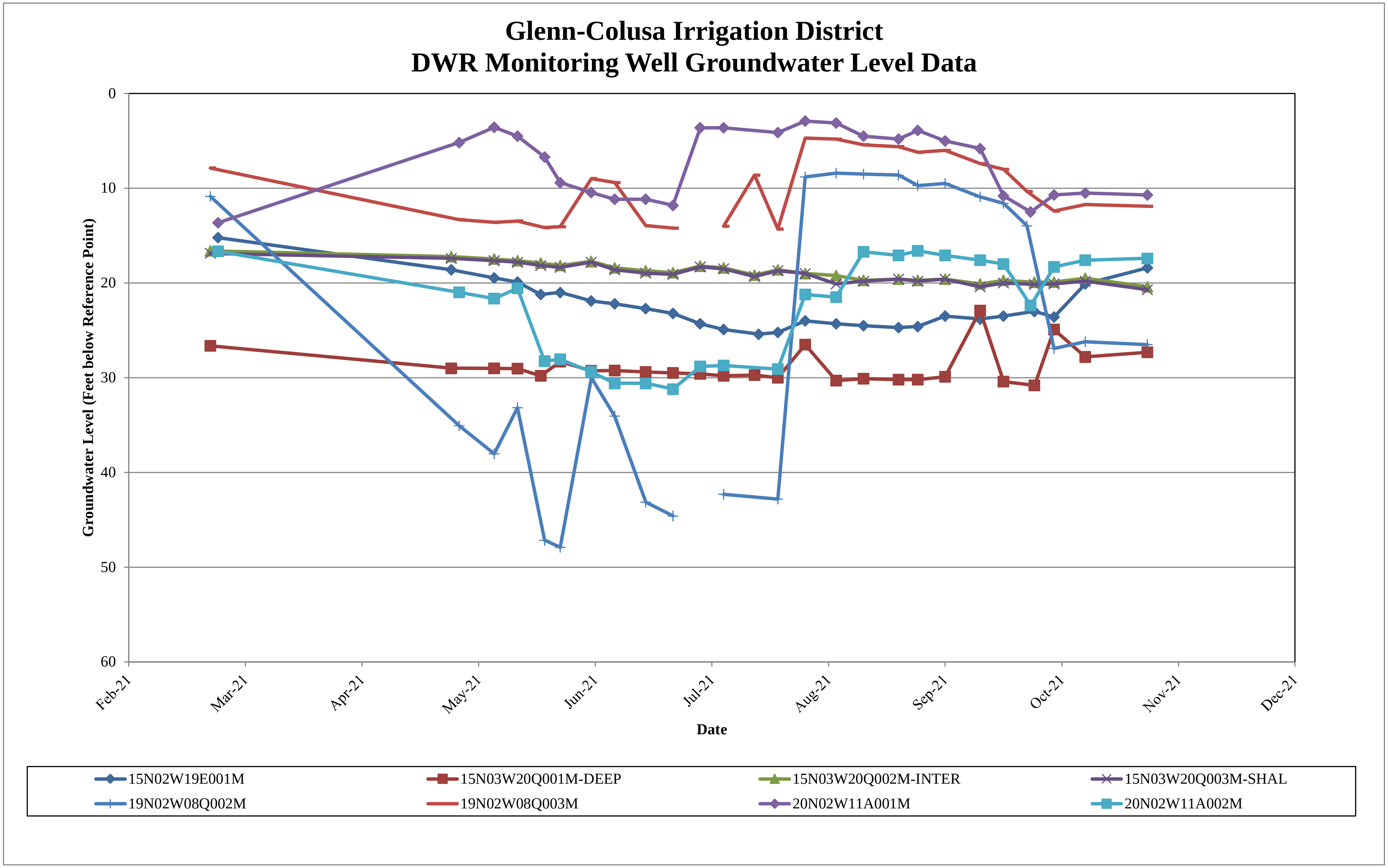

Glenn-Colusa Irrigation District
Production Well Groundwater Level Data
0
20
40
60
80
100
120
140
160
180
200
Groundwater Level (Feet below Reference Point)
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
322N
GCID 17 2 6B 1
GCID GRS 34N 1
GCID GRS 35A 2
GCID GRS 84A 1
GCID Haymen
GCID Lacroix 1
GCID Lacroix 2

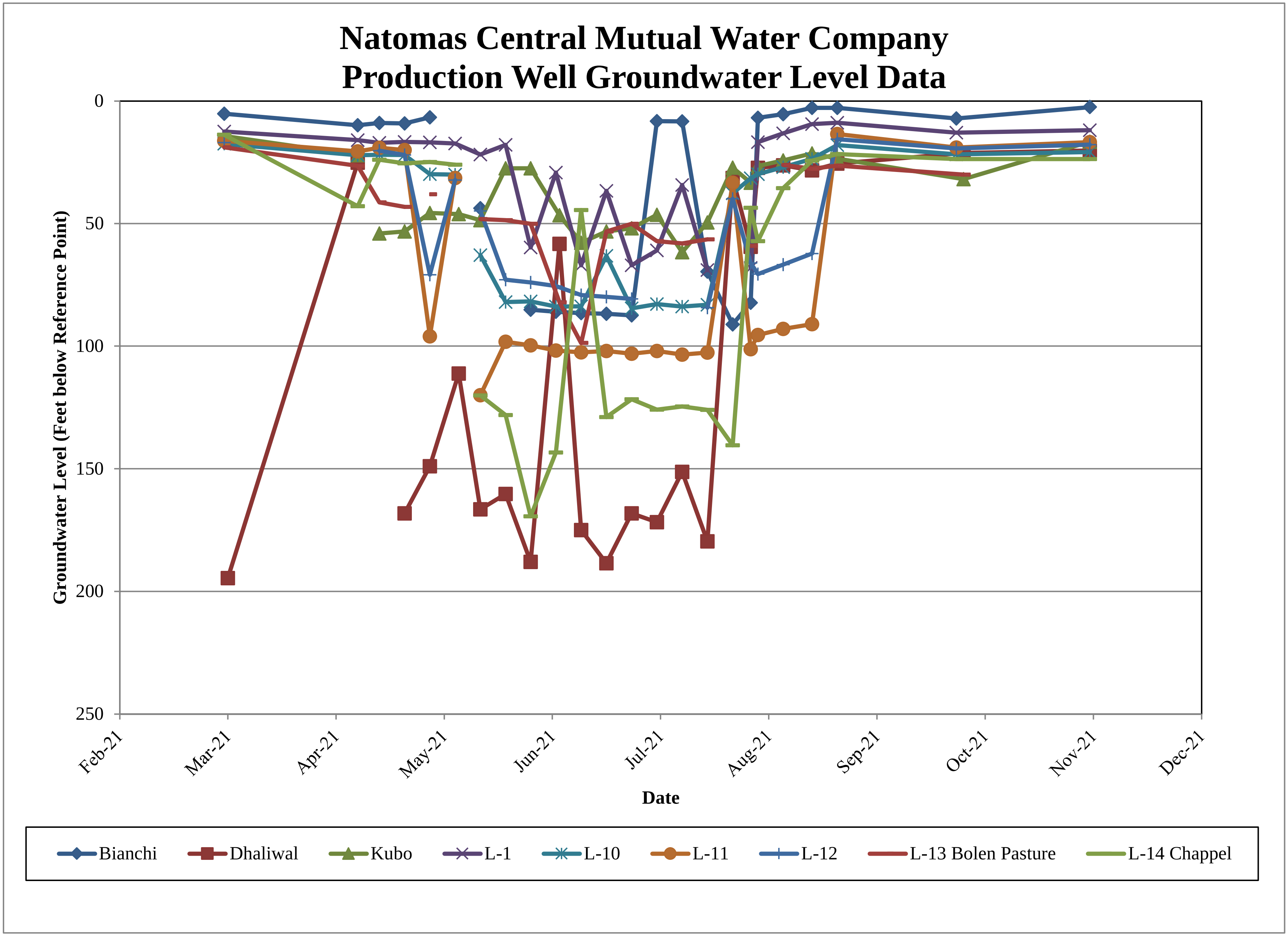


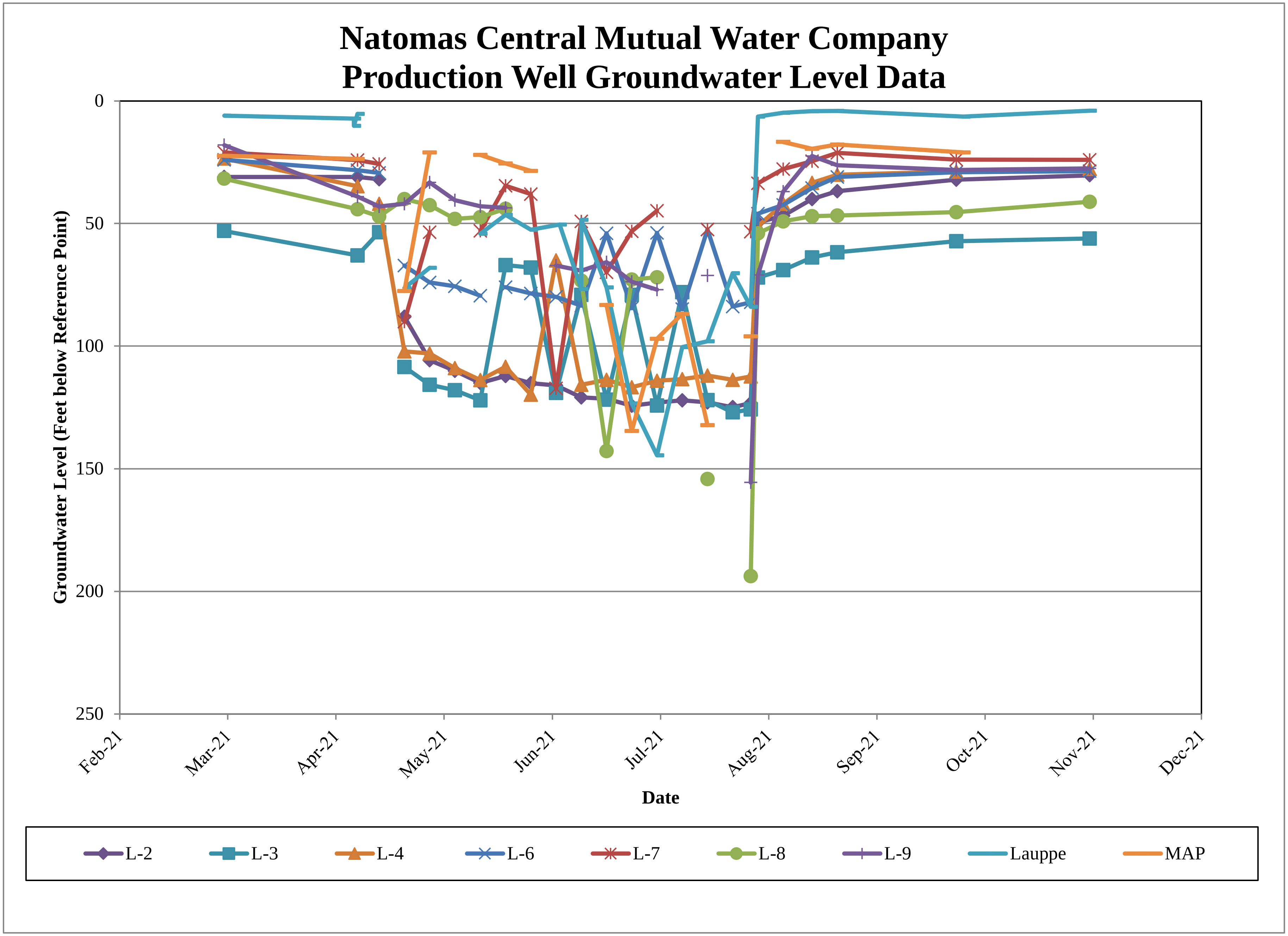
Glenn-Colusa Irrigation District
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
GCID Lacroix 3
GCID Lagrande
GCID Reister 1
GCID Reister 2
GCID Reister 4
GCID Vann 1
GCID Vann 2
S2 - 36 T



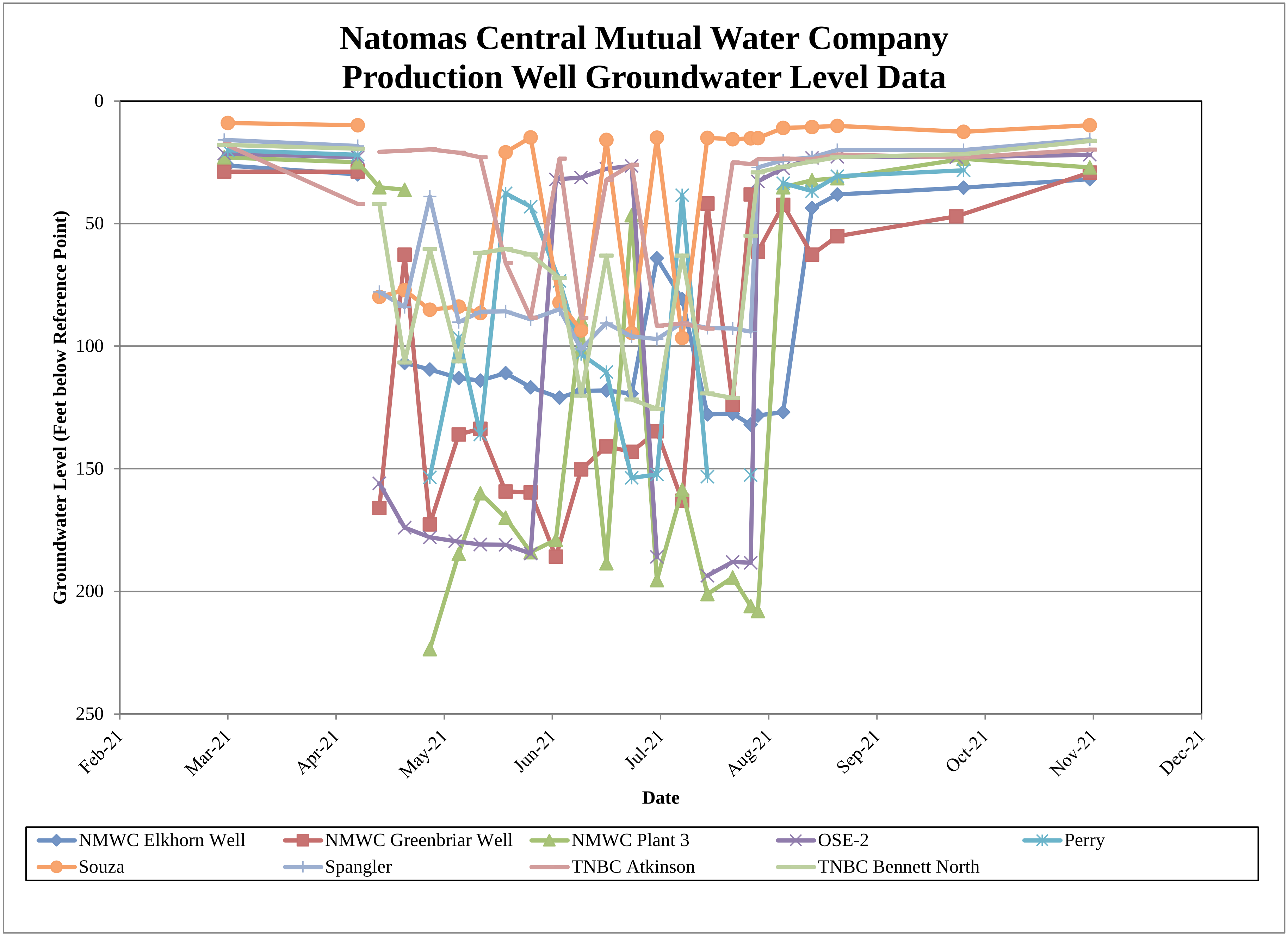
Glenn-Colusa Irrigation District
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
200
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
15N03W35G001M
17N03W12B001M
20N02W07R001M
20N02W18R007M
20N02W18R008M
GCID Reister 3
Lacroix MW
Lonestar MW
Husted and Canal

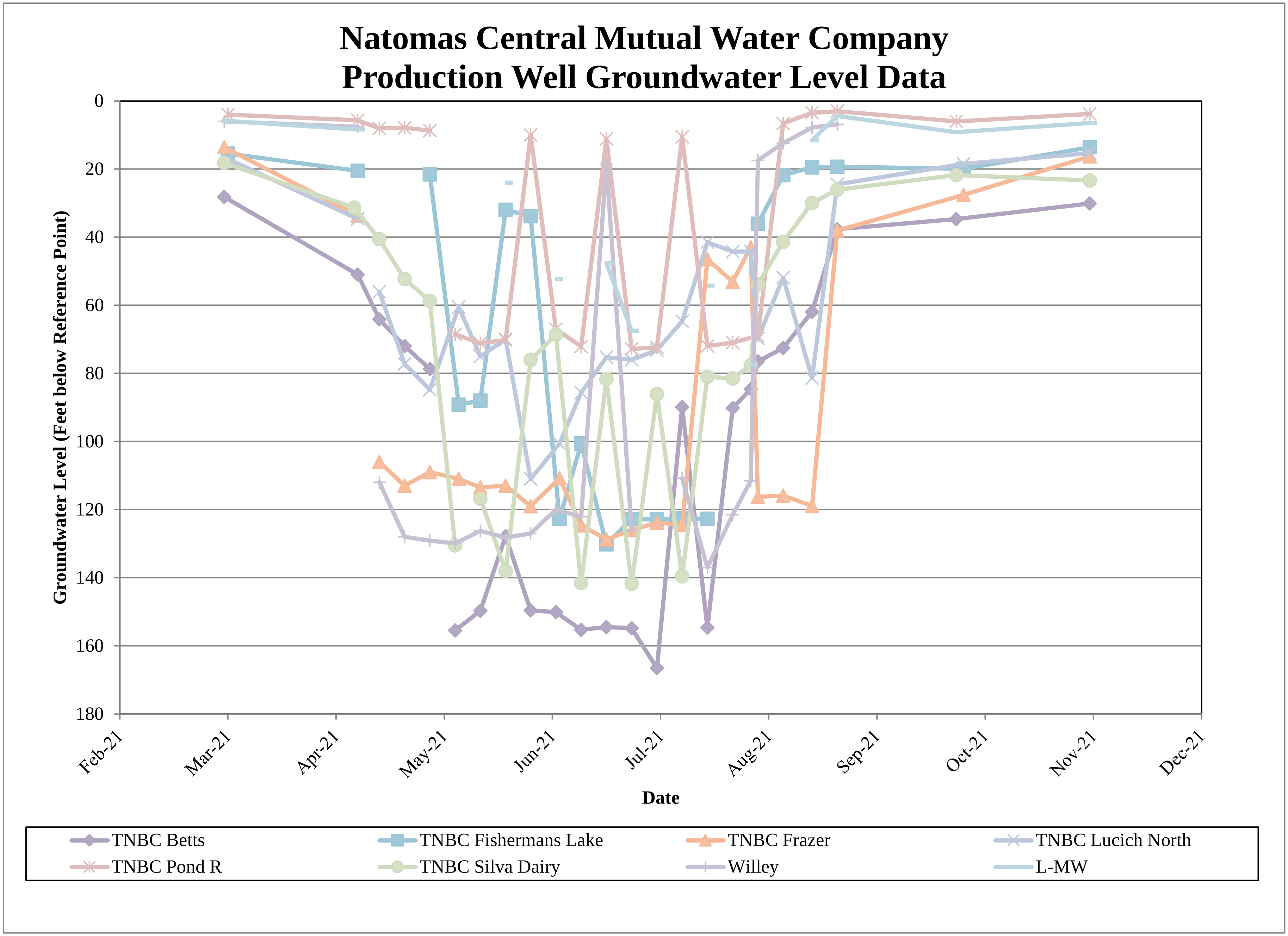

Glenn-Colusa Irrigation District
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
15N02W19E001M
15N03W20Q001M-DEEP
15N03W20Q002M-INTER
15N03W20Q003M-SHAL
19N02W08Q002M
19N02W08Q003M
20N02W11A001M
20N02W11A002M


