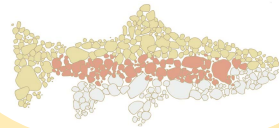


Using a Geotechnical Assessment to Guide Riparian Restoration, Muddy River Reserve




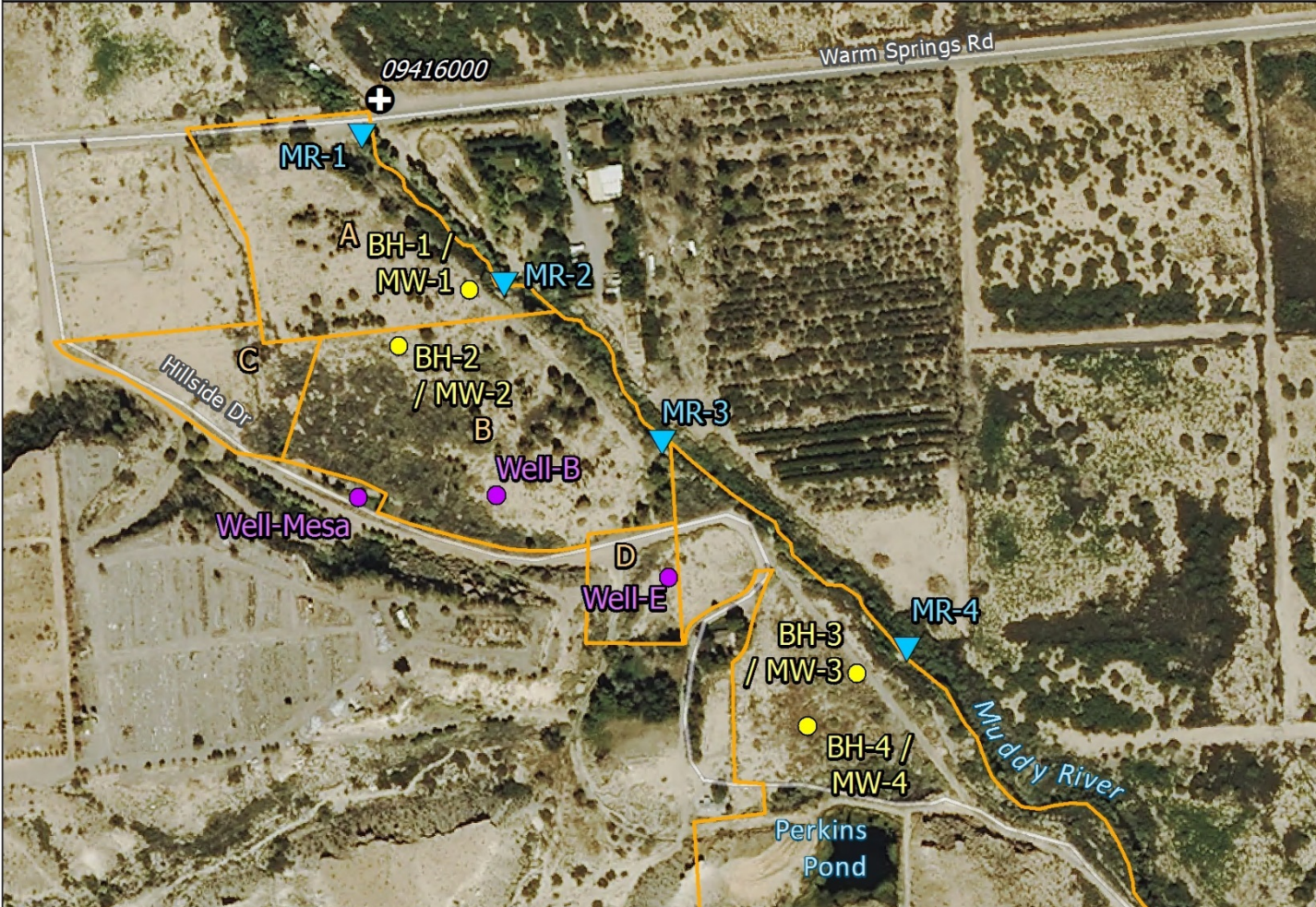
CCDCP Symposium
Las Vegas, NV
August 13, 2015



Glen Leverich – Stillwater Sciences
Bruce Orr – Stillwater Sciences
Elizabeth Bickmore – CCDCP

