Groundwater Well Specifications

Prepared for the City of New Orleans

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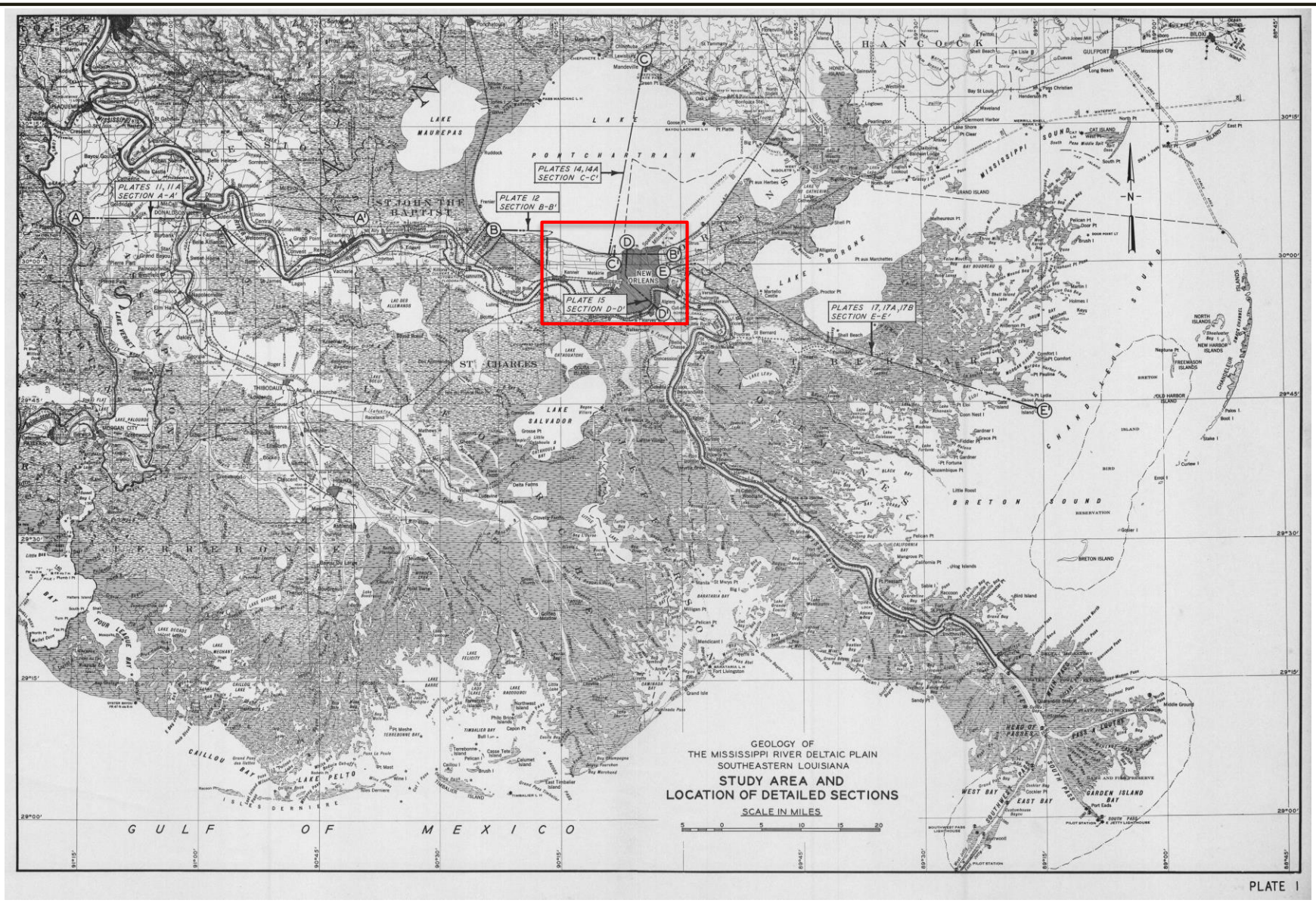
Introduction

The City of New Orleans is moving forward in awarding construction projects that will lead to infrastructural improvements in the water supply and wastewater/sewer network overseen by the Sewerage and Water Board (SWB). The opportunity exists to begin framing a monitoring system that can be utilized to (1) monitor system performance, (2) identify possible hazards to the populace and infrastructure, and to (3) serve as calibration and validation datasets for the application of real-time forecasting and other numerical models to optimize future system performance, and to provide advance information about flooding risks associated with rainfall events.

The Water Institute of the Gulf, working with its partners at Deltares, is working to develop a set of instrumentation and deployment guidelines. As the City is already awarding contracts to construction firms who will be carrying out street-level and subsurface improvements to the drainage (wastewater and sewer) and water supply network, the opportunity exists to install wells and gages at these sites that can monitor surface and groundwater parameters. The overall intent is to provide comprehensive guidelines about many different types of sensors that might become part of a comprehensive monitoring network.