Natomas Central Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
Bianchi
Dhaliwal
Kubo
L-1
L-10
L-11
L-12
L-13 Bolen Pasture
L-14 Chappel

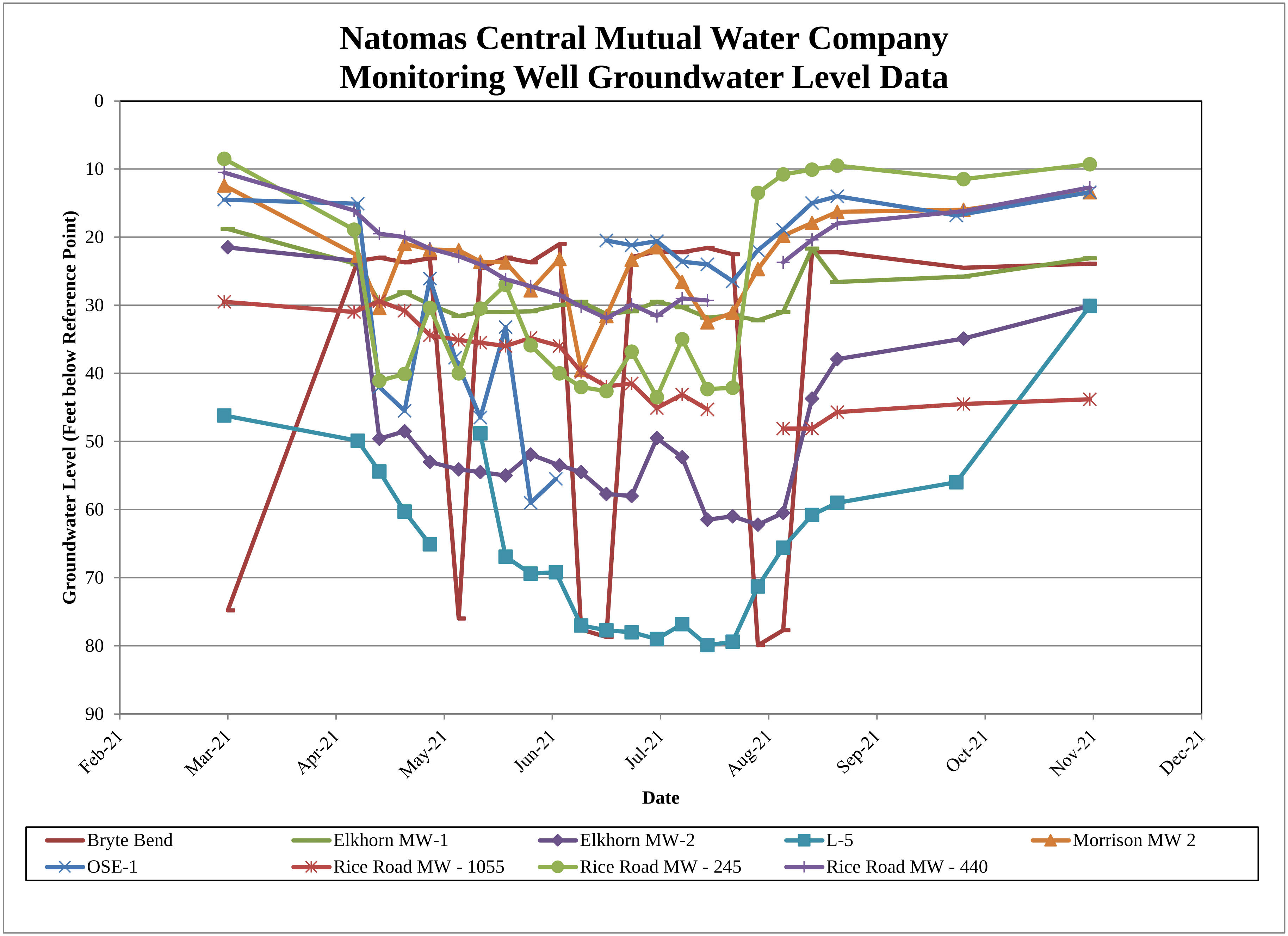


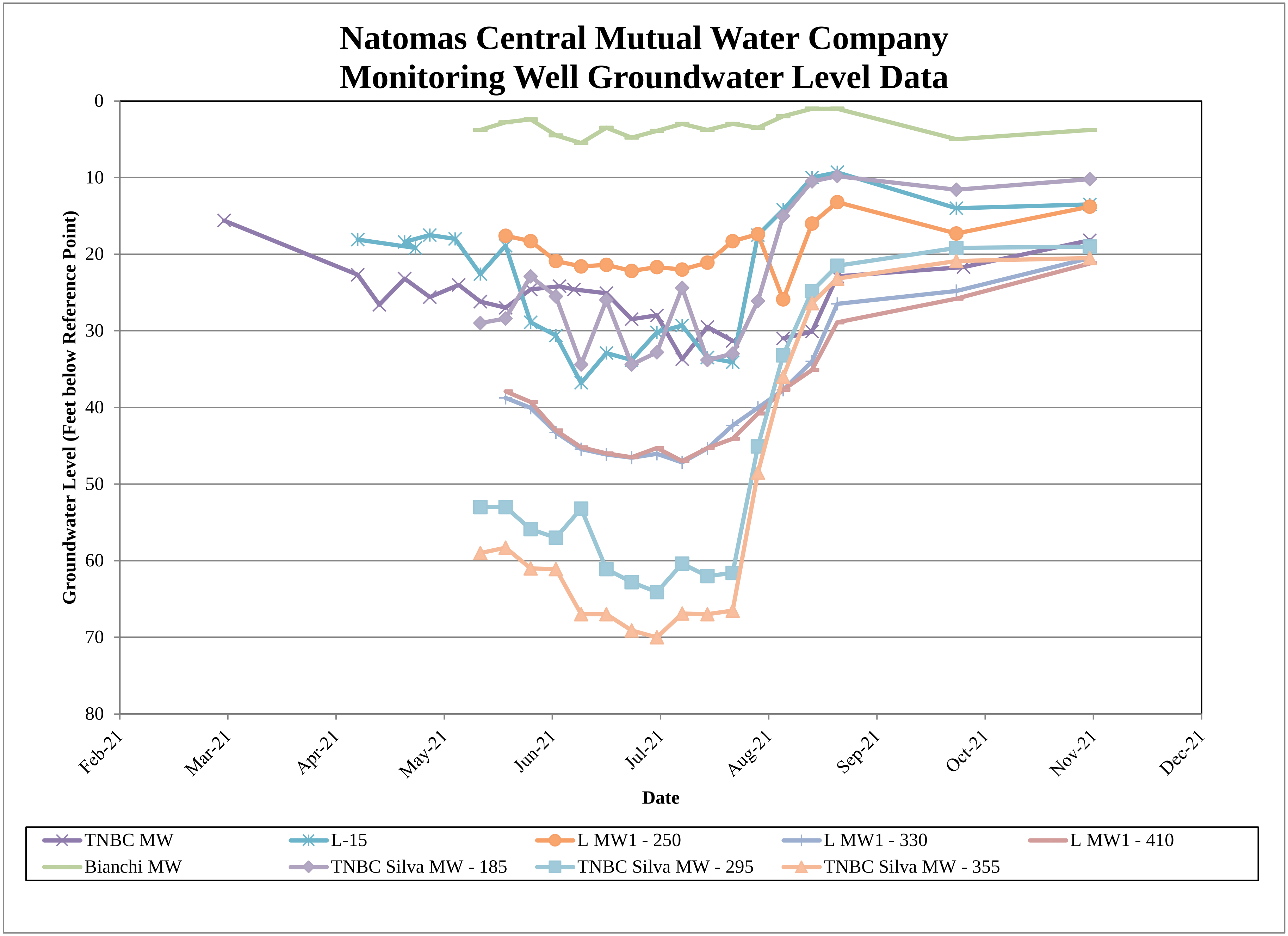
Natomas Central Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
L-2
L-3
L-4
L-6
L-7
L-8
L-9
Lauppe
MAP

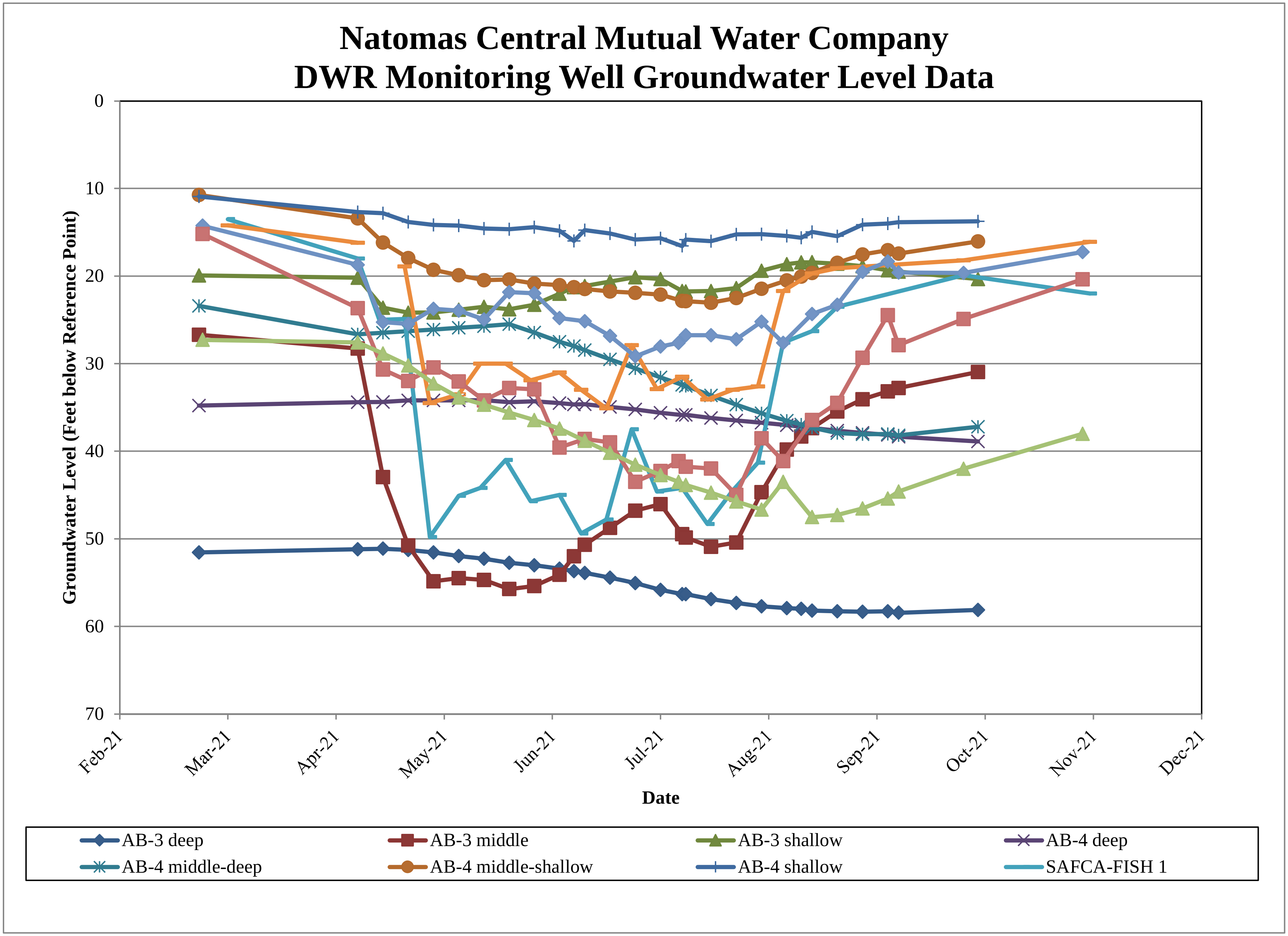

Natomas Central Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
NMWC Elkhorn Well
NMWC Greenbriar Well
NMWC Plant 3
OSE-2
Perry
Souza
Spangler
TNBC Atkinson
TNBC Bennett North

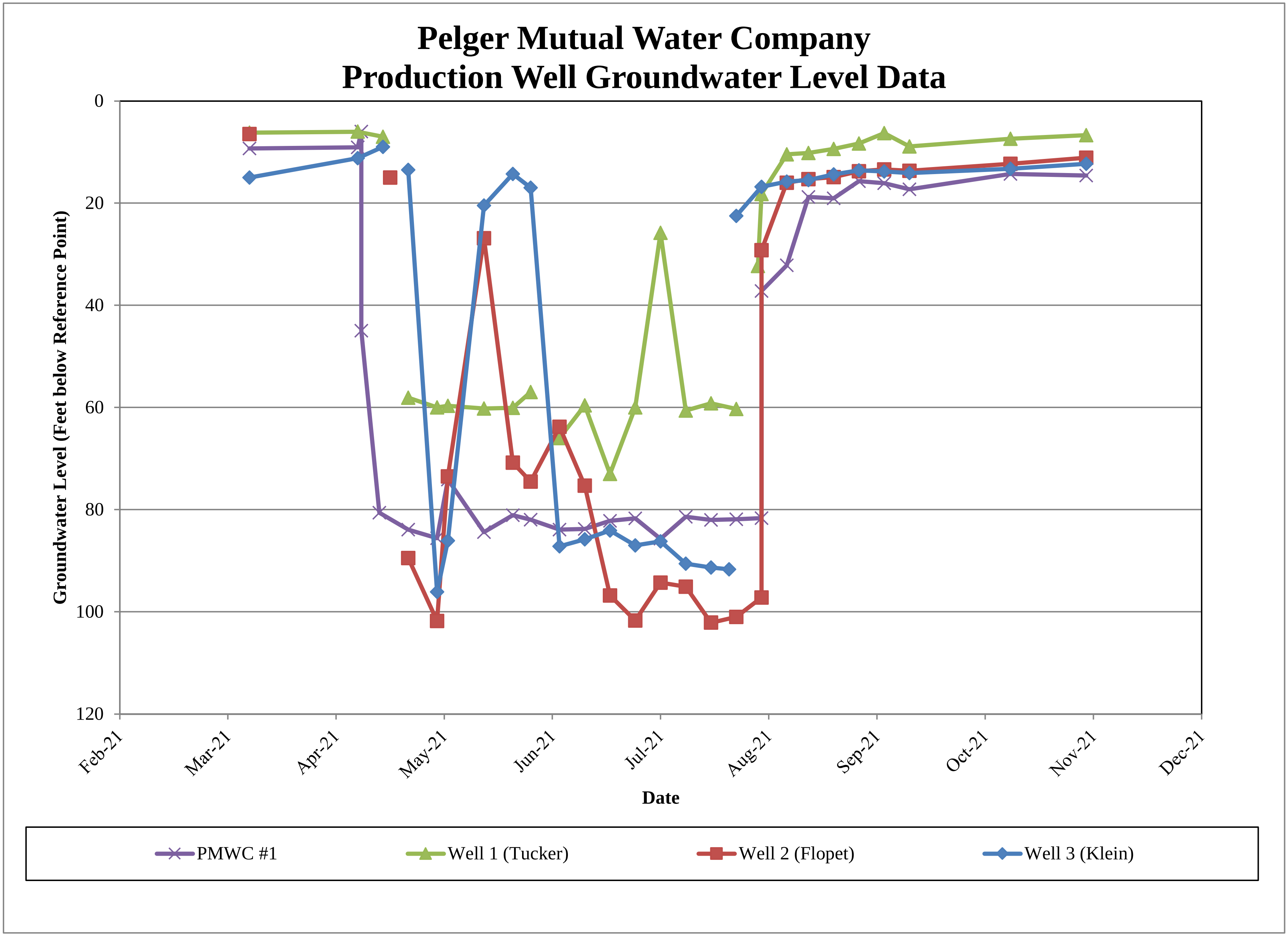


Natomas Central Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
TNBC Betts
TNBC Fishermans Lake
TNBC Frazer
TNBC Lucich North
TNBC Pond R
TNBC Silva Dairy
Willey
L-MW

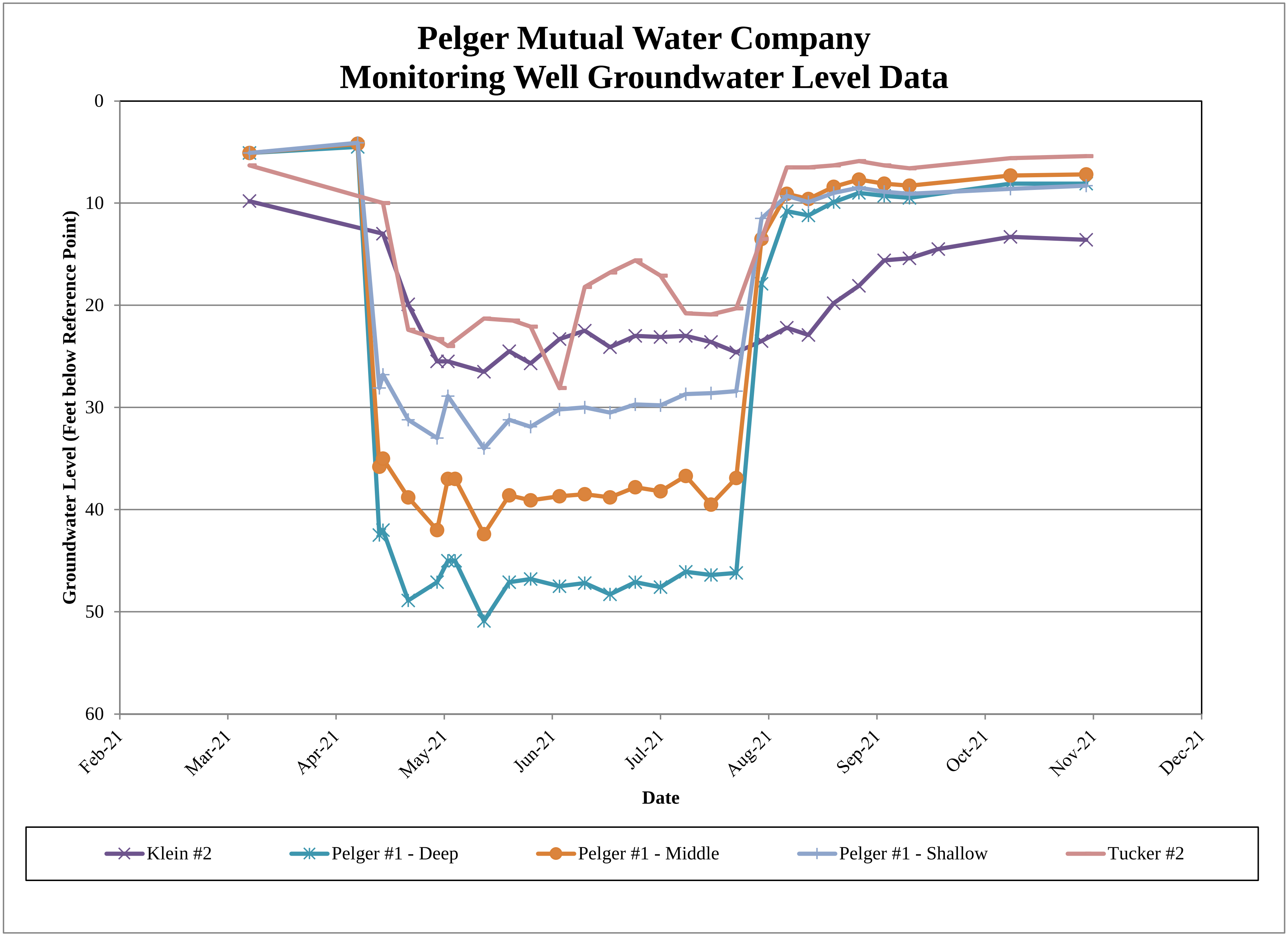

Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
Bryte Bend
Elkhorn MW-1
Elkhorn MW-2
L-5
Morrison MW 2
OSE-1
Rice Road MW - 1055
Rice Road MW - 245
Rice Road MW - 440