Project Goals at Muddy River Reserve

- 
- An aerial photograph of a river valley. A dirt road runs along the right side of the river. The landscape is a mix of green vegetation and brownish soil. In the background, there are mountains under a clear blue sky.
- Goal 1:** Identify existing soil layer that will create planting areas that will be self-sustaining and make recommendations for soil removal that will maximize the creation and enhancement of riparian and wetland habitat with minimum costs based on geotechnical and geomorphic assessments.
- Goal 2:** Design restoration areas that will maximize the creation of riparian and wetland habitat while incorporating high-flow events into the design. Restoration areas should be self-sustaining with a multi-tier structure and provide for natural recruitment and succession of native plant species.
- Goal 3:** Provide guidance to County for development of a grading plan for construction of Perkins Pond, Riparian Pilot Site on Unit E.



Location

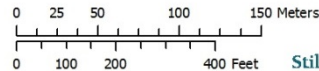
Muddy River Reserve
Parcels A, B, and E

A: 4.9 ac
B: 3.0 ac
E: 25 ac

Basemap

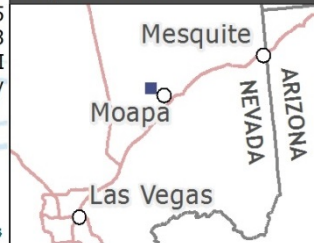
- Borings/Piezometers
- ▼ Water surface elevation
- Water-supply well
- ⊕ USGS gage
- Parcels

Map Sources:
Borings, WSE, wells: Stillwater Sciences 2015
Imagery: NAIP 2013
Roads, counties, cities: ESRI
Parcels: Clark County



Stillwater Sciences

Map Location



Assessment Approach



Review Existing Information:

Physical Setting and Topography

Hydrology

Surficial Geology

Soils

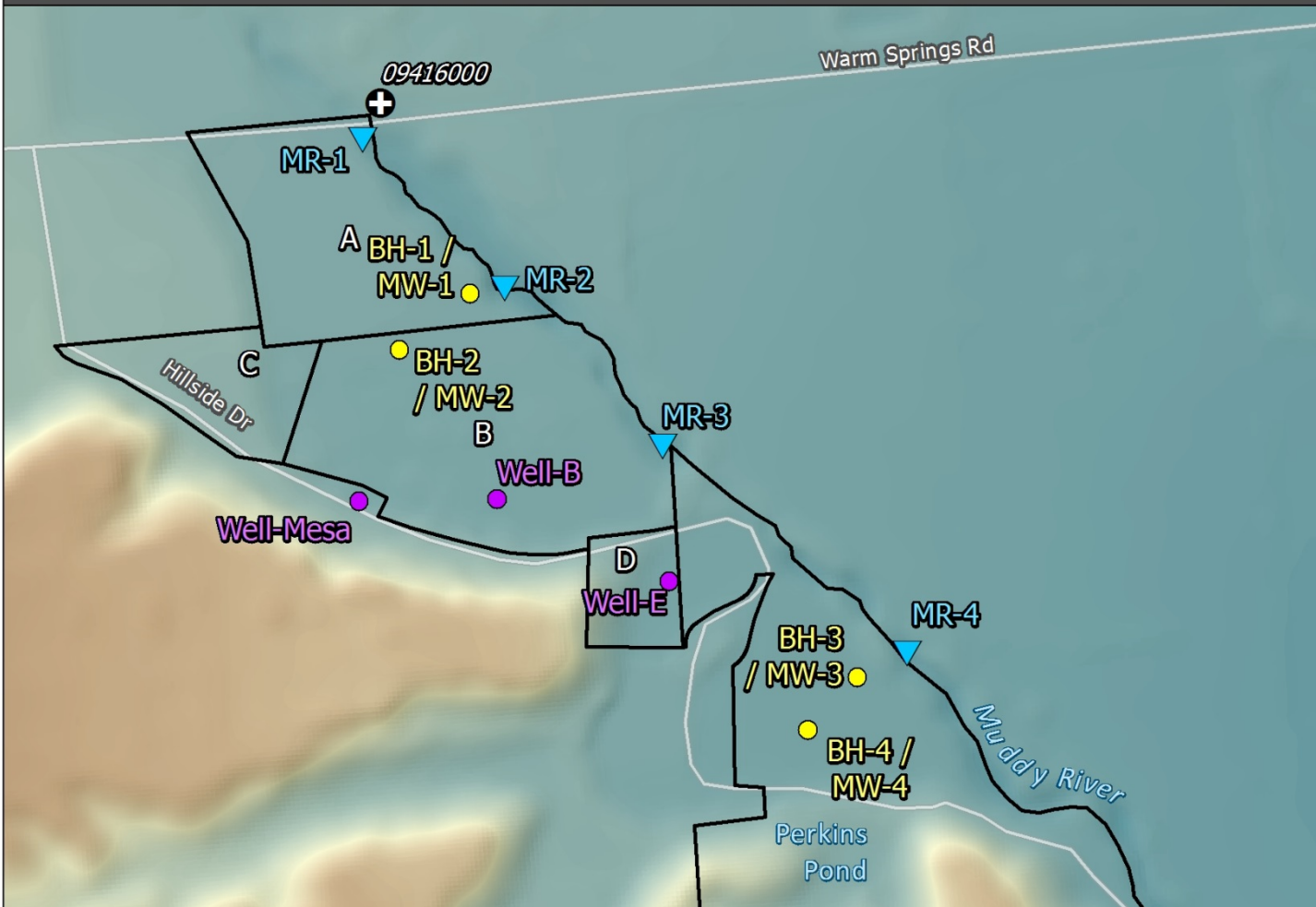
Site-Scale Assessment:

Field-based Soil Characterization

Lab Analyses (geotech properties and planting suitability)

Groundwater and Surface-Water Measurements

Grading Plan Recommendations



Topography

Lidar from 2008 (SNWA)

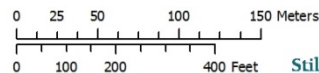
Flat floodplain

Incised channel, ~15 ft below floodplain (field observation)

Topography

- Borings/Piezometers
 - ▼ Water surface elevation
 - Water-supply well
 - + USGS gage
 - Parcels
- 2008 LiDAR (ft)
-

Map Sources:
 Borings, WSE, wells: Stillwater Sciences 2015
 LiDAR: SNWA 2008
 Roads, counties, cities: ESRI
 Parcels: Clark County



Stillwater Sciences

Map Location





Hydrology

4–8 in annual average rainfall

Perennial flow from upstream springs

Consistent flows, ~40 cfs

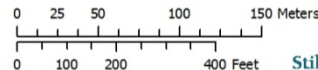
Flashy floods (e.g., 9/27/2014 = 3,320 cfs [~38-yr return period])

100-year floodplain (FEMA)

Assumed shallow groundwater

Floodplain

- Borings/Piezometers
- ▼ Water surface elevation
- Water-supply well
- + USGS gage
- Parcels
- ⬇ FEMA 100-year floodplain



Map Sources:

Floodplain: FEMA
 Borings, WSE, wells: Stillwater Sciences 2015
 Imagery: NAIP 2013
 Roads, counties, cities: ESRI
 Parcels: Clark County