Hydrogeology

The placement and design of the monitoring wells provided in these specifications were informed by a hydrogeologic investigation of existing reports, well bore logs, and geologic cross-sections. Rationale behind well placement, design and depth was provided in the *Greater New Orleans Water Plan: Groundwater Monitoring Network* (Stuurman and Buma, 2013). Information on geology and well types for site-specific data collection objectives was obtained from *Ground Water monitoring network of Greater New Orleans: Orleans, Jefferson & St. Bernard Parishes – Design* (Stuurman, 2017). Hydrogeologic cross-sections (Figures 1 and 2) were adapted from Kolb and Van Lopik (1958). A cross section, D-D'(Figure 3), in that report generally follows the route of US Hwy 90 (Pontchartrain Expressway). A contour map of the depth to Pleistocene deposits is included as Figure 4 (Kolb and Van Lopik, 1958). Surface soil character is presented on the location maps for the monitoring wells and was adapted from NRCS (1989) and NRCS (2017). General geology and groundwater resources of the region were investigated in Prakken (2008).



GEOLOGIC MAP OF THE MISSISSIPPI RIVER DELTAIC PLAIN: SOUTHEASTERN LOUISIANA

Prepared by: R. Clark
August 16, 2018

FIGURE 1

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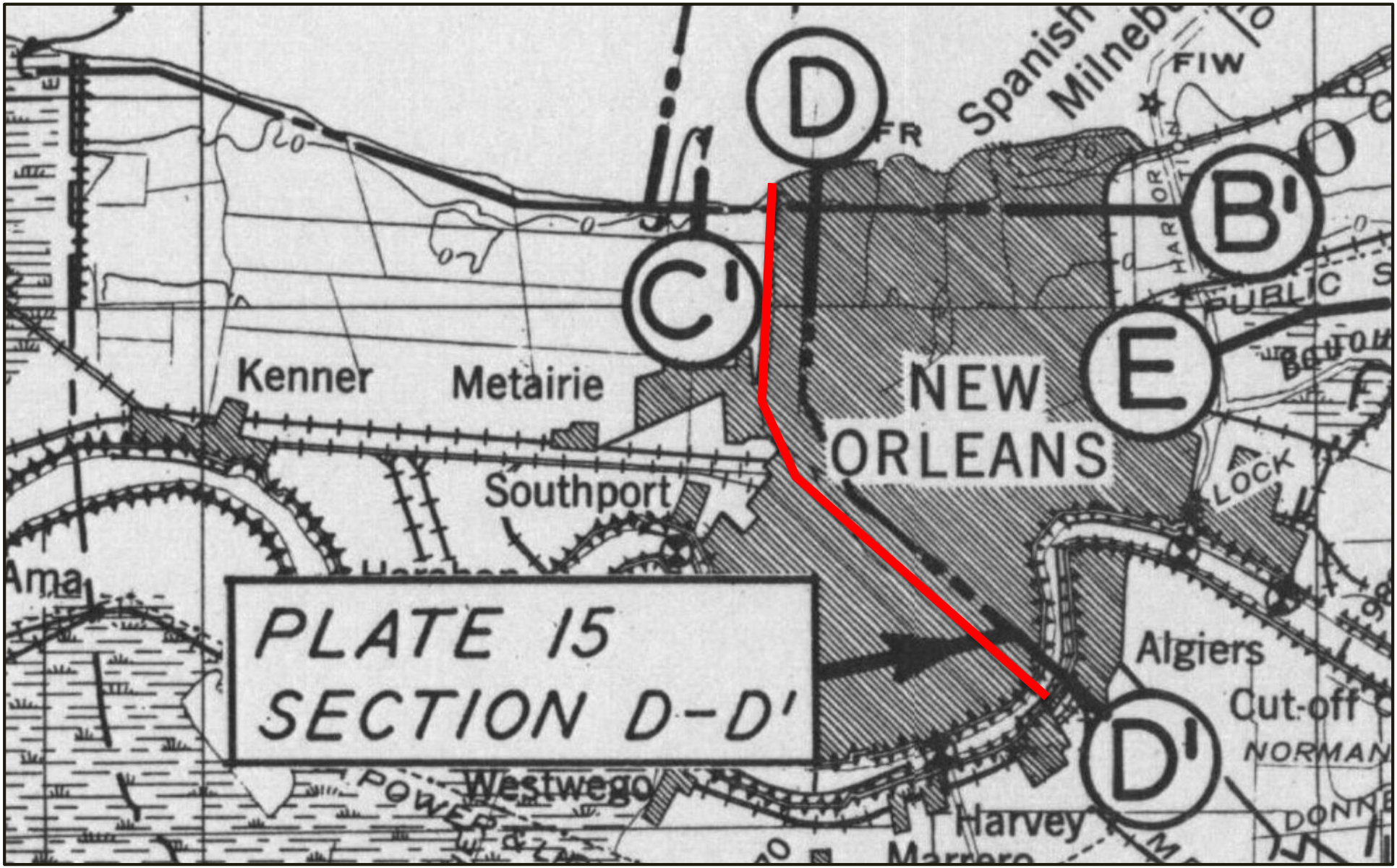