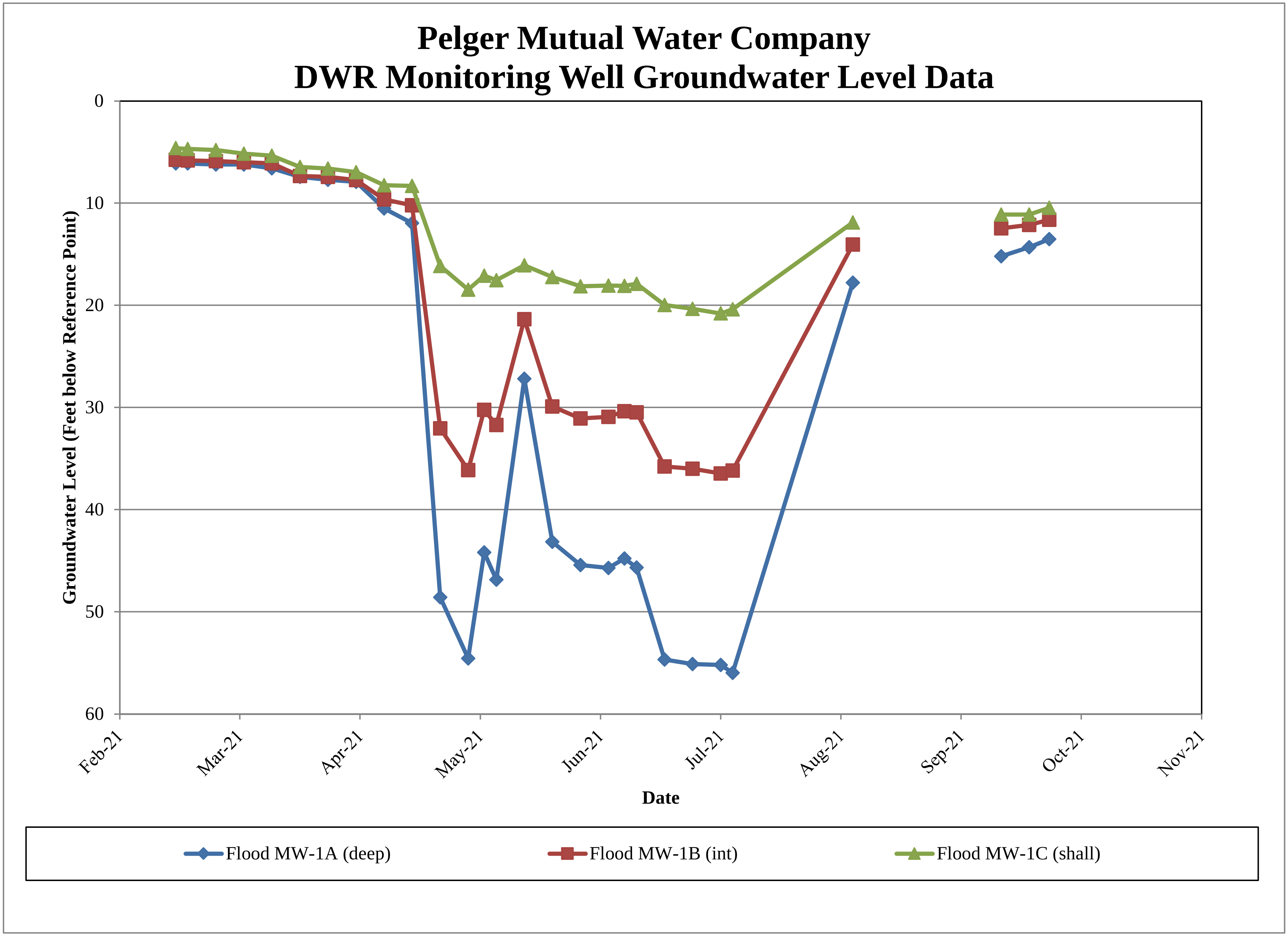

Natomas Central Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
TNBC MW
L-15
L MW1 - 250
L MW1 - 330
L MW1 - 410
Bianchi MW
TNBC Silva MW - 185
TNBC Silva MW - 295
TNBC Silva MW - 355

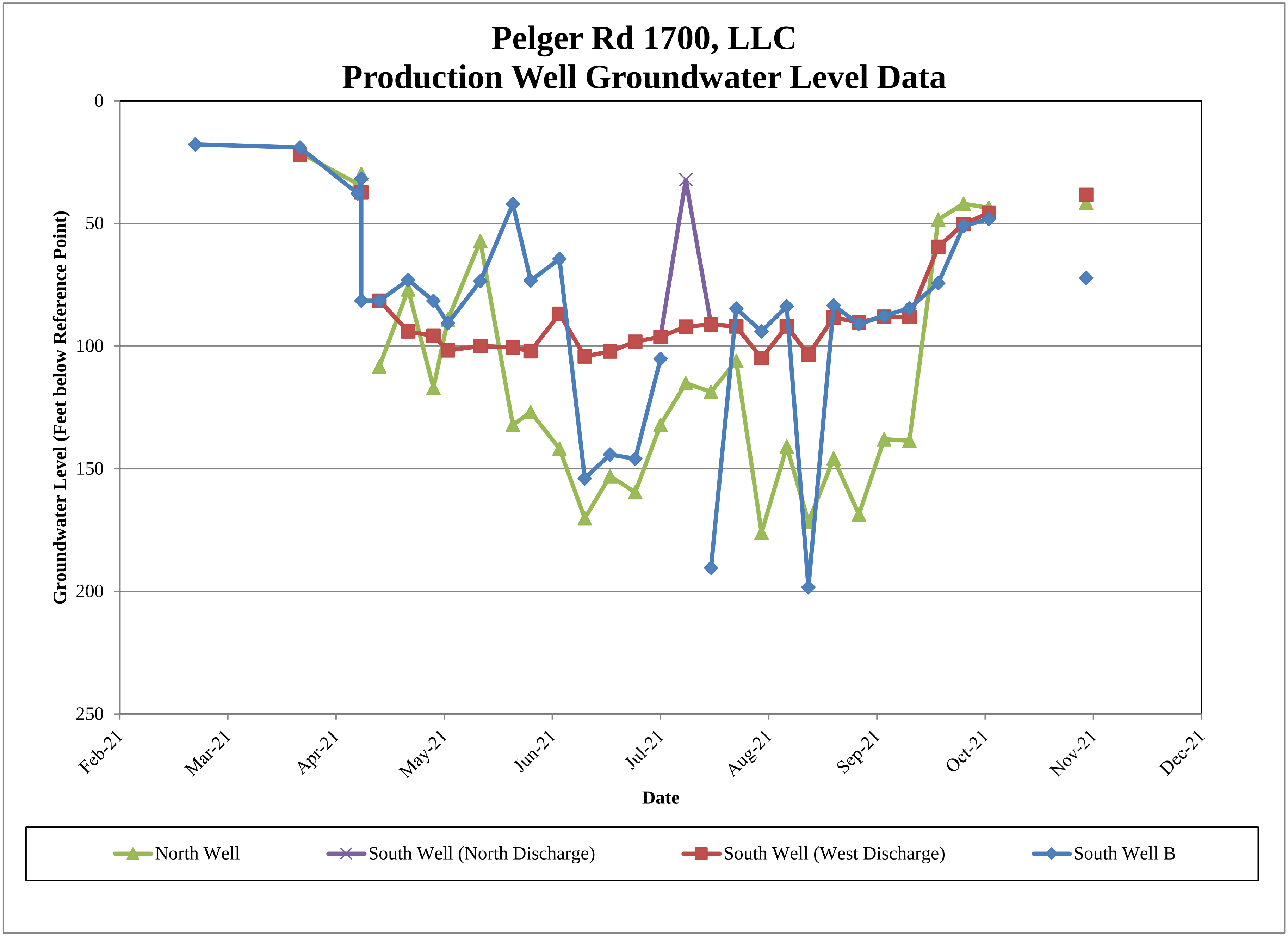

Natomas Central Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
AB-3 deep
AB-3 middle
AB-3 shallow
AB-4 deep
AB-4 middle-deep
AB-4 middle-shallow
AB-4 shallow
SAFCA-FISH 1

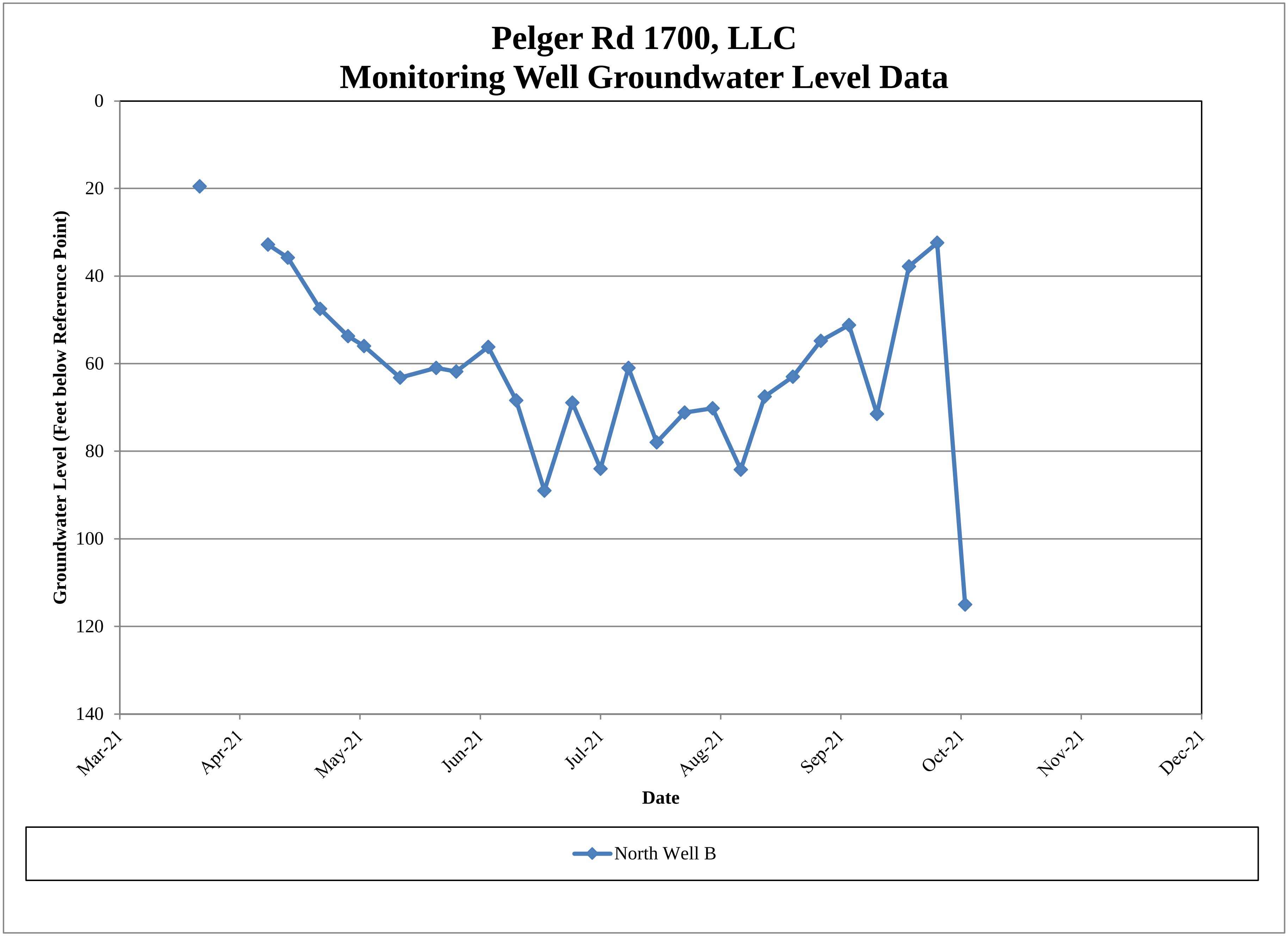


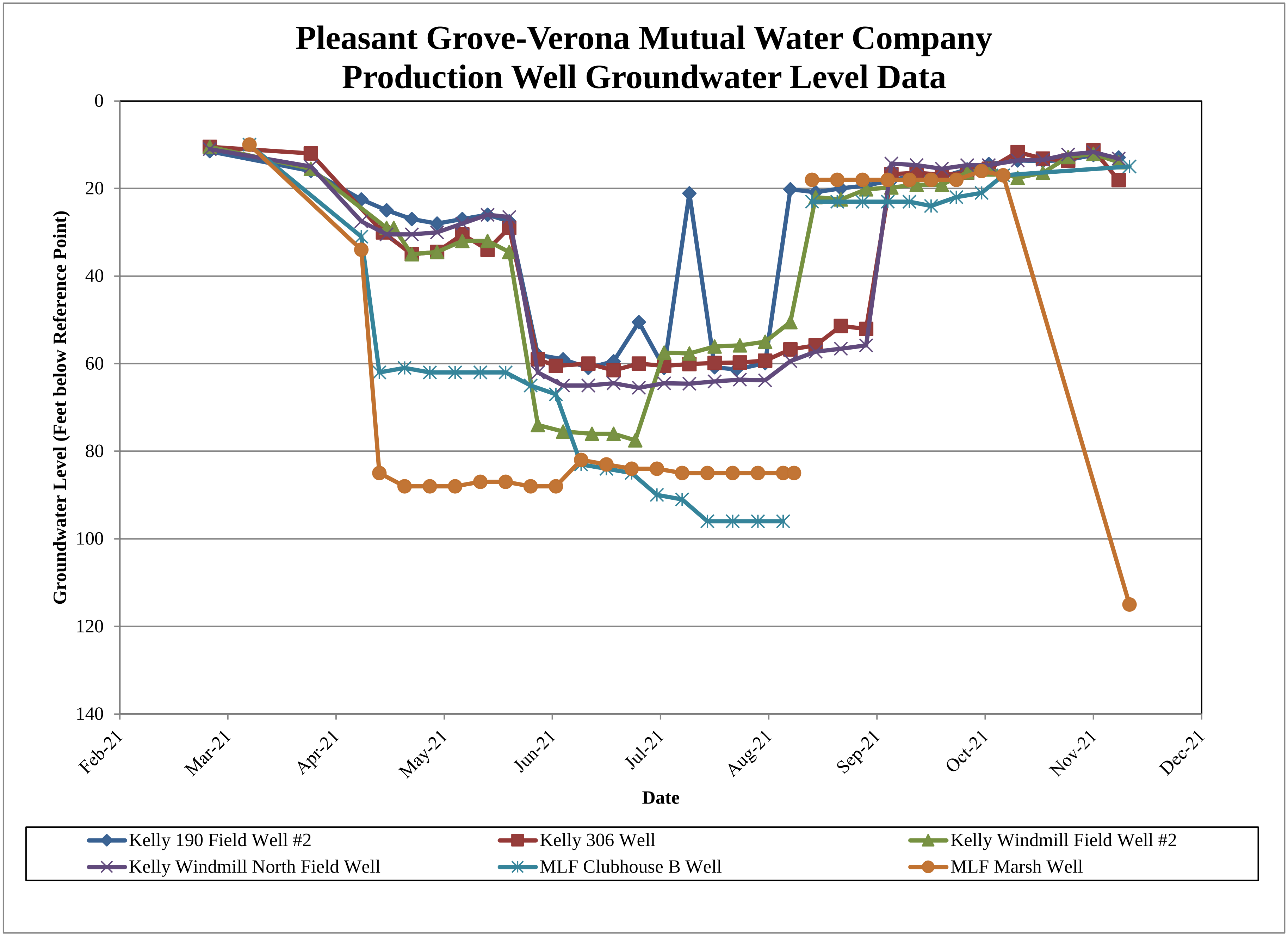
Pelger Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
PMWC #1
Well 1 (Tucker)
Well 2 (Flopet)
Well 3 (Klein)


Pelger Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
Klein #2
Pelger #1 - Deep
Pelger #1 - Middle
Pelger #1 - Shallow
Tucker #2

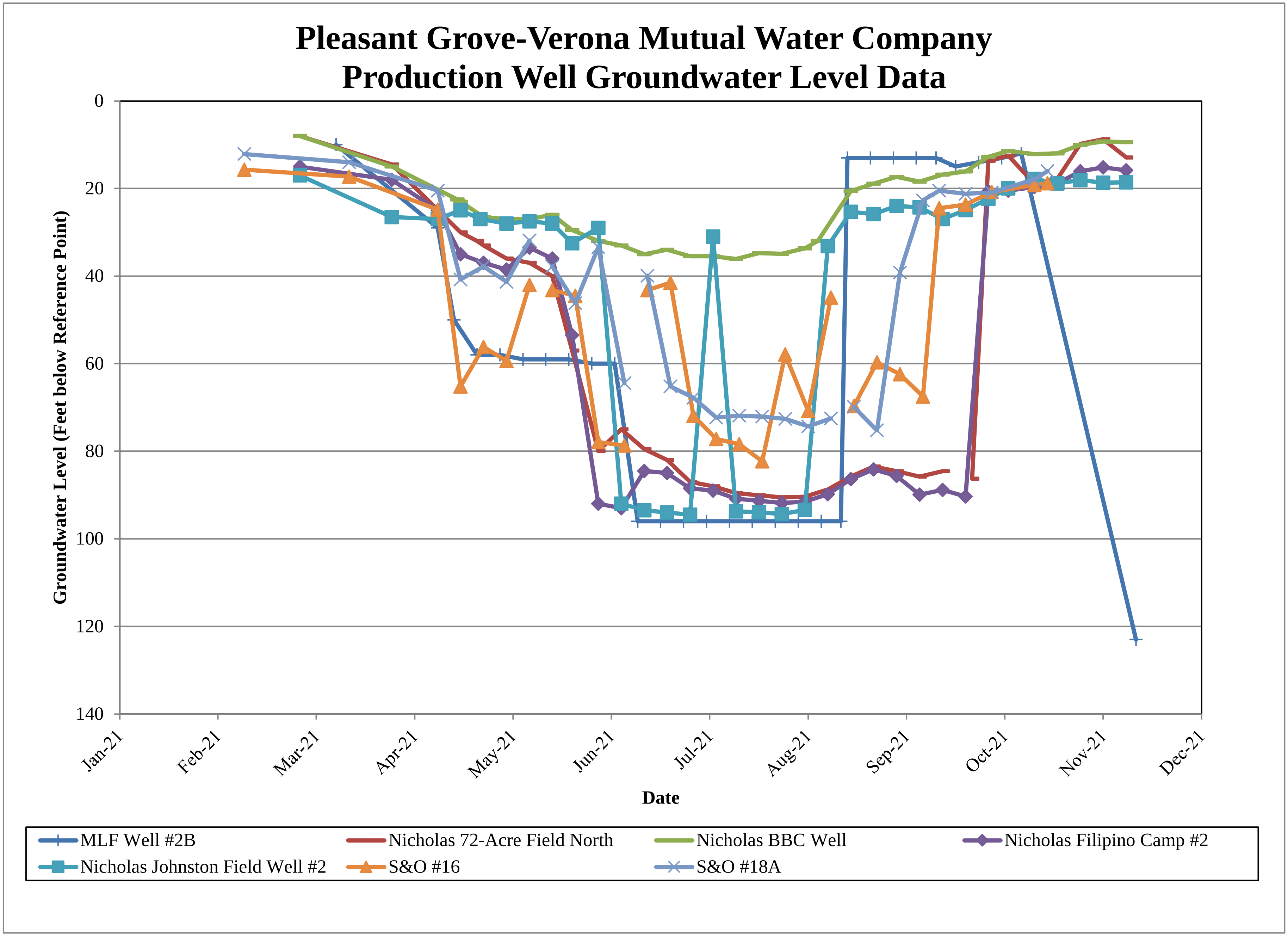

Pelger Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Date
Flood MW-1A (deep)
Flood MW-1B (int)
Flood MW-1C (shall)