Map Location

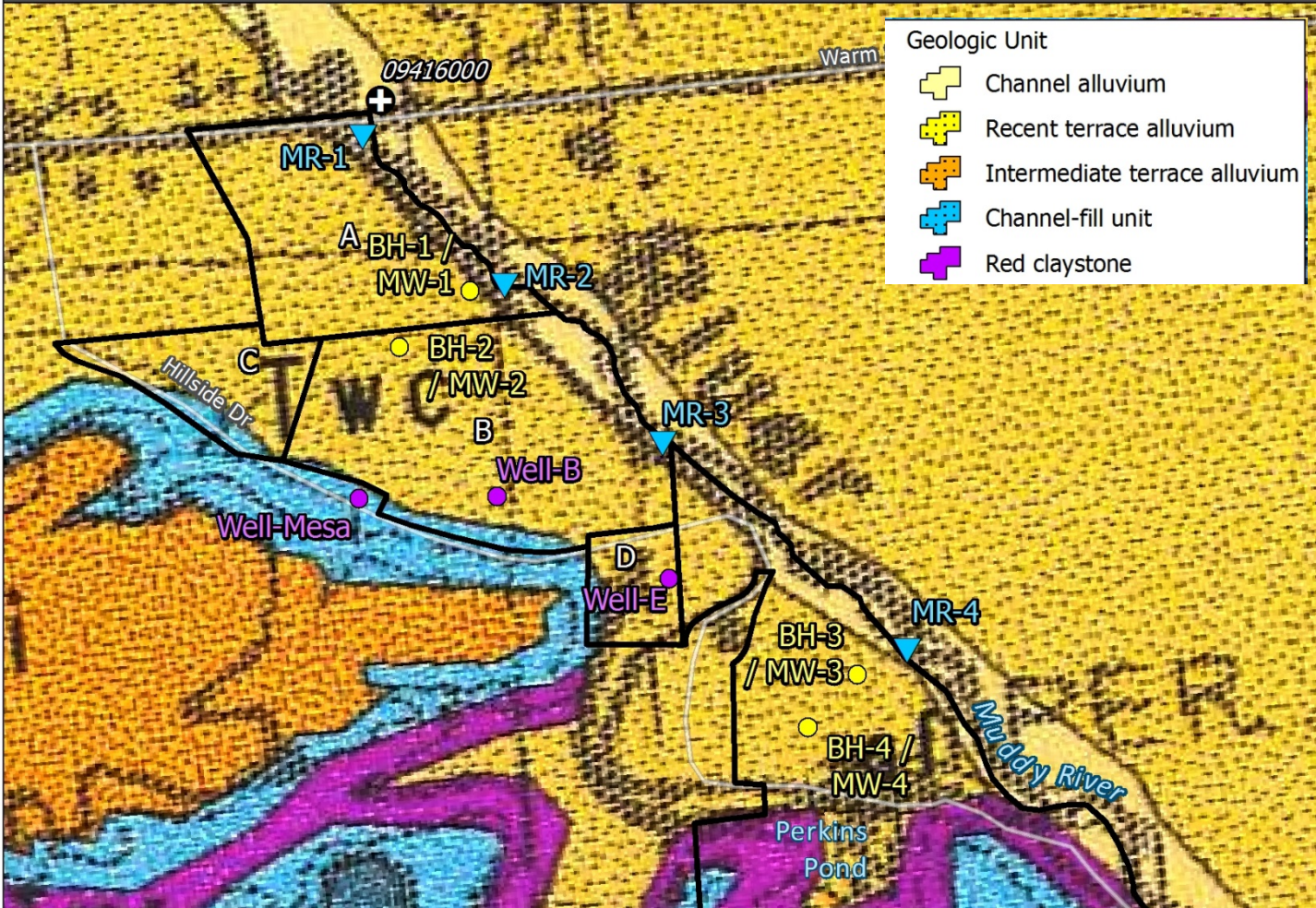




Recently scoured wash channel on Parcel E
(photo taken 10/31/2014 by B. Orr)



Recently accumulated sediment and woody material in river channel below wash near Parcel E (photo taken 10/31/2014 by B. Orr)



Geology

Geologic mapping published in 1996 (USGS)