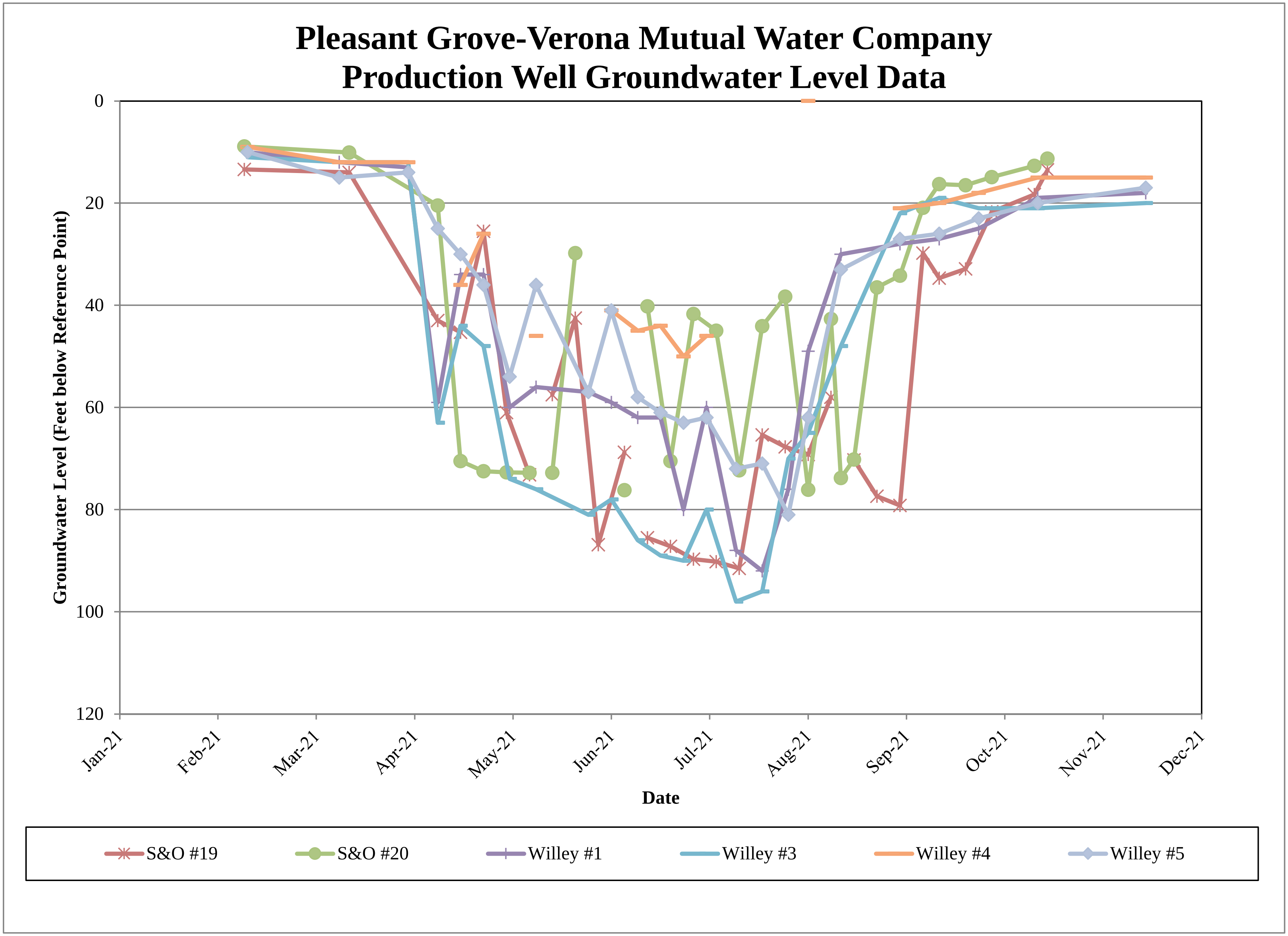

Pelger Rd 1700, LLC
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
North Well
South Well (North Discharge)
South Well (West Discharge)
South Well B


Pelger Rd 1700, LLC
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
North Well B

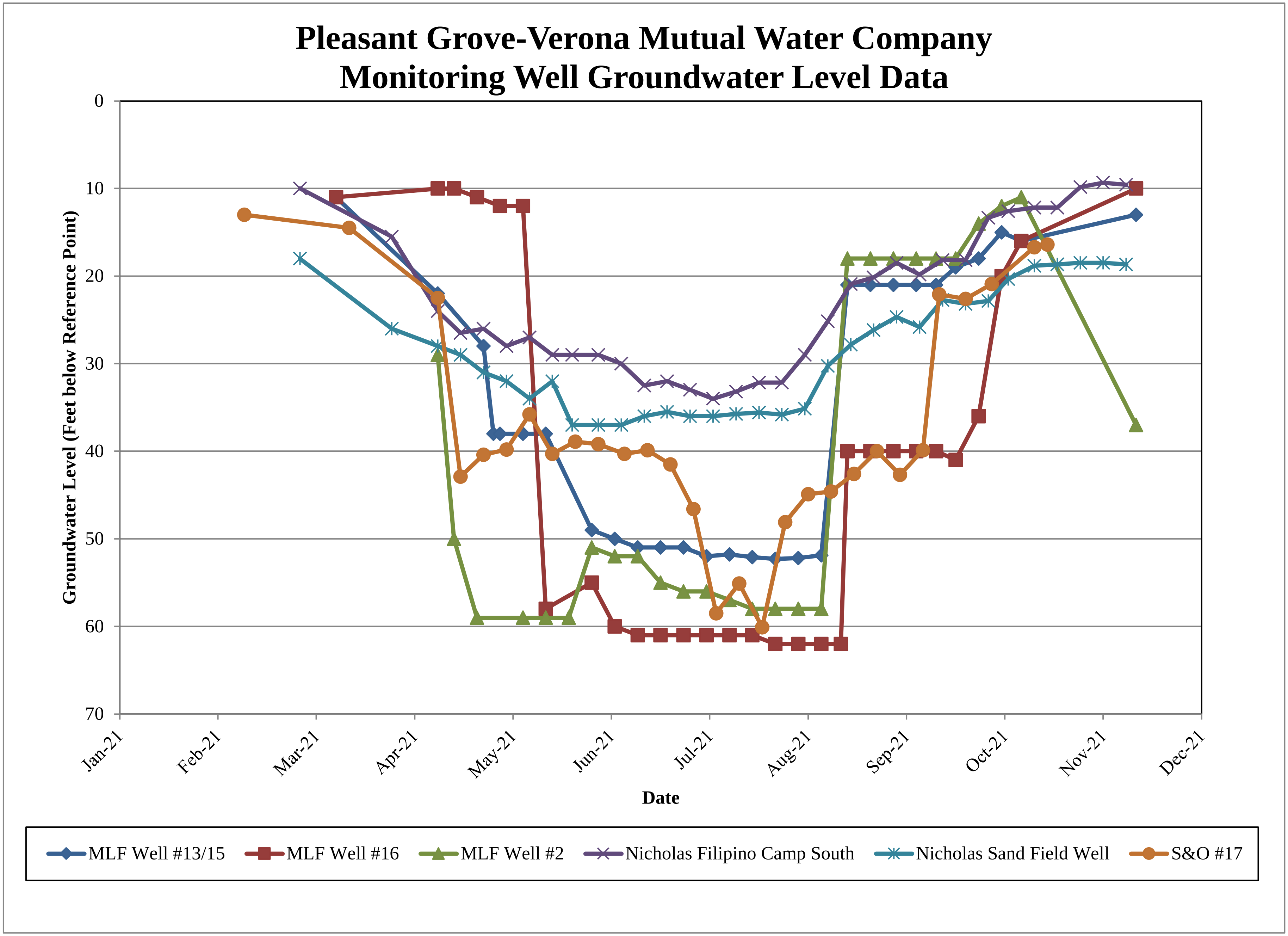


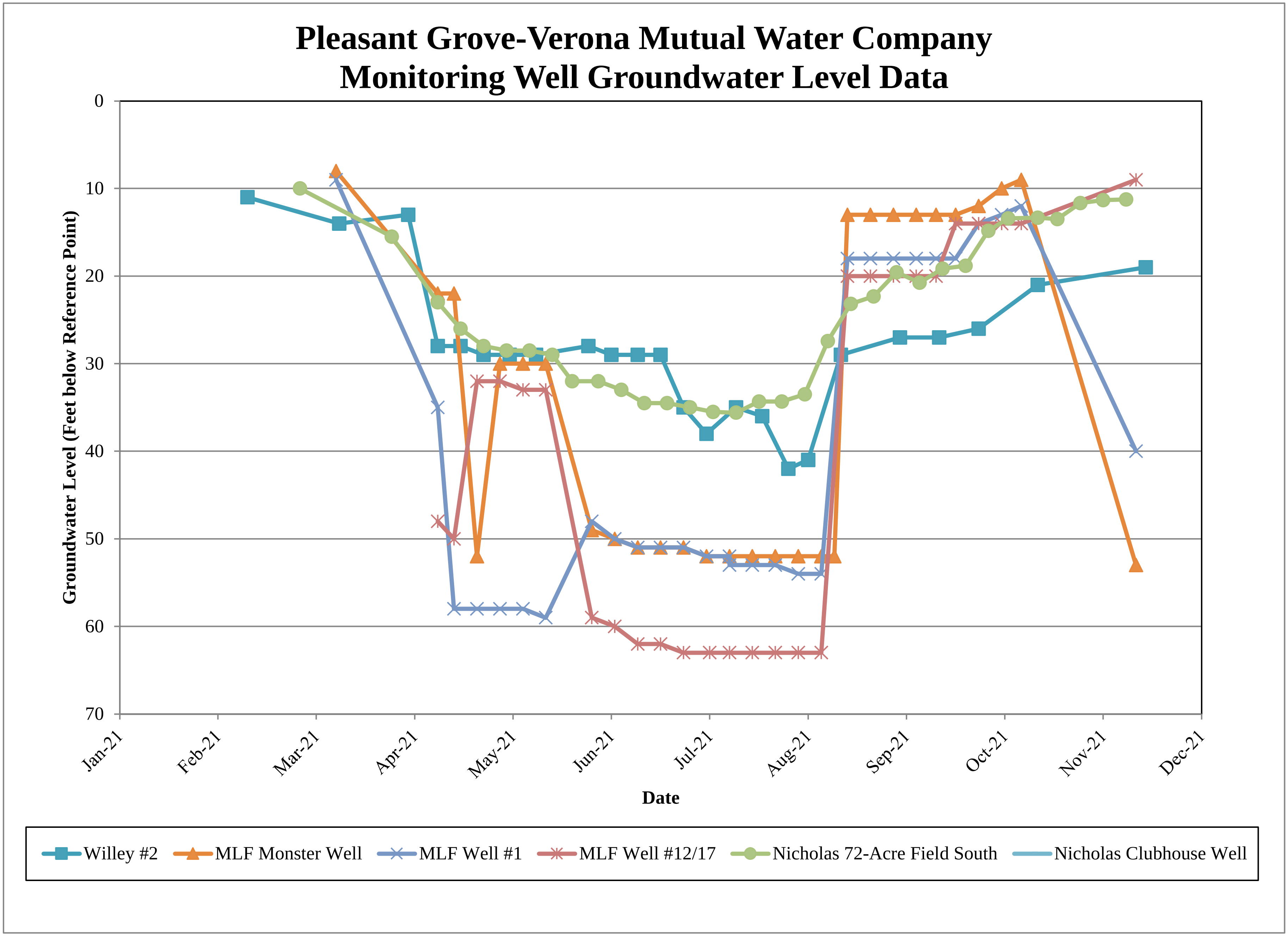
Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
Kelly 190 Field Well #2
Kelly 306 Well
Kelly Windmill Field Well #2
Kelly Windmill North Field Well
MLF Clubhouse B Well
MLF Marsh Well

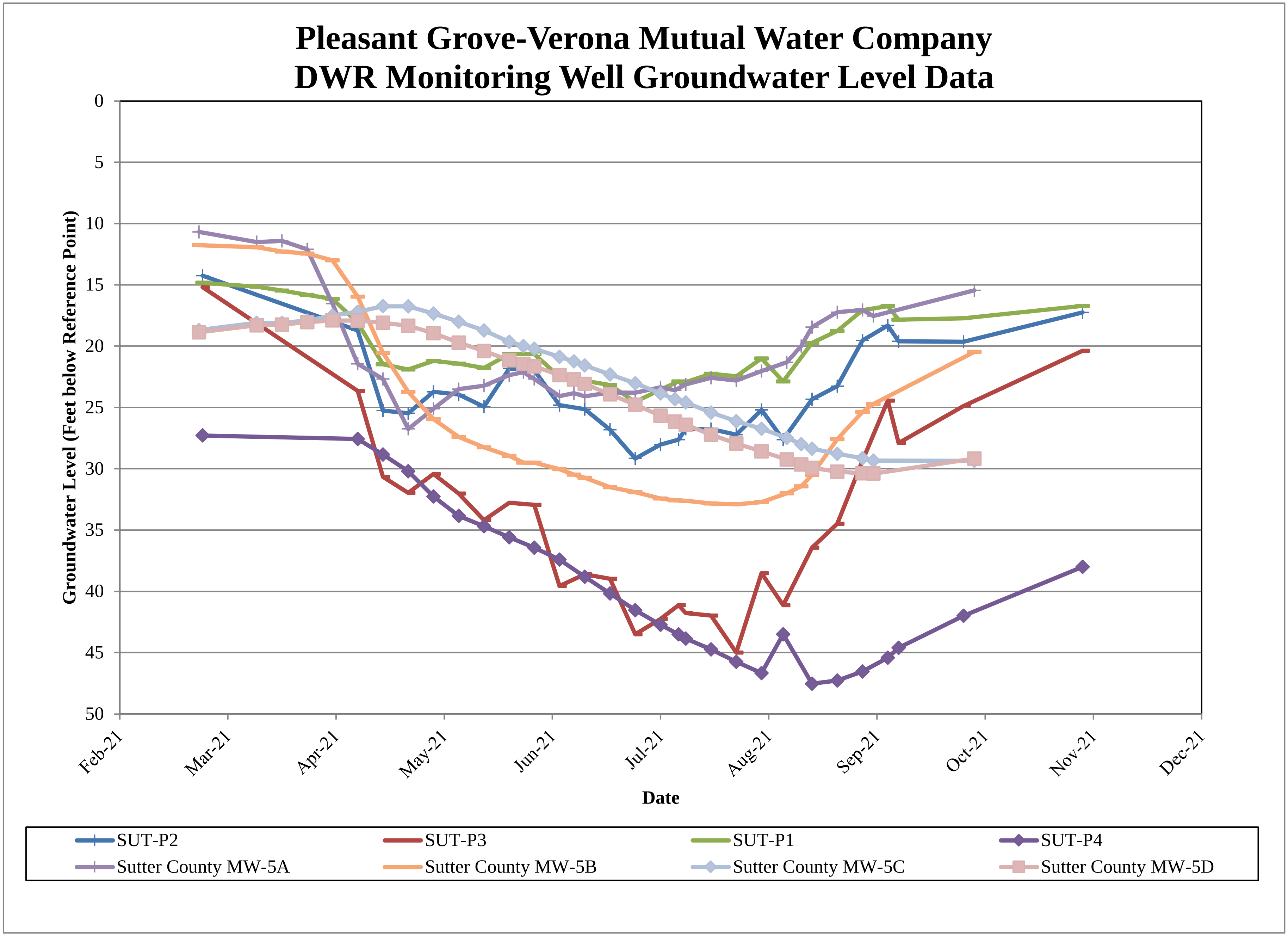

Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
MLF Well #2B
Nicholas 72-Acre Field North
Nicholas BBC Well
Nicholas Filipino Camp #2
Nicholas Johnston Field Well #2
S&O #16
S&O #18A