Area composed of young sedimentary units

River composed of Channel Alluvium: silts, sands, gravels

Floodplain composed of Terrace Alluvium: silt and sand

Muddy River has incised 10–20 ft over past century

Geology

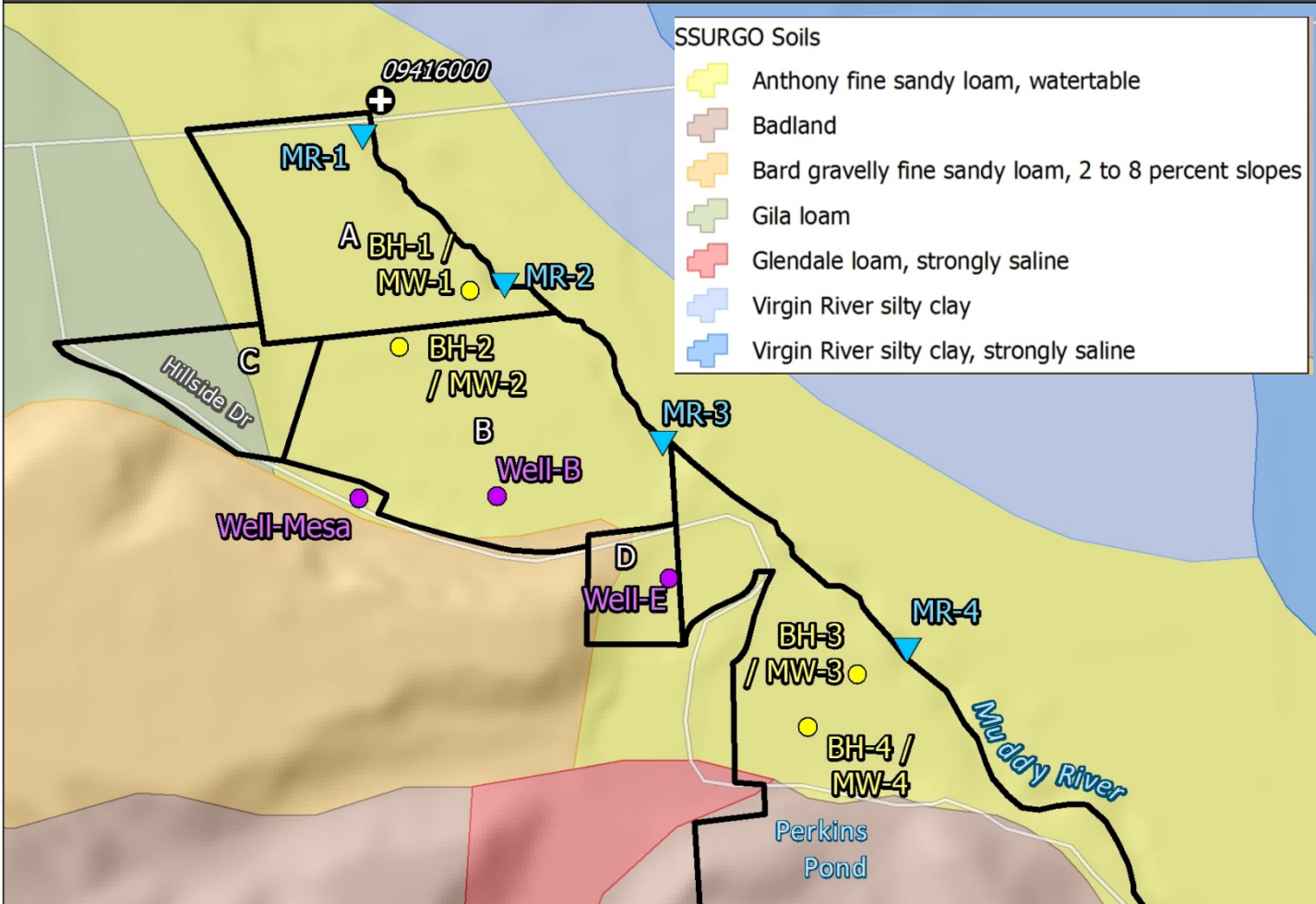
- Borings/Piezometers
- ▼ Water surface elevation
- Water-supply well
- + USGS gage
- Parcels

Map Sources:

Borings, WSE, wells: Stillwater Sciences 2015
 Geology: USGS 1996
 Roads, counties, cities: ESRI
 Parcels: Clark County

Map Location

Stillwater Sciences



Soils

Soils mapping (NRCS)

River corridor composed of Anthony Fine Sandy Loam, with shallow groundwater

Moderately well drained, sandy alluvium with clay and gravel

Low organic content

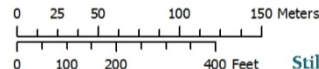
Low salinity

Moderately alkaline (pH)

Soils

- Borings/Piezometers
- ▼ Water surface elevation
- Water-supply well
- + USGS gage
- Parcels