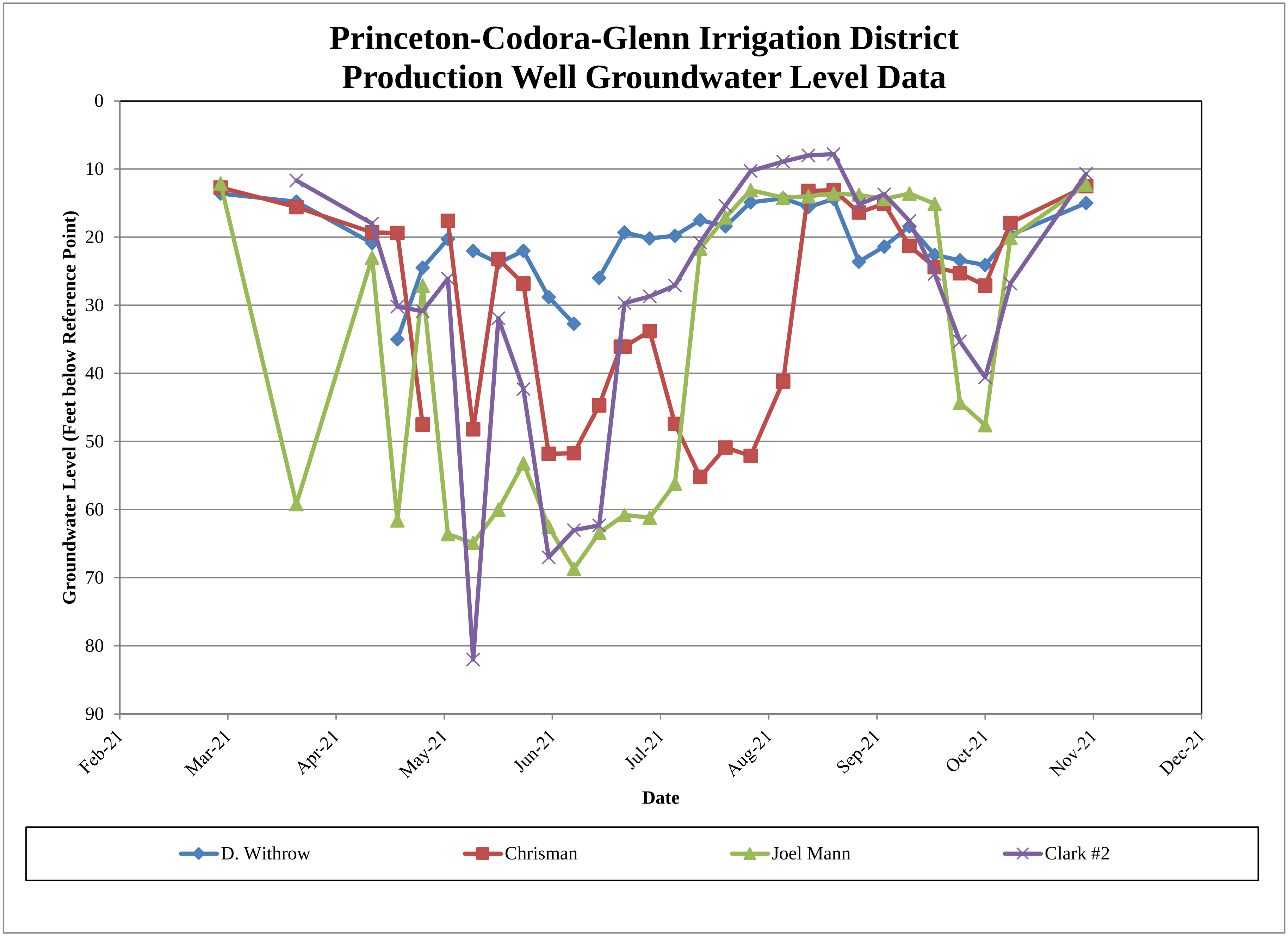
Pleasant Grove-Verona Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
S&O #19
S&O #20
Willey #1
Willey #3
Willey #4
Willey #5


Pleasant Grove-Verona Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
MLF Well #13/15
MLF Well #16
MLF Well #2
Nicholas Filipino Camp South
Nicholas Sand Field Well
S&O #17

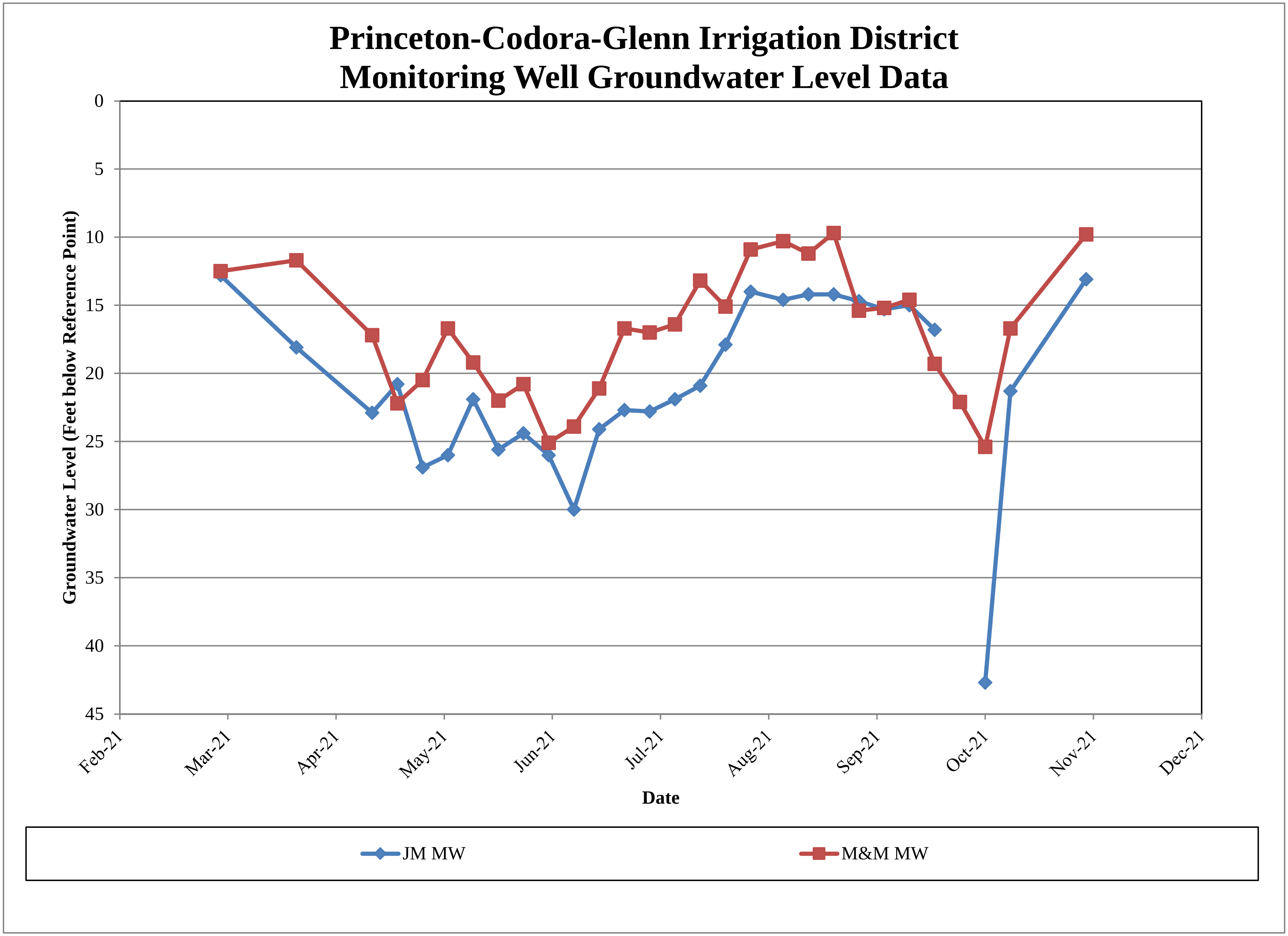

Pleasant Grove-Verona Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
Willey #2
MLF Monster Well
MLF Well #1
MLF Well #12/17
Nicholas 72-Acre Field South
Nicholas Clubhouse Well



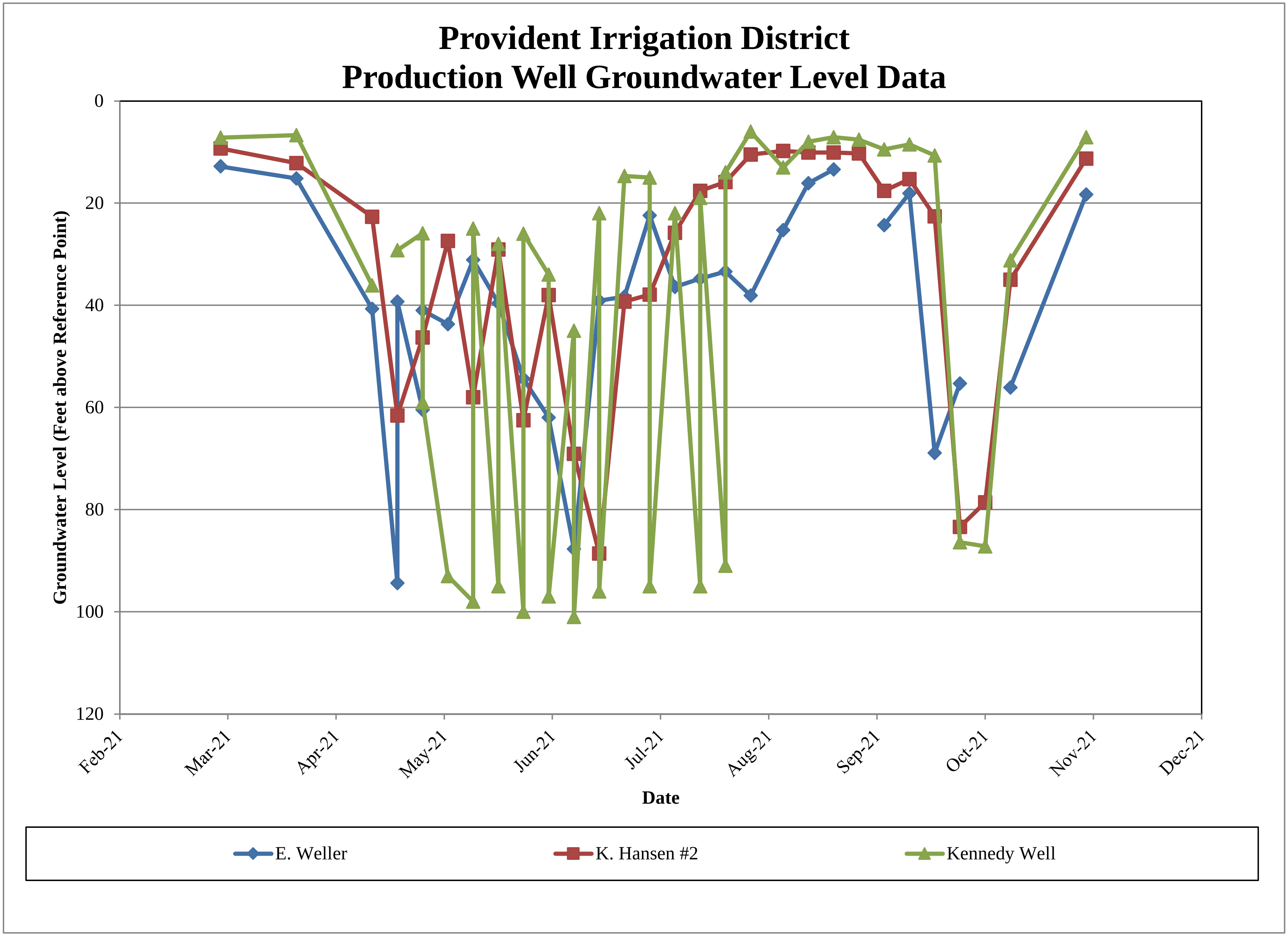
Pleasant Grove-Verona Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
5
10
15
20
25
30
35
40
45
50
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
SUT-P2
SUT-P3
SUT-P1
SUT-P4
Sutter County MW-5A
Sutter County MW-5B
Sutter County MW-5C
Sutter County MW-5D



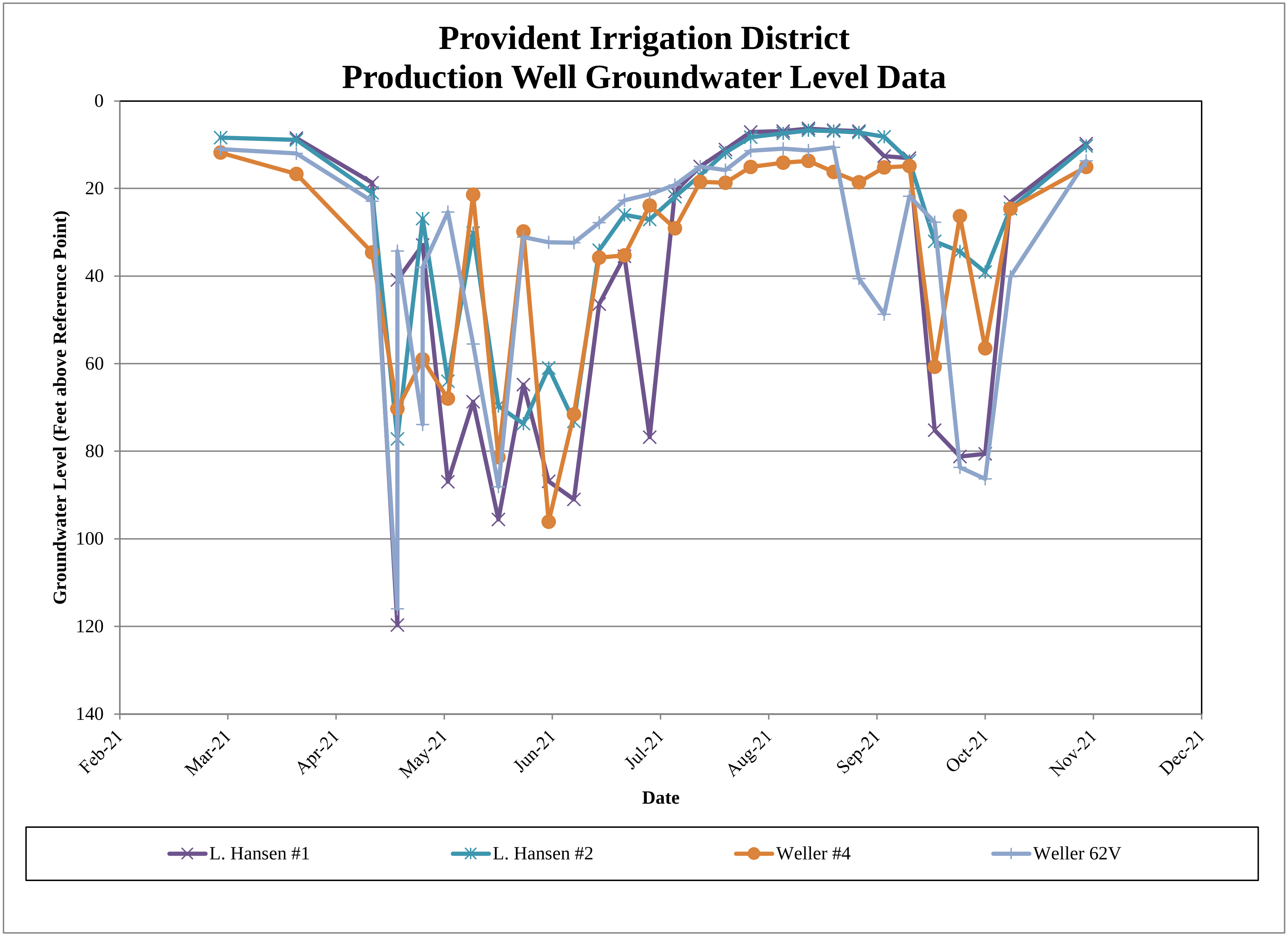
Princeton-Codora-Glenn Irrigation District
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
D. Withrow
Chrisman
Joel Mann
Clark #2

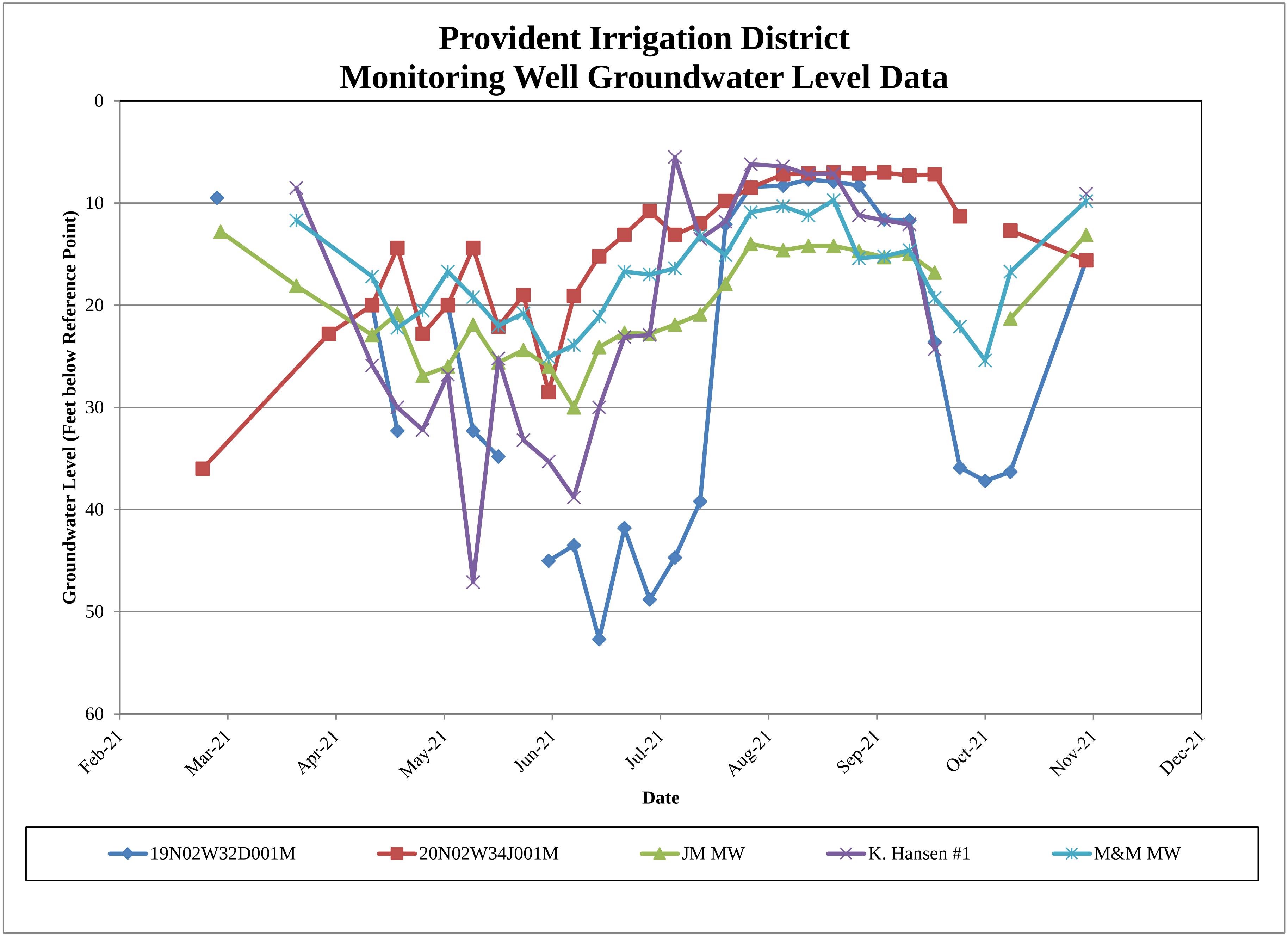


Princeton-Codora-Glenn Irrigation District
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
5
10
15
20
25
30
35
40
45
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
JM MW
M&M MW

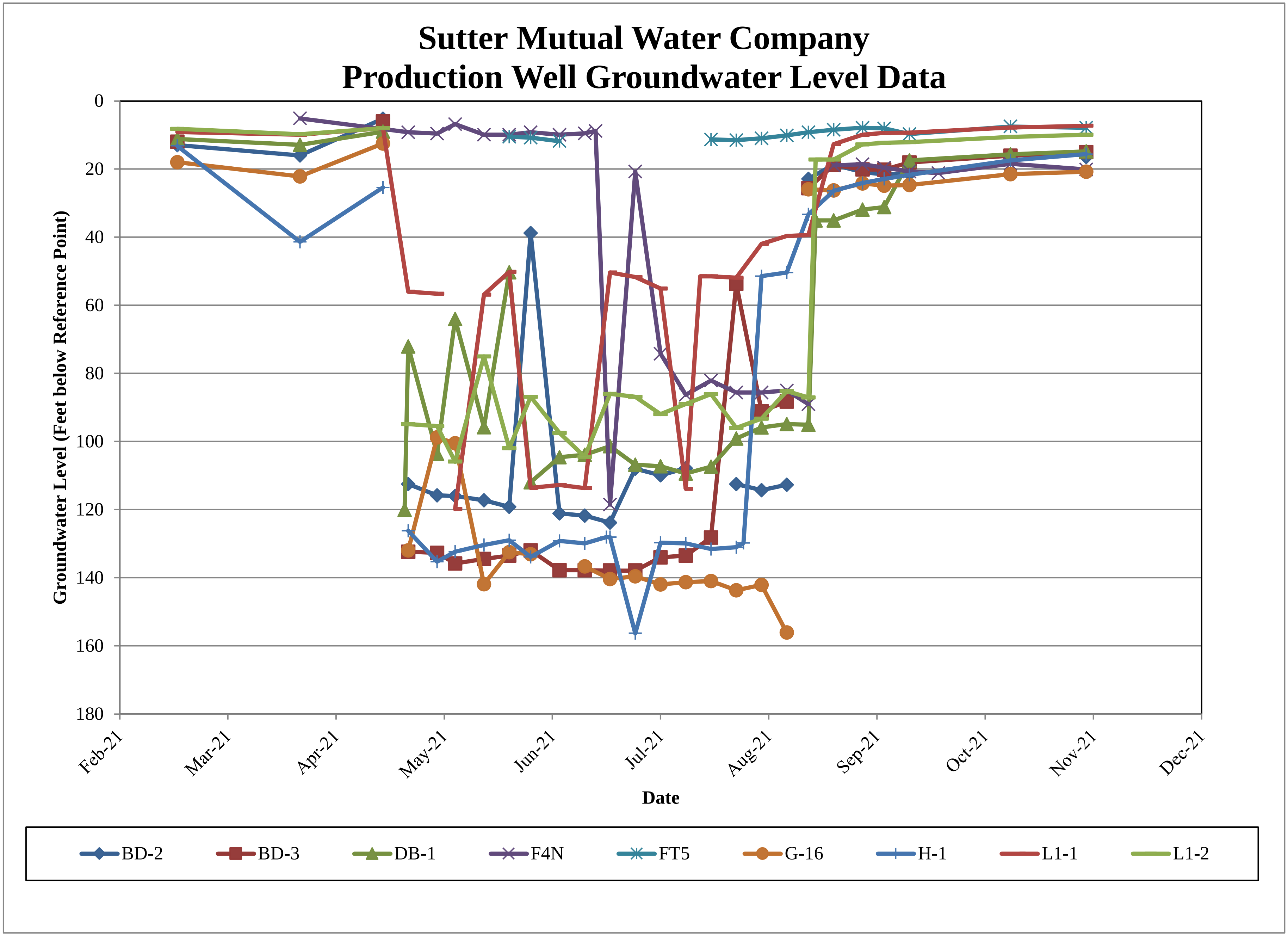


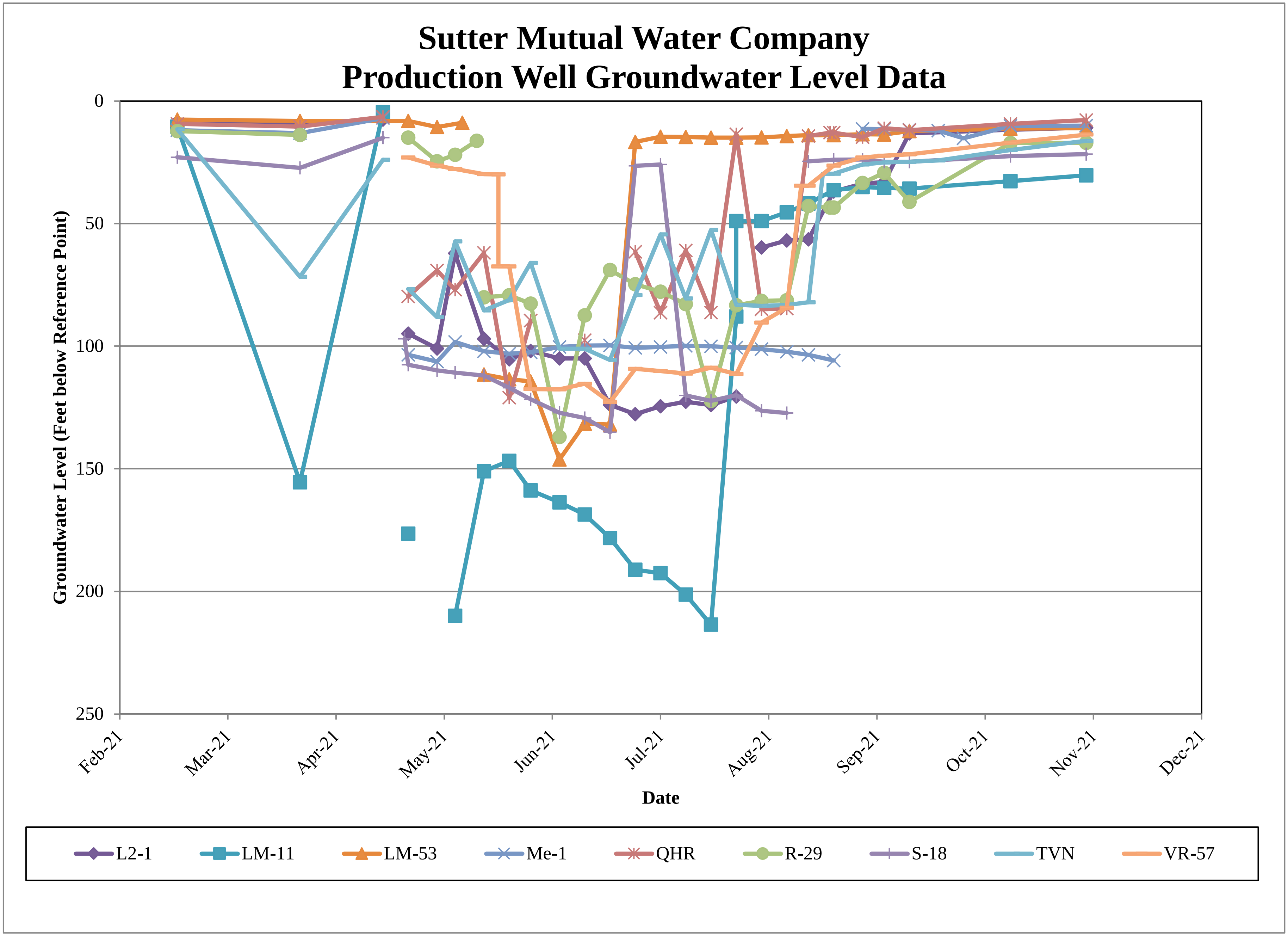
Provident Irrigation District
Production Well Groundwater Level Data
Groundwater Level (Feet above Reference Point)
0
20
40
60
80
100
120
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
E. Weller
K. Hansen #2
Kennedy Well


Provident Irrigation District
Production Well Groundwater Level Data
Groundwater Level (Feet above Reference Point)
0
20
40
60
80
100
120
140
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
L. Hansen #1
L. Hansen #2
Weller #4
Weller 62V

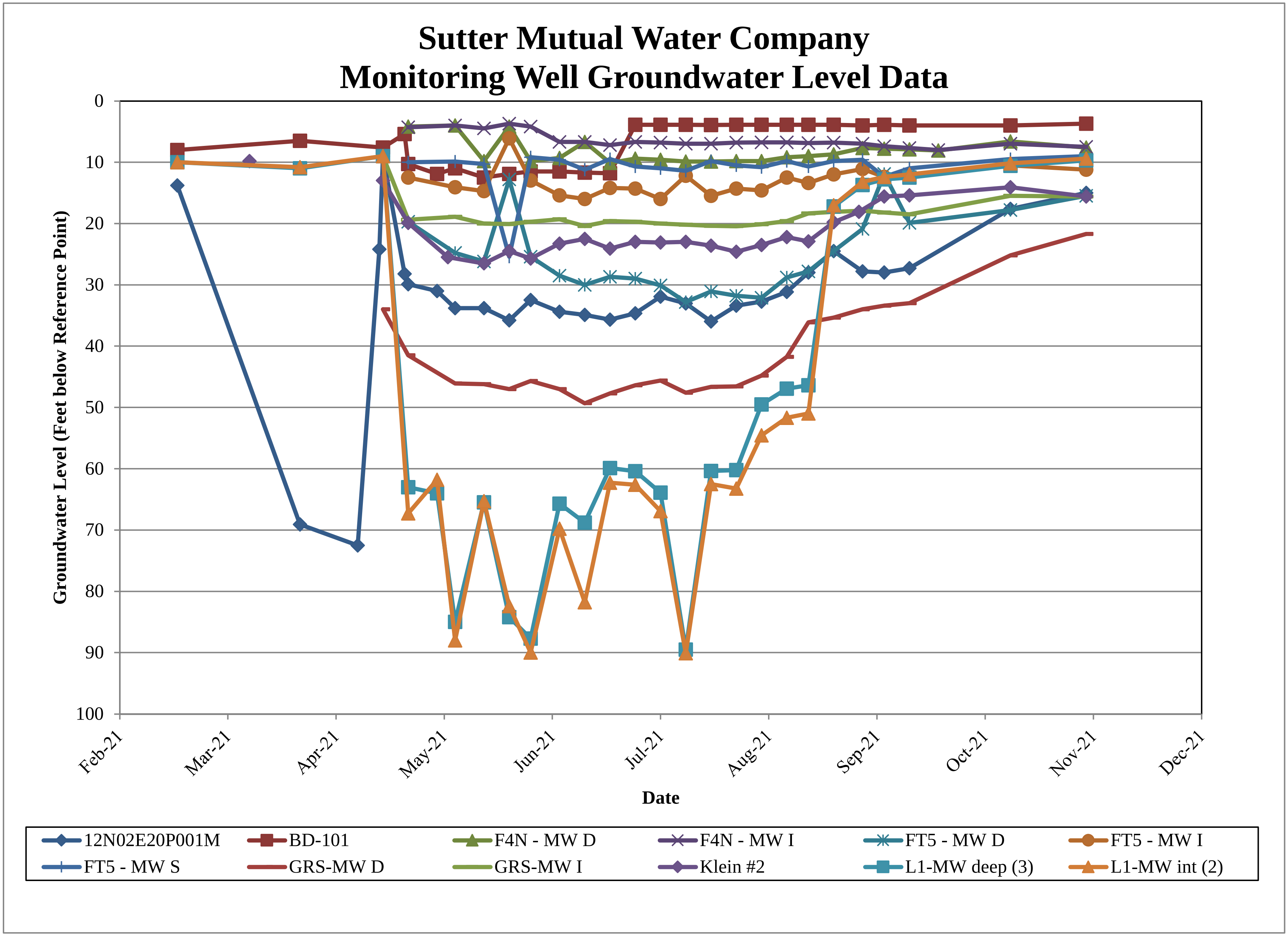


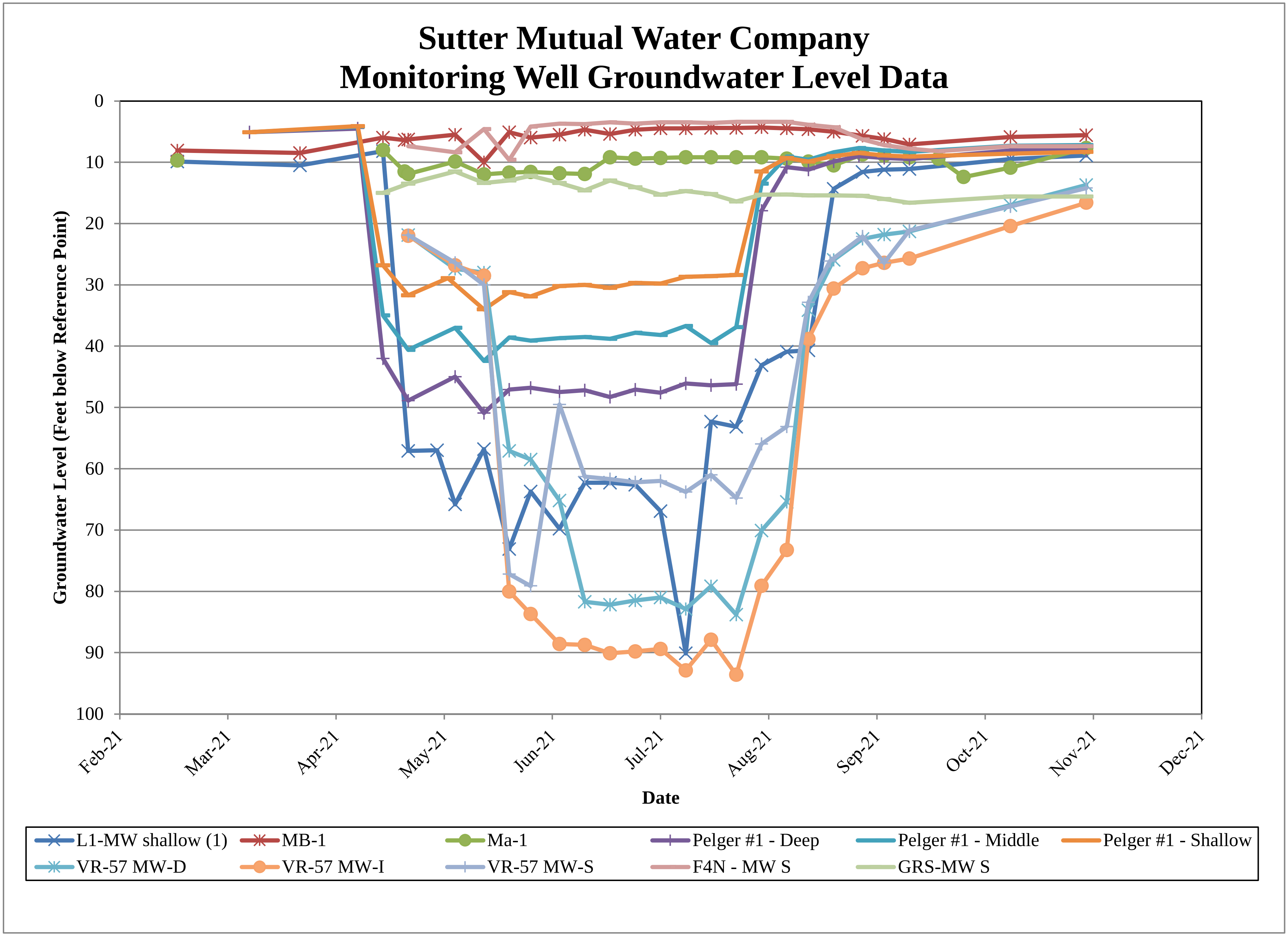
Provident Irrigation District
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
19N02W32D001M
20N02W34J001M
JM MW
K. Hansen #1
M&M MW


Sutter Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
140
160
180
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
BD-2
BD-3
DB-1
F4N
FT5
G-16
H-1
L1-1
L1-2