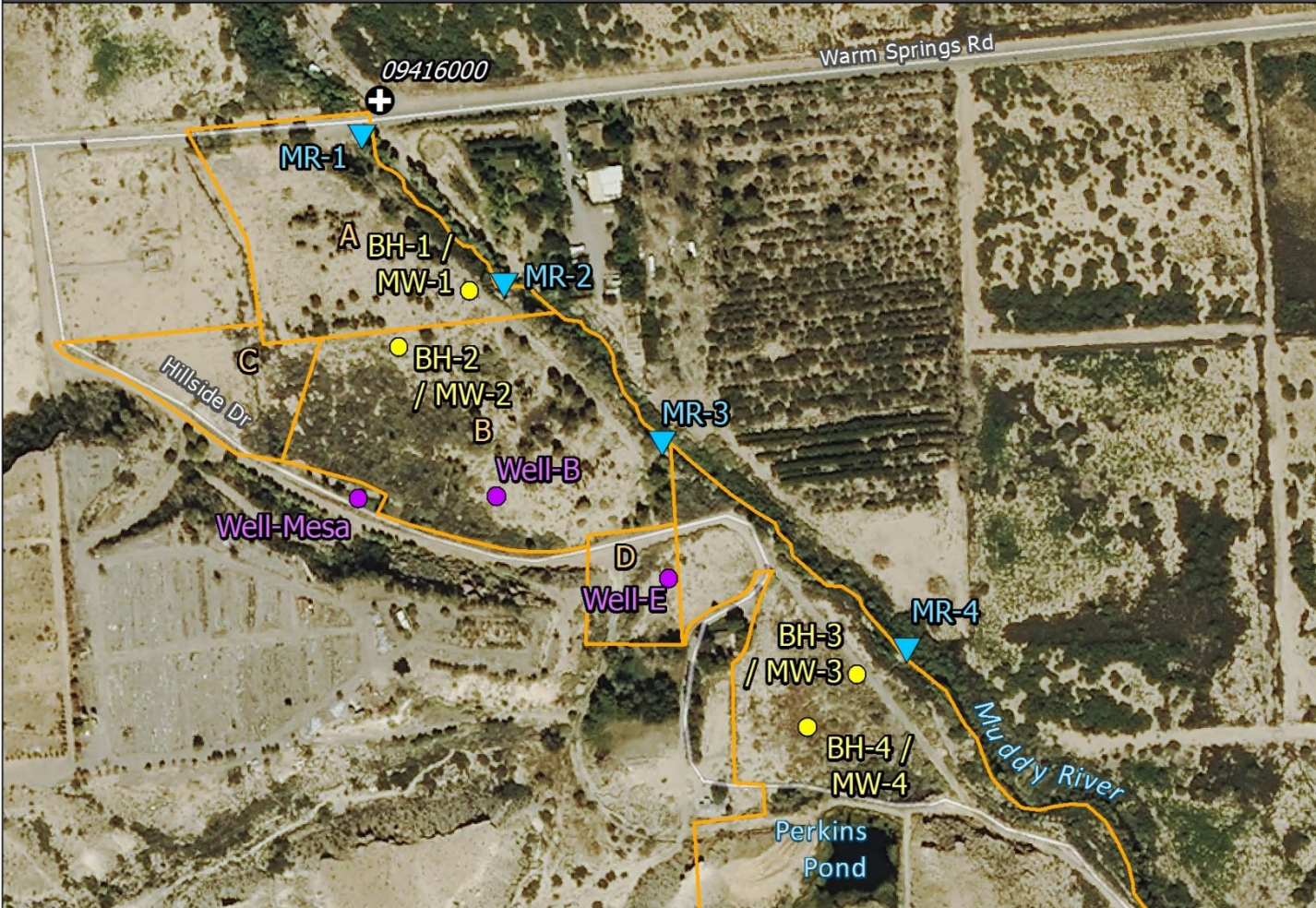
Map Sources:
 Borings, WSE, wells: Stillwater Sciences 2015
 Soils: SSURGO
 Roads, counties, cities: ESRI
 Parcels: Clark County



Stillwater Sciences

Map Location





Field Data Collection

4 Boreholes:
cored 20–25 ft bgs

4 piezometers
(monitoring wells)

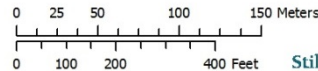
Water-level
measurements

Surveyed well
heads and other
points of interest

Basemap

- Borings/Piezometers
- ▼ Water surface elevation
- Water-supply well
- ⊕ USGS gage
- Parcels

Map Sources:
Borings, WSE, wells: Stillwater Sciences 2015
Imagery: NAIP 2013
Roads, counties, cities: ESRI
Parcels: Clark County



Stillwater Sciences

Map Location





Geotechnical sample collection of BH-3 / MW-3 on Parcel E
(photo taken 5/27/2015 by G. Leverich)

Results

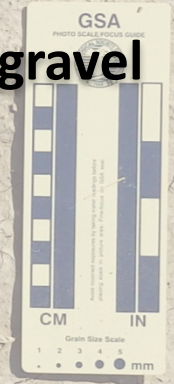
Entrenched river channel, ~15 feet below floodplain