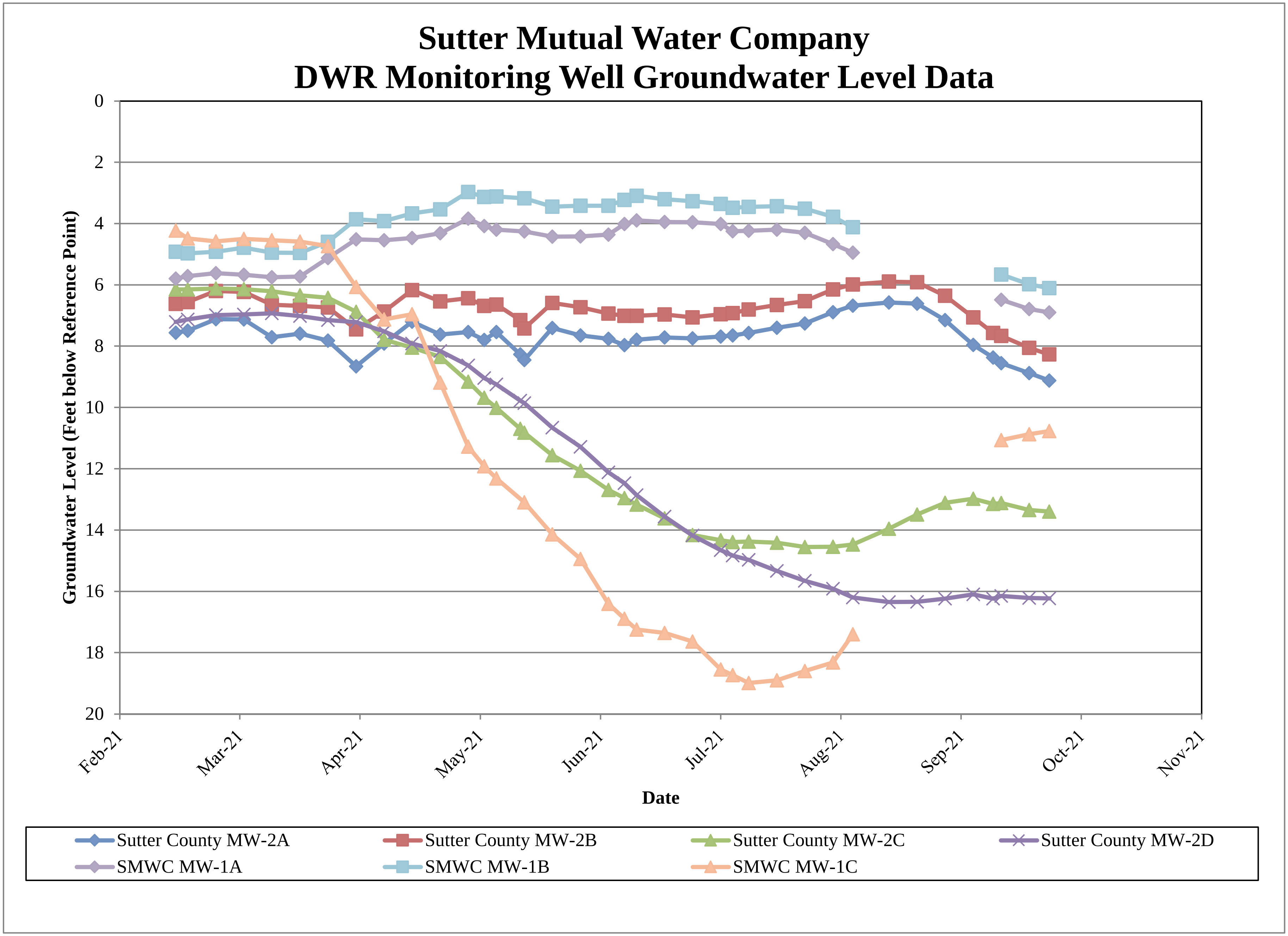


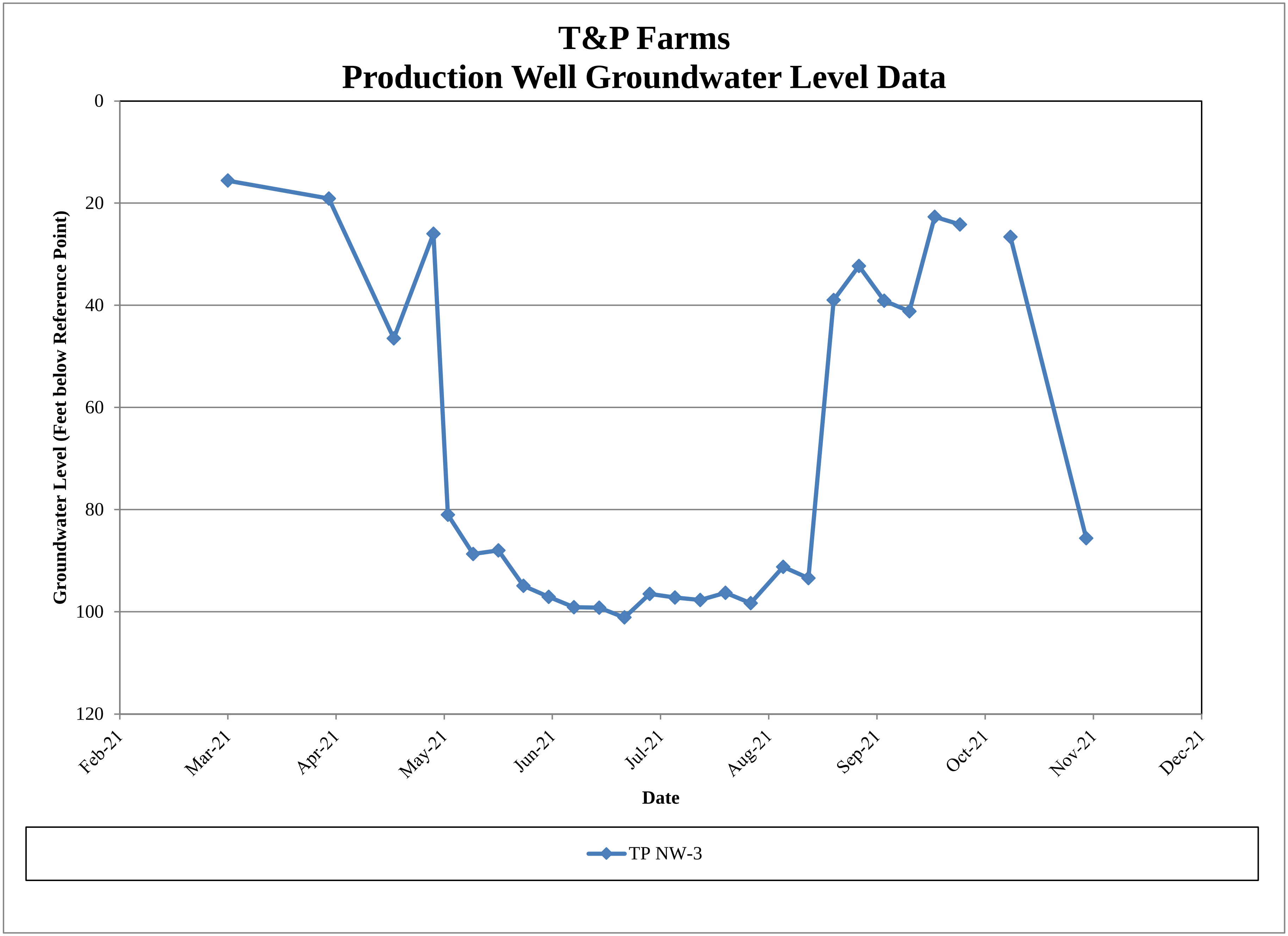
Sutter Mutual Water Company
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
L2-1
LM-11
LM-53
Me-1
QHR
R-29
S-18
TVN
VR-57

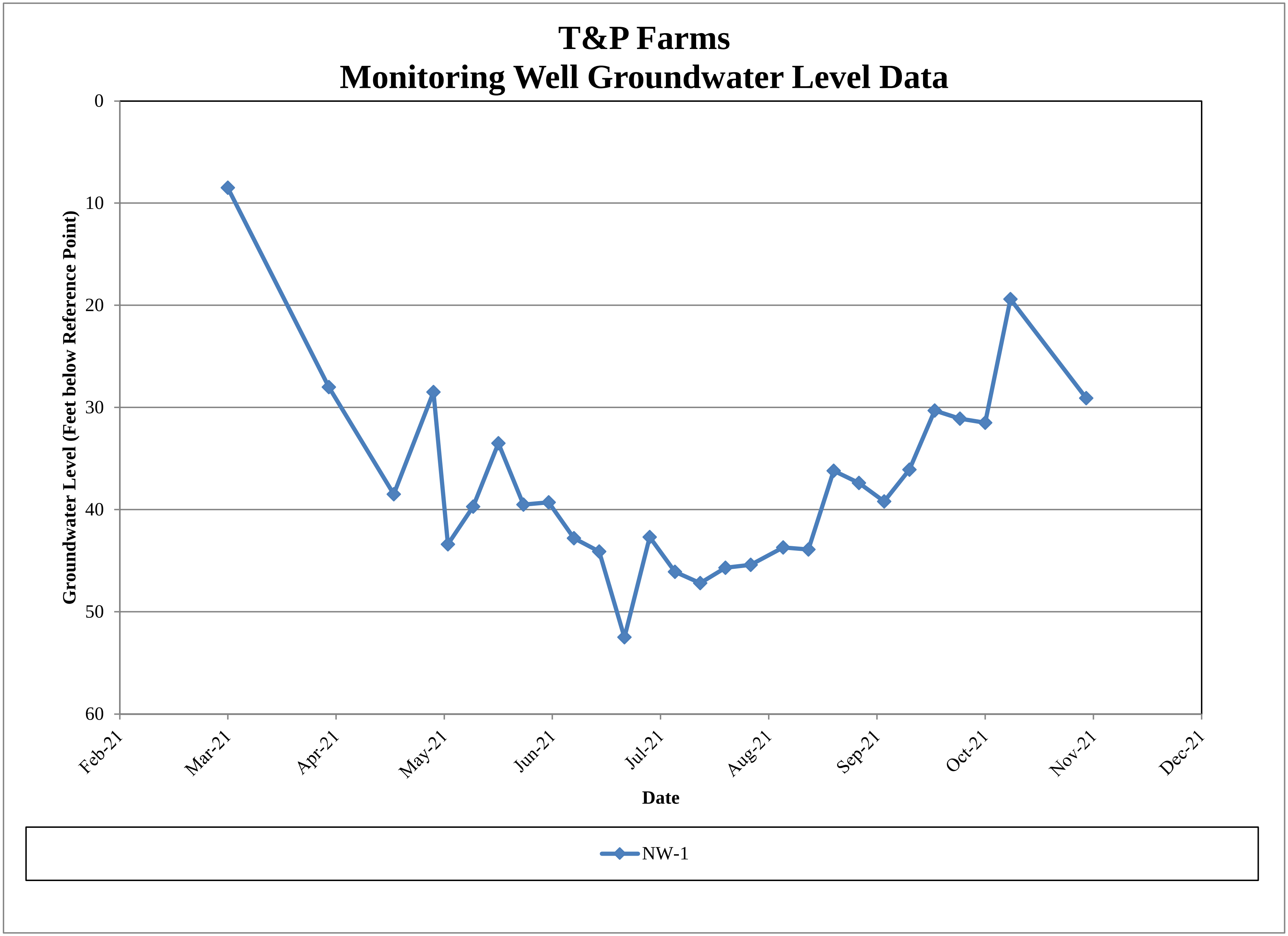

Sutter Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
100
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
12N02E20P001M
BD-101
F4N - MW D
F4N - MW I
FT5 - MW D
FT5 - MW I
FT5 - MW S
GRS-MW D
GRS-MW I
Klein #2
L1-MW deep (3)
L1-MW int (2)

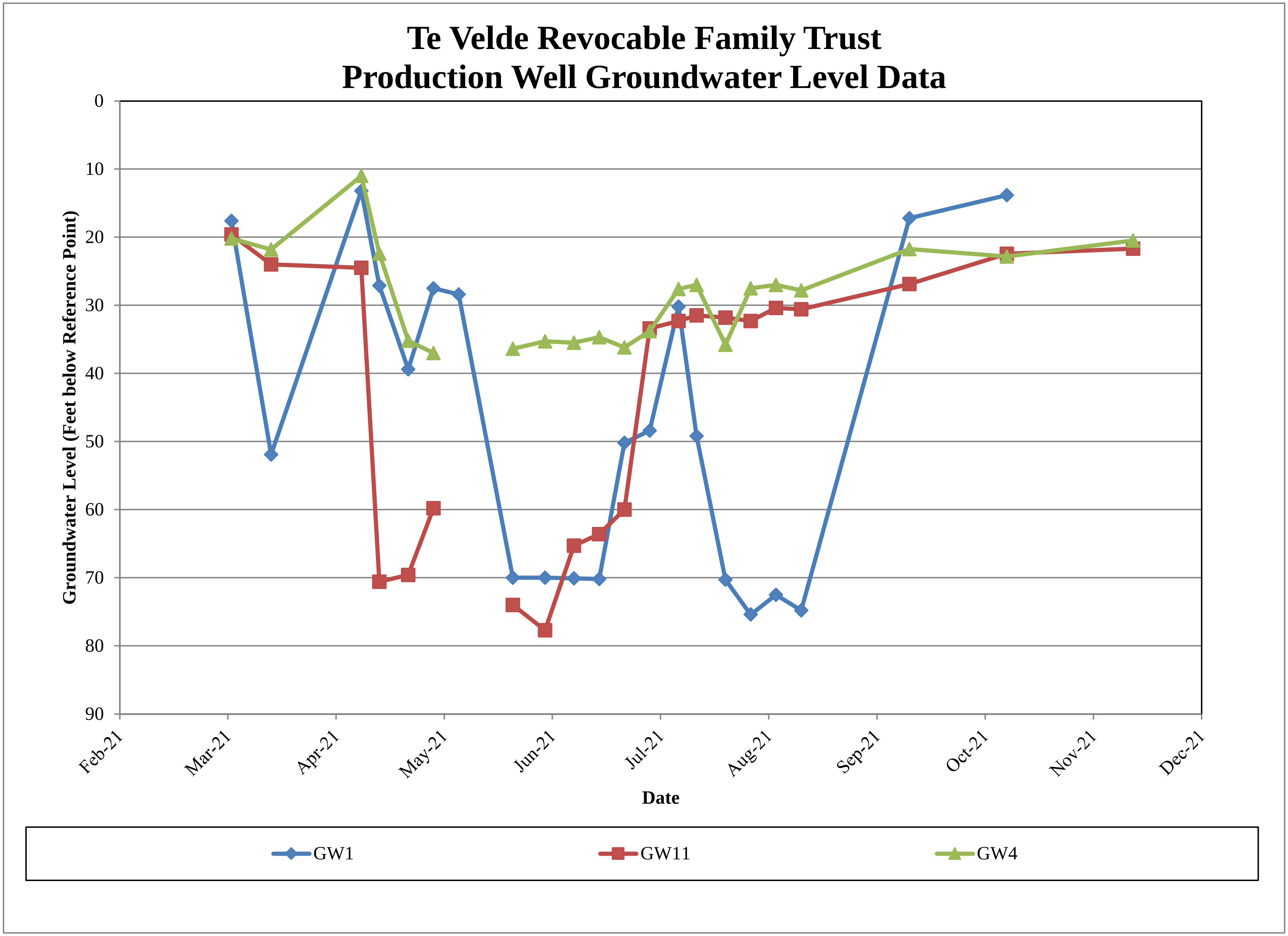


Sutter Mutual Water Company
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
100
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
L1-MW shallow (1)
MB-1
Ma-1
Pelger #1 - Deep
Pelger #1 - Middle
Pelger #1 - Shallow
VR-57 MW-D
VR-57 MW-I
VR-57 MW-S
F4N - MW S
GRS-MW S

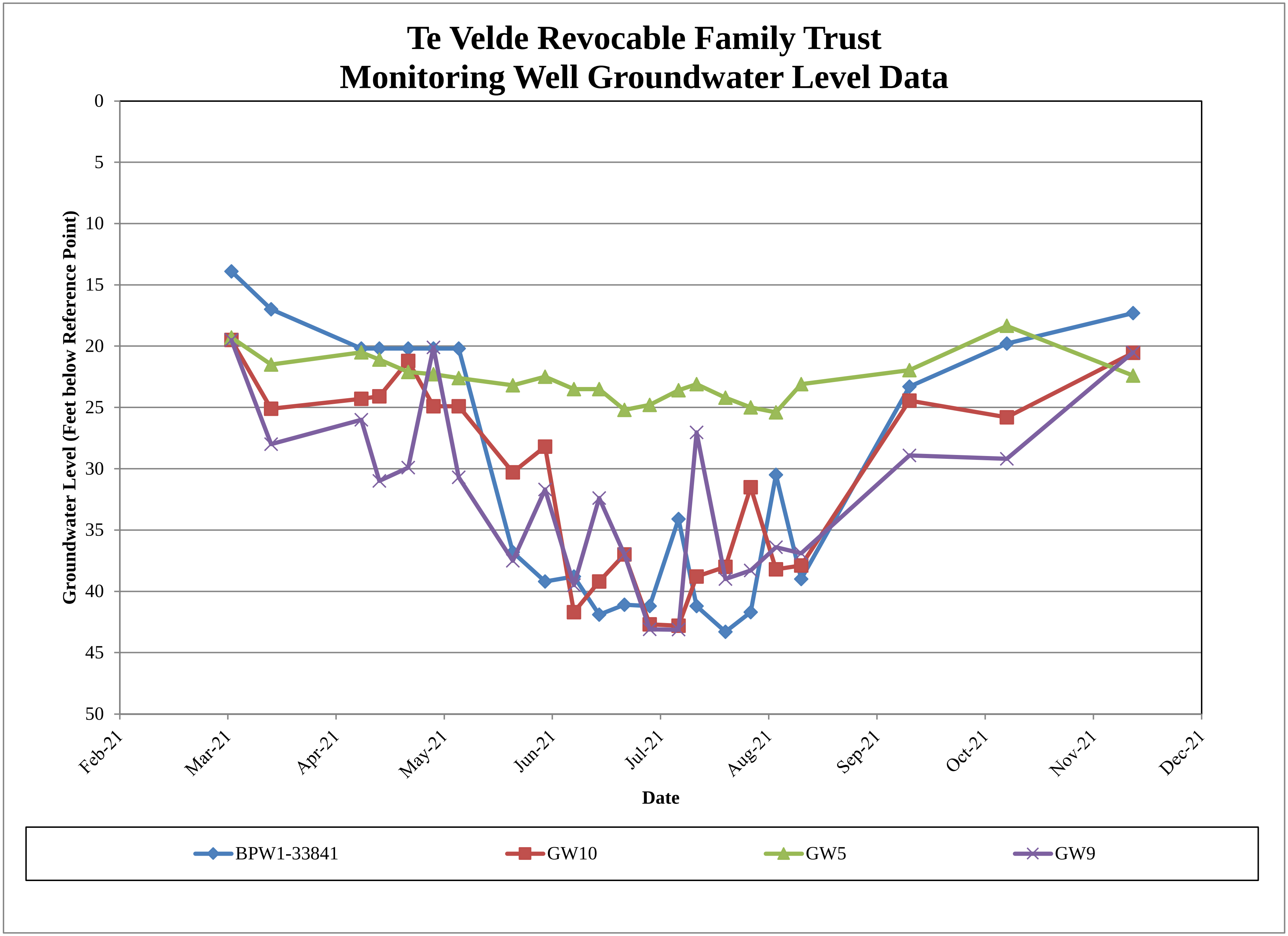

Sutter Mutual Water Company
DWR Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
2
4
6
8
10
12
14
16
18
20
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Date
Sutter County MW-2A
Sutter County MW-2B
Sutter County MW-2C
Sutter County MW-2D
SMWC MW-1A
SMWC MW-1B
SMWC MW-1C

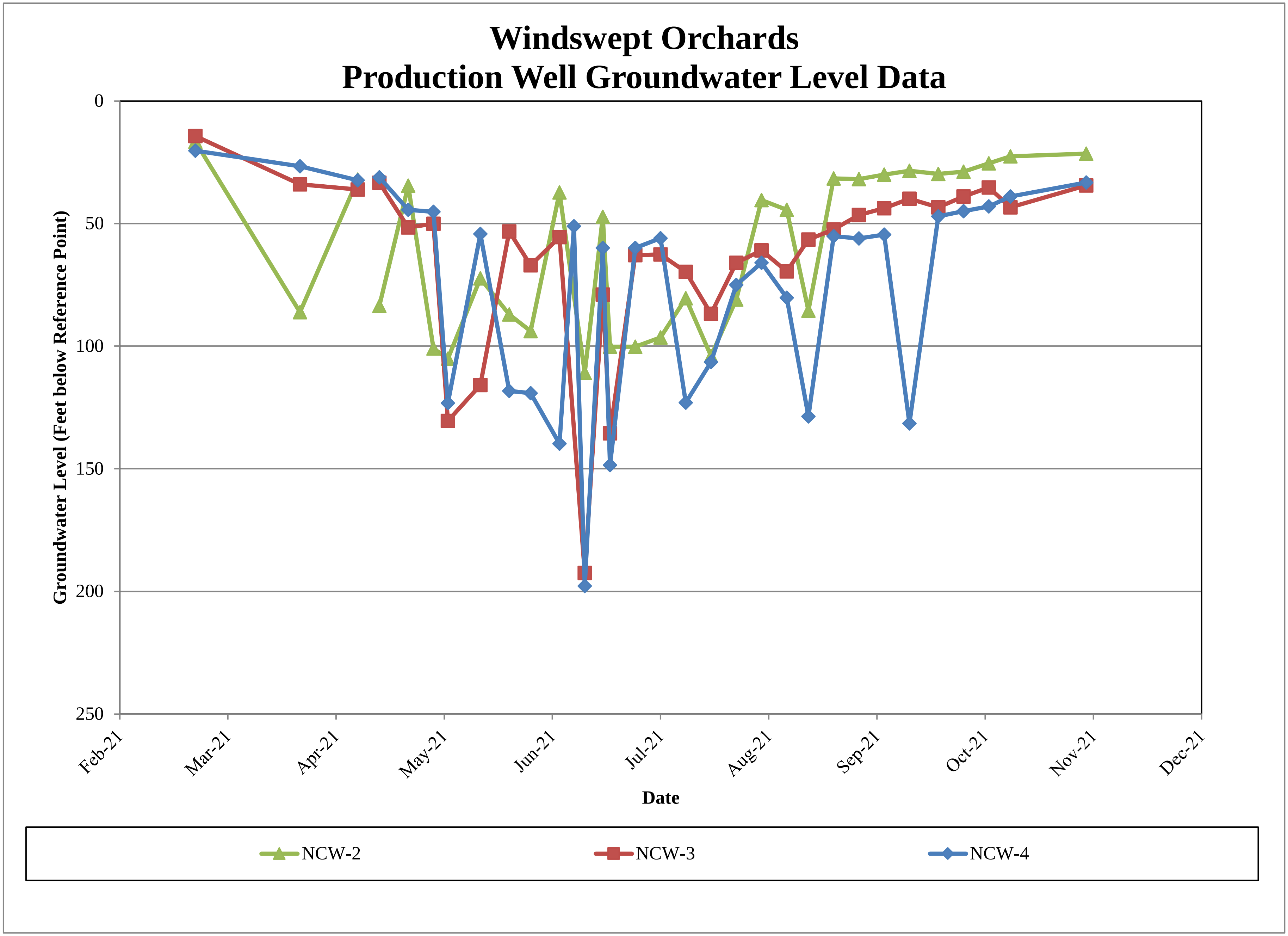

T&P Farms
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
20
40
60
80
100
120
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
TP NW-3