Well sorted fine-grained silt with clay and sand, and some gravel

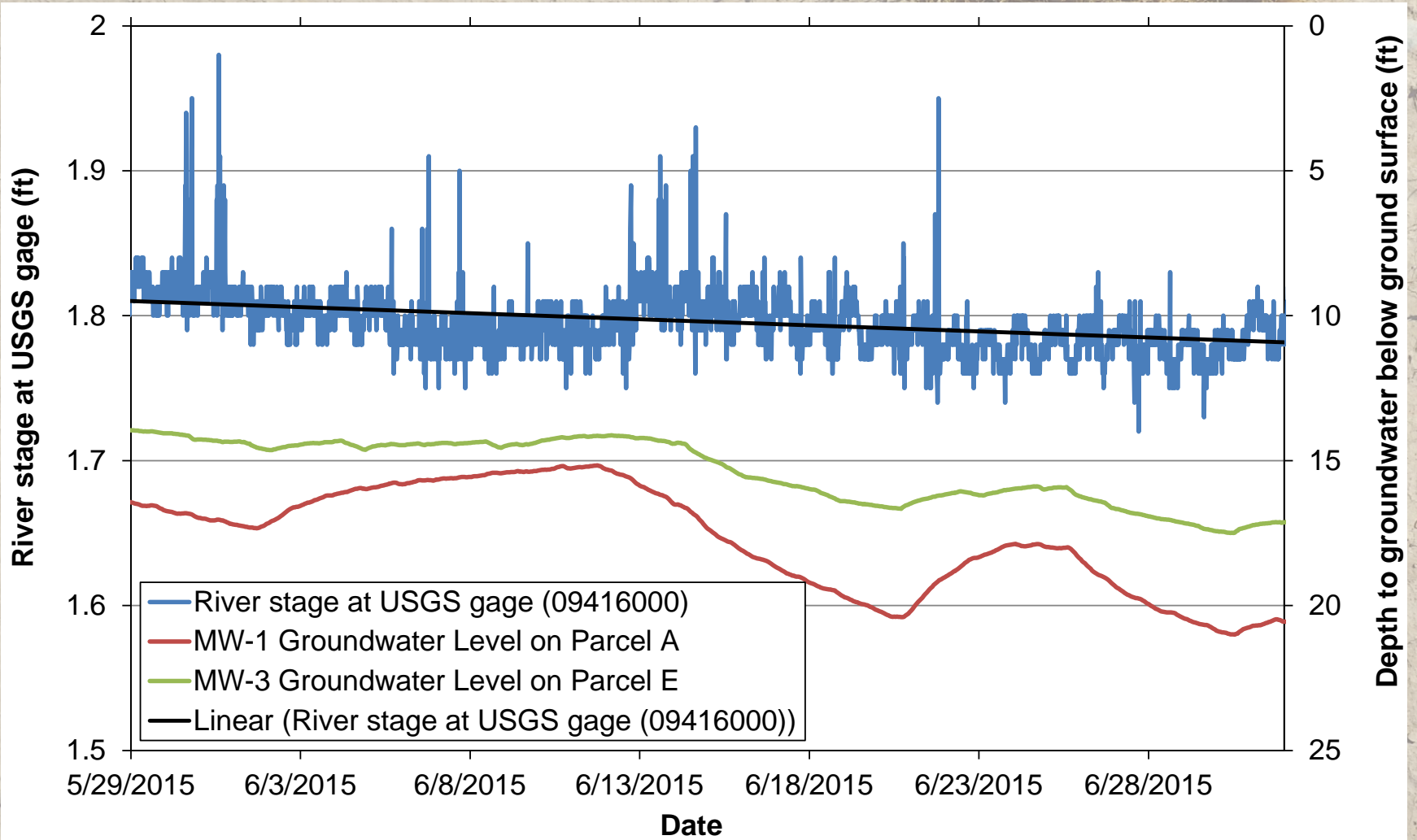
Low to moderate permeability, porosity, and bulk density

Moderately alkaline (pH≈8), slightly to moderately saline (EC≈1–10 mmhos/cm), and “high” presence of lime

Water table at 13–17 feet bgs, sloped toward river channel



Results



Grading Plan Recommendations for Parcel E

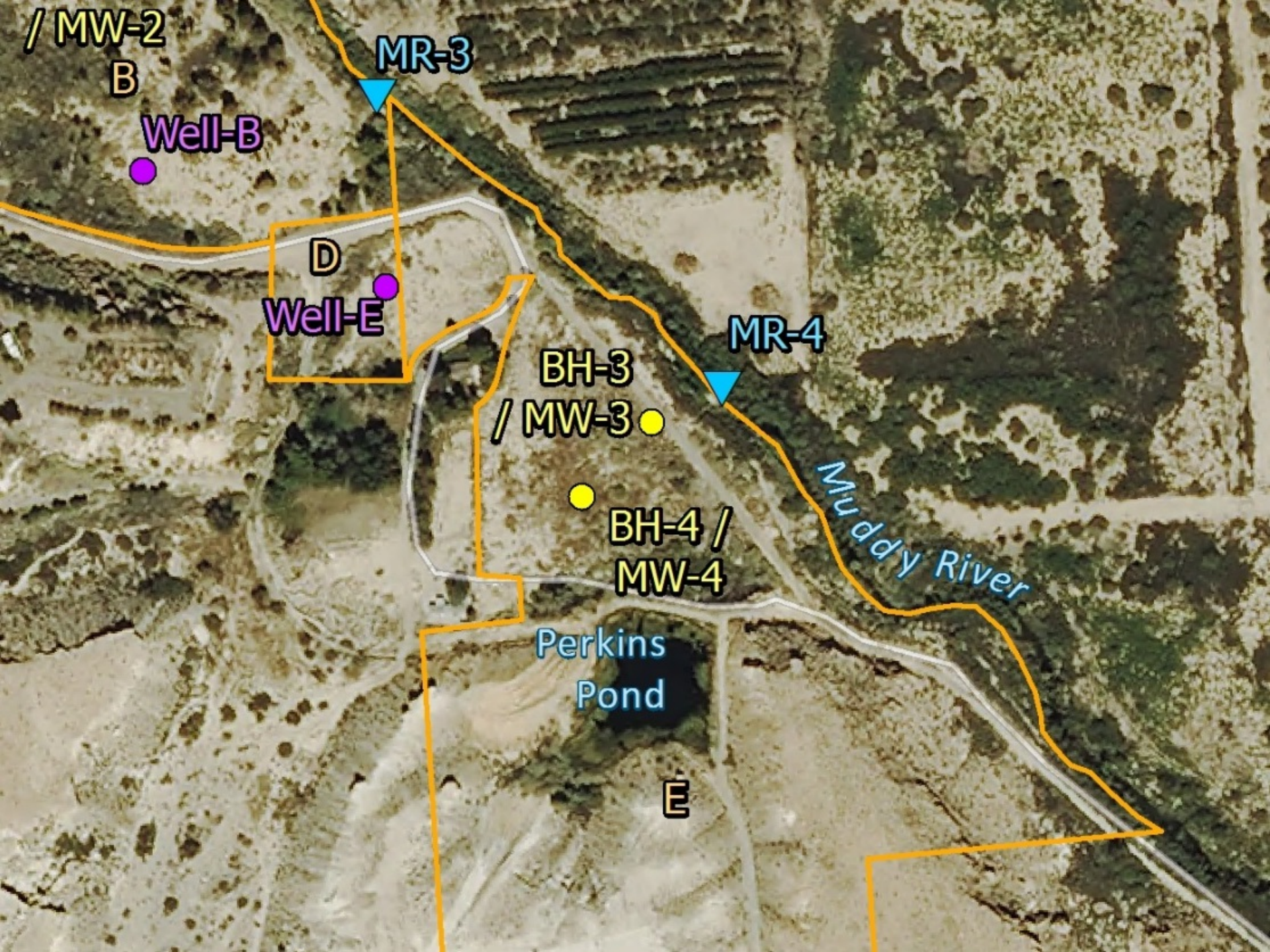
Lowering of the floodplain <10 ft to re-establish hydrologic connectivity with active river channel

Create an arcuate, semi-circle planform shape centered on unnamed wash and sloped toward river

Grading plan to consider hydro-geomorphic assets (perennial water supply) and hazards (bank erosion)

Alkalinity and salinity of soils may limit planting suitability for some native woody riparian species (e.g., *Populus f.*, *Salix g.*, *Fraxinus v.*), and instead favor other riparian and upland species (e.g., *Baccharis spp.*, *Prosopis spp.*, *Atriplex spp.*)

Irrigate from local water-supply wells



/ MW-2

B

Well-B

MR-3

D

Well-E

BH-3

/ MW-3

MR-4

BH-4 /

MW-4

Muddy River

Perkins
Pond

E

Final Thoughts

Existing information aided regional-view assessment of project area

Field data collection necessary for site-scale planning

Notable differences in topography (2008 Lidar) and soil chemistry (NRCS data)

Geotechnical assessment remains limited by resolution of sampling performed

An aerial photograph showing two people standing on a wide, sandy dirt road. The person on the left is wearing a green cap, a grey polo shirt, and khaki pants, holding a white cup and waving. The person on the right is wearing a white cap, a blue t-shirt, and black pants, also waving. The road is surrounded by dry, yellowish-brown grass and some green shrubs. The scene is brightly lit, casting shadows on the ground.

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