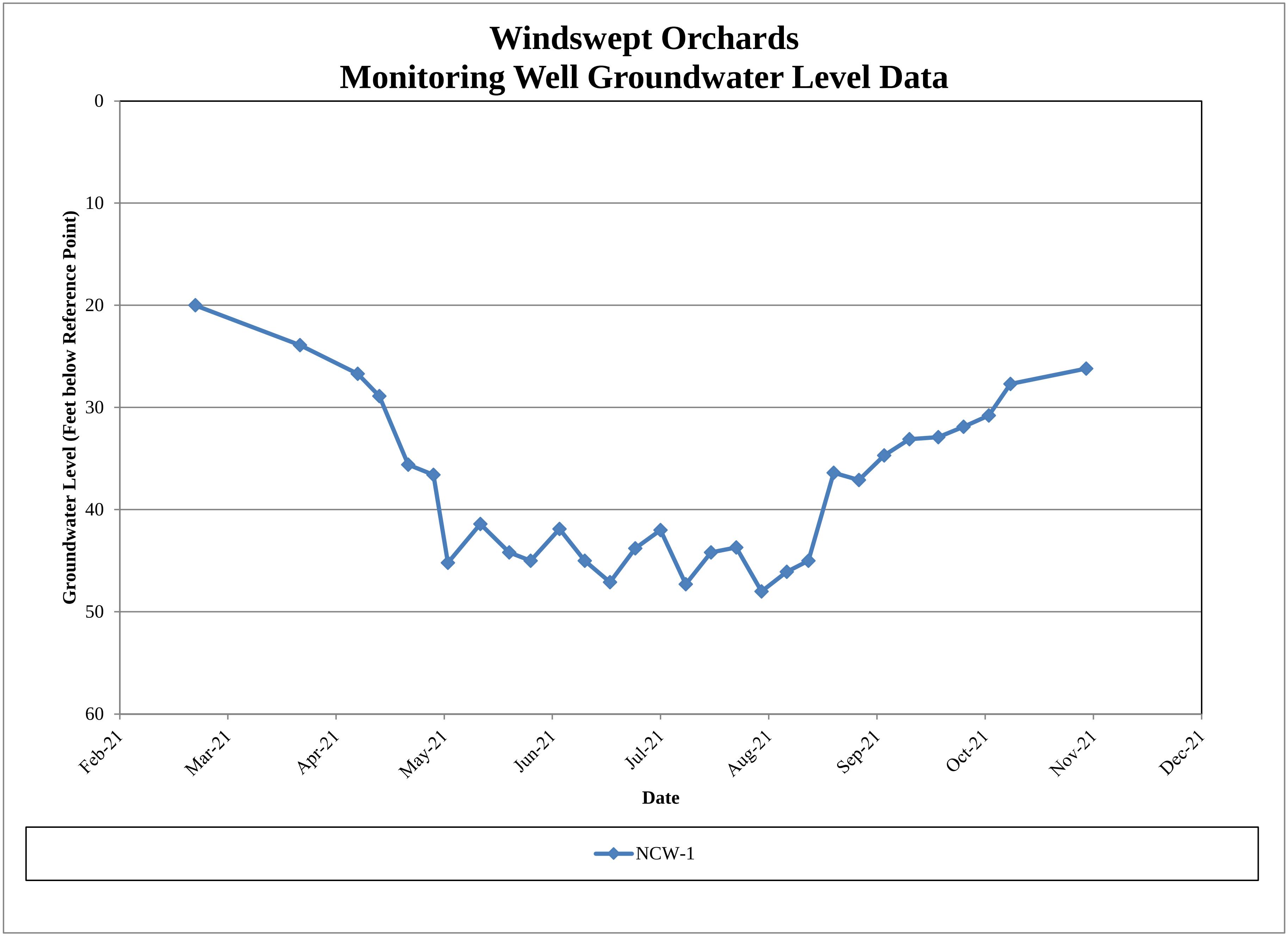

T&P Farms
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
NW-1



Te Velde Revocable Family Trust
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
70
80
90
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
GW1
GW11
GW4


Te Velde Revocable Family Trust
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
5
10
15
20
25
30
35
40
45
50
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
BPW1-33841
GW10
GW5
GW9


Windswept Orchards
Production Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
50
100
150
200
250
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
NCW-2
NCW-3
NCW-4



Windswept Orchards
Monitoring Well Groundwater Level Data
Groundwater Level (Feet below Reference Point)
0
10
20
30
40
50
60
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Date
NCW-1

Appendix J

Cumulative Projects

Appendix J Cumulative Projects

This appendix provides an analysis of overall cumulative effects of the Proposed Action taken together with other past, present, and reasonably foreseeable probable future projects (or actions) as required by the National Environmental Policy Act (NEPA) implementing regulations (40 CFR, Section 1508.1(g)(1)) and California Environmental Quality Act (CEQA) Guidelines (Section 15063(d)(3) and Appendix G). The reasonably foreseeable probable future actions considered in this cumulative effects analysis are actions located within the Seller Service Area that have been identified as potentially having an effect on resources that also may be affected by the Proposed Action. This analysis follows applicable guidance provided by the Council on Environmental Quality (CEQ) in *Considering Cumulative Effects under the National Environmental Policy Act* (1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (*2005).

J.1 Cumulative Projects

The cumulative analysis considers other potential water transfers that could occur in the 2023 transfer season, including other Central Valley Project (CVP) water transfers, non-CVP water transfers, and additional water transfers. No construction projects within the Seller Service Area were analyzed. Table J-1 lists potential sellers, including those in the Proposed Action, that have indicated interest or have provided water for transfer in the past, including:

- Potential transfers from sellers in the Sacramento River, American River, Yuba River, and north-westerly Delta areas. Most of these potential sellers, which include the sellers in the Proposed Action, were evaluated in the Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report (EIS/EIR) and subsequent Long-Term Water Transfers Revised EIR/Supplemental EIS prepared by San Luis and Delta Mendota Water Authority (SLDMWA) and Bureau of Reclamation (Reclamation) that analyzed potential CVP-related transfers from 2019 to 2024. Additional sellers in the Sacramento River area not evaluated in the EIS/EIR have indicated interest in selling water in 2023 and are also included in Table J-1.

- Potential transfers from sellers in the Feather River Region from entities holding settlement agreements with the California Department of Water Resources (DWR) that could make surface water available for CVP or State Water Project (SWP) contractors. These transfers would be approved and facilitated by DWR.

The Lower Yuba River Accord (Yuba Accord) transfers were not included in the cumulative condition analysis in Section 3 because water would be made available for transfer in a different geographical area than the Proposed Action. The Yuba Accord provides for both stored water and groundwater substitution transfers ranging from 60,000 acre-feet (AF) per year and up to an additional 140,000 AF for state and federal contractors in drier years. From 2007 through 2014, Yuba Accord transfers averaged approximately 129,000 AF. Water made available for transfer through groundwater substitution actions under the Yuba Accord would occur in the North Yuba and South Yuba subbasins and would not affect groundwater levels near the Proposed Action.

J.1.1 Potential transfers analyzed in the cumulative analysis

The cumulative analysis considers other CVP and non-CVP water transfers that could occur in addition to the Proposed Action. Methods of making water available for transfer under these other transfers could include cropland idling and groundwater substitution (the same as described for the Proposed Action). Other methods of making water available for transfer could also include conservation, where a seller takes a conservation action to reduce irrecoverable water losses, and stored reservoir water releases, which includes releases of water that would have remained in storage in non-CVP or SWP reservoirs absent the transfer action.

Water made available for transfer, shown in Table J-1, could be sold to multiple agencies. These agencies include the Tehama-Colusa Canal Authority (TCCA), East Bay Municipal Utility District (MUD), SWP contractors receiving water from the North Bay Aqueduct, and buyers south of the Sacramento-San Joaquin River Delta (Delta), including SLDMWA and Metropolitan Water District of Southern California. Unlike transfers of water to TCCA and East Bay MUD that would be diverted off the Sacramento River, transfers of water to south of Delta buyers would be exported through the Delta via Banks or Jones Pumping Plants.

Table J-1. Potential Sellers Analyzed in the Cumulative Analysis (Upper Annual Transfer Volume Limits)

Water Agency	Groundwater Substitution[1] (AF)	Cropland Idling/ Crop Shifting[1] (AF)	Stored Reservoir Release[1] (AF)	Conservation[1] (AF)	Maximum Potential Transfer (AF)
Sacramento River Area					
Anderson-Cottonwood Irrigation District	5,225				5,225
Baber, Jack, et al.		2,310			2,310
Canal Farms	1,000	635			1,635
Conaway Preservation Group	35,000	21,349			35,000
Cranmore Farms (Pelger Road 1700 LLC)	8,000	2,500			8,000
Eastside Mutual Water Company	2,230				2,230
Giusti Farms	1,000				1,000
Glenn-Colusa Irrigation District	25,000	66,000			91,000
Henle Family Limited Partnership	700				700
Lewis Ranch		2,310			2,310
Maxwell Irrigation District	3,000	5,000			8,000
Natomas Central Mutual Water Company	30,000				30,000
Pelger Mutual Water Company	4,670	2,538			4,670
Pleasant Grove-Verona Mutual Water Company	18,000	9,000			18,000
Princeton-Codora-Glenn Irrigation District	6,600	6,600			12,100
Provident Irrigation District	10,000	9,900			19,900

Water Agency	Groundwater Substitution[1] (AF)	Cropland Idling/ Crop Shifting[1] (AF)	Stored Reservoir Release[1] (AF)	Conservation[1] (AF)	Maximum Potential Transfer (AF)
Reclamation District 108	15,000	40,000			35,000
Reclamation District 1004	7,175	20,000			27,175
River Garden Farms	10,000	10,000			16,000
Sutter Mutual Water Company	18,000	18,000			18,000
Sycamore Mutual Water Company	15,000	10,000			20,000
T&P Farms	1,200	890			1,200
Te Velde Revocable Family Trust	7,094	6,975			7,094
Windswept Land & Livestock	2,000				2,000
American River Area					
City of Sacramento	5,000				5,000
Placer County Water Agency			47,000		47,000
Sacramento County Water Agency	15,000				15,000
Sacramento Suburban Water District	30,000				30,000
Yuba River Area					
Browns Valley Irrigation District			5,000	3,100	8,100
Cordua Irrigation District	12,000				12,000
Feather River Area					
Butte Water District	5,500	11,500			17,000
Garden Highway Mutual Water Company	14,000				14,000
Gilsizer Slough Ranch	3,900				3,900
Goose Club Farms and Teichert Aggregates	10,000	10,000			10,000
Nevada Irrigation District			15,000		15,000
South Sutter Water District			15,000		15,000
Tule Basin Farms	7,320				7,320
Biggs-West Gridley Water District[2]		32,190			32,190
Richvale Irrigation District[2]		22,345			22,345
Plumas Mutual Water Company[2]	5,000	1,750			4,550
South Feather Water and Power[2]			10,000		10,000
Sutter Extension Water District[2]	4,000	11,000			15,000
Western Canal Water District[2]		37,655			37,655
Total	**337,614**	**360,447**	**92,000**	**3,100**	**689,609**

Notes:

[1] These totals cannot be added together. Agencies could make water available through groundwater substitution, cropland idling, or a combination of the two; however, they will not make the full quantity available through both methods. The last column reflects the total upper limit for each agency and will not equal the sum of all the individual transfer quantities for each agency.

[2] Entity holds Settlement Agreement with DWR.

Key: AF=acre-feet

Table J-1 lists the transfer method and associated maximum annual transfer quantity potentially available from each seller. The actual quantity of water transferred in a given year, as evidenced by past dry years, is less than the totals shown in Table J-1 and depends on a number of factors, including hydrologic conditions and available conveyance capacity. Cross Delta transfers to south-of-Delta buyers require pumping at the CVP and SWP south Delta export facilities and historically account for the majority of the transfers from sellers listed in Table J-1. Table J-2 lists the total quantities of cross Delta transfers from 2009 to 2015 that ranged from zero to 414,629 AF from 2009 through 2015, or approximately zero to 55 percent of the maximum total shown in Table J-1. In 2014, Sacramento Valley sellers transferred 35,446 AF to TCCA Member Units. In 2015 and 2021, TCCA Member Units used 23,997 AF and 57,060 AF of transfer water from Settlement Contractors, respectively. TCCA did not engage in water transfers in 2016 – 2020, 2022, and cross-Delta water transfers were not implemented.

Table J-2. Historic Cross Delta Water Transfers (2009 – 2015)

Year	Total Acre-Feet
2009	274,551
2010	264,165
2011	0
2012	84,781
2013[1]	351,515
2014[1]	414,629
2015[1]	262,466

Source: DWR and State Water Resources Control Board (SWRCB) 2015

Notes:

[1] Data for 2013, 2014 and 2015 are for quantities made available North of the Delta and include Streamflow Depletion losses (where applicable) but do not include carriage water losses across the Delta. Cross Delta water transfers using facilities operated by DWR in 2014 and 2015 were 305,699 AF and 104,348 AF, respectively and Reclamation 73,930 AF and 157,018 AF, respectively.

Transfers originating from the Sacramento Valley represent a small portion of the Sacramento Valley's overall water supply. In addition to the transfers described in Table J-1, TCCA may also engage in "Project Water" transfers under the Central Valley Project Improvement Act (CVPIA) section 3405(a)(1)(M). Transfers or exchanges of Project Water for contract years 2021 to 2025 were covered by the Reinitiation of Consultation on the Coordinated Long-Term Operation of the Central Valley Project and State Water (ROC on LTO) Project. The ROC on LTO biological opinions are currently under litigation, as such Reclamation and DWR are operating under the Interim Operations Plan for the CVP and SWP issued by Reclamation and DWR on September 27, 2021 (Reclamation 2021). The Reinitiation of Consultation on the Coordinated Long-Term Operation of the CVP and SWP EIS identified no effect to biological resources and potentially small, beneficial effects to other resources. Because these transfers would not have adverse effects, they are not included in the cumulative conditions analysis in Section 3.

J.1.2 Voluntary Agreements

On December 12, 2018, the State Water Resources Control Board (SWRCB) adopted Resolution 2018-0059, approving an update to the Bay-Delta Water Quality Control Plan (Bay-Delta Plan). The agreement included flow and non-flow measures to improve water quality in the Bay-Delta watershed to support viability of native fishes. On March 1, 2019, several parties, including the Sacramento River Settlement Contractors, entered into the "*Planning Agreement Proposing Project Description and Procedures for the Finalization of the Voluntary Agreements to Update and Implement the Bay-Delta Water Quality Control Plan*" (Planning Agreement).

The flow measures discussed in the Planning Agreement provide instream flows above existing conditions and in a manner that: (a) does not conflict with the requirements of the Sustainable Groundwater Management Act and (b) maintains reliability of water supply for other beneficial uses, including designated wildlife refuges. These flows above existing conditions will be generated through land fallowing, reservoir reoperation and/or demand reduction, and limited use of groundwater substitution. Table J-3 shows the flow contributions from the Sacramento River watershed.

Table J-3. Contribution of Flow to the Voluntary Agreement in the Sacramento River Watershed

Tributary	Season	Source	Application[2]	Flow Contributions (in TAF)				
				C	D	BN	AN	W
Sacramento	Spring or summer[1]	Land fallowing	Block		100	100	100	
Feather	Spring or summer [1]	Land fallowing	Block		50	50	50	
Yuba	Assume spring likely [1]	Reservoir storage	Block		50	50	50	
American	Spring	Groundwater substitution	Hybrid	10	10			
		Reservoir storage				10	10	
		Reservoir storage and/or groundwater substitution			10			
		Reservoir storage and/or groundwater substitution		20	20			

Key: AN – Above Normal Water Year; C – Critical Water Year; D – Dry Water Year; BN – Below Normal Water Year; TAF – Thousand acre-feet; W- Wet Water Year
Notes:
[1] Flow represents an instream target, Blocks can be scheduled within constraints, and Hybrid represents a combination.
[2] Subject to coordination with California Department of Fish and Wildlife (DFW) (Yuba) or fisheries agencies (Sacramento, Feather)

J.1.3 Coordinated Operations Agreement

Reclamation and DWR would continue to operate their respective facilities in accordance with the Agreement between the United States and the State of California for Coordinated Operation of the Central Valley Project and the State Water Project executed in 1986 (Coordinated Operations Agreement, hereinafter referred to as COA). The COA defines the project facilities and their water supplies, sets forth procedures for coordinating operations, and identifies formulas for sharing joint responsibilities for meeting Delta standards and other legal uses of water. COA further identifies how unstored flow is shared, sets up a framework for exchange of water and services between the projects, and provides for periodic review of the agreement.

Implementation of the COA principles has evolved since 1986, as changes have occurred to CVP and SWP facilities, operating criteria, and overall physical and regulatory environment. For example, updated water quality and flow standards adopted by the SWRCB, CVPIA, and Endangered Species Act (ESA) responsibilities have affected both CVP and SWP operations. The 1986, COA incorporated the SWRCB Water Right Decision 1485 (D-1485) provisions regarding Delta salinity, outflow, and export restrictions. D-1485 included implementation provisions for the Bay-Delta Water Quality Control Plan (WQCP) that was current at the time but has since been updated with Water Right Decision 1641 (D-1641). COA envisioned and provided a methodology to incorporate future regulatory changes, such as Delta salinity requirements, but did not explicitly envision or address sharing of export restrictions. D-1641 and the 2008 U.S. Fish and Wildlife Service (USFWS) Biological Opinion and 2009 National Marine Fisheries Service (NMFS) Biological Opinion included various export restrictions not explicitly addressed in the 1986 COA. However, the available export capacity as a result of these export restrictions was shared between the CVP and the SWP in absence of a formal update to the COA.

In 2018, Reclamation and DWR amended four key elements of the COA to address changes since the COA was signed: (1) in-basin uses, (2) export restrictions, (3) CVP use of Banks Pumping Plant up to 195,000 acre-feet per year, and (4) periodic review. The COA sharing percentages for meeting Sacramento Valley in-basin uses now vary from 80 percent responsibility of the United States and 20 percent responsibility of the state of California in wet year types to 60 percent responsibility of the United States and 40 percent responsibility of the state of California in critical year types. In a dry or critical year following two dry or critical years, the United States and state of California will meet to discuss additional changes to the percentage sharing of responsibility to meet in-basin uses. When exports are constrained and the Delta is in balanced conditions, Reclamation may pump up to 65 percent of the allowable total exports with DWR pumping the remaining capacity. In excess conditions, these percentages change to 60/40. The COA defines balanced conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flow approximately equal the water supply needed to meet Sacramento Valley in-basin uses, plus exports. The COA defines excess conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses, plus exports.

J.2 References

California Department of Water Resources (DWR) and State Water Resources Control Board (SWRCB). 2015. Background and Recent History of Water Transfers in California. July 2015. Available at: https://cawaterlibrary.net/wp-content/uploads/2018/03/Background_and_Recent_History_of_Water_Transfers.pdf [Accessed on December 29, 2022].

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