GEOLOGIC [INSET] MAP OF THE MISSISSIPPI RIVER DELTAIC PLAIN: SOUTHEASTERN LOUISIANA

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FIGURE 2

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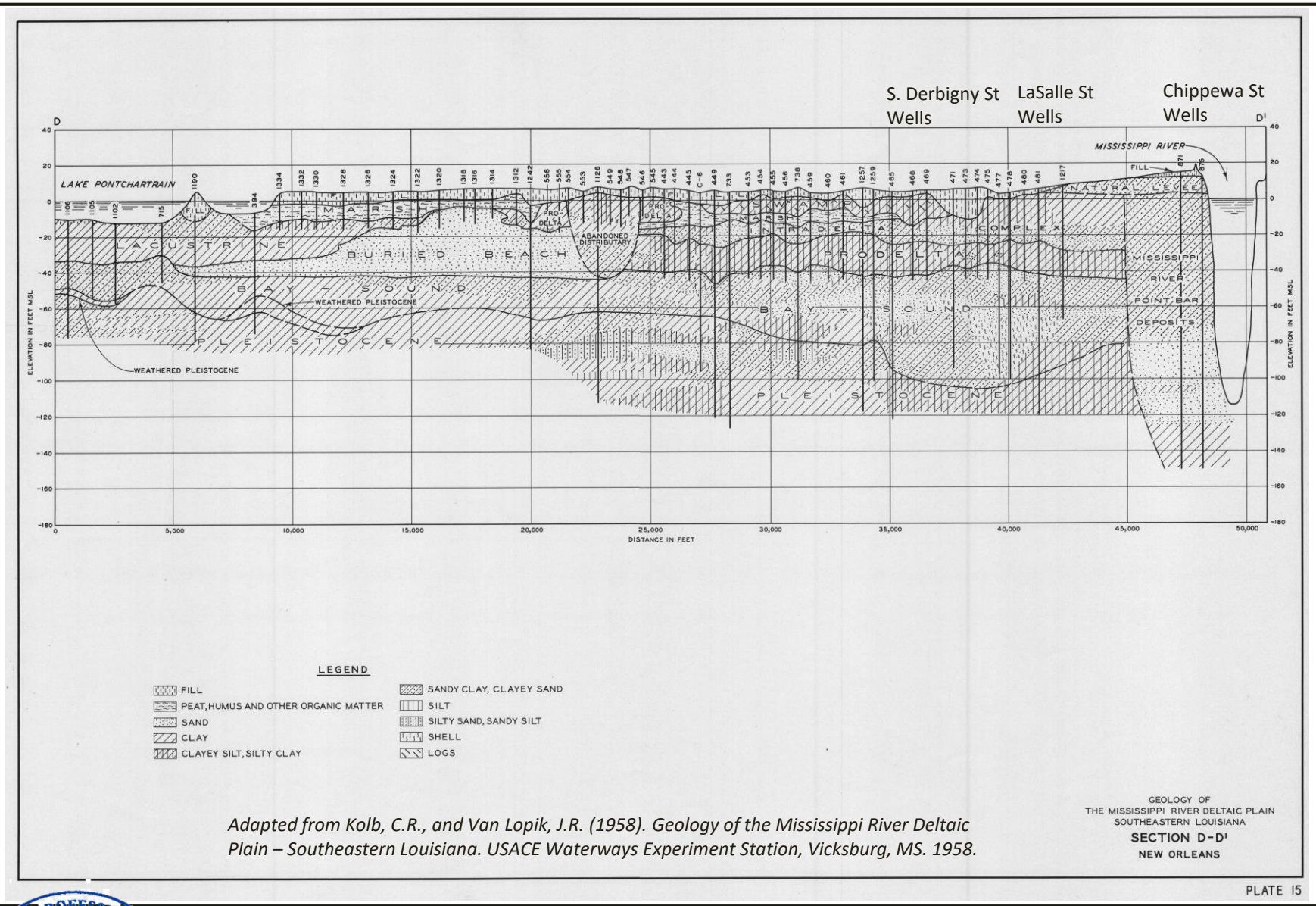

Adapted from Kolb, C.R., and Van Lopik, J.R. (1958). Geology of the Mississippi River Deltaic Plain – Southeastern Louisiana. USACE Waterways Experiment Station, Vicksburg, MS. 1958.

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APPROXIMATE WELL LOCATIONS ALONG SECTION D-D'

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FIGURE 3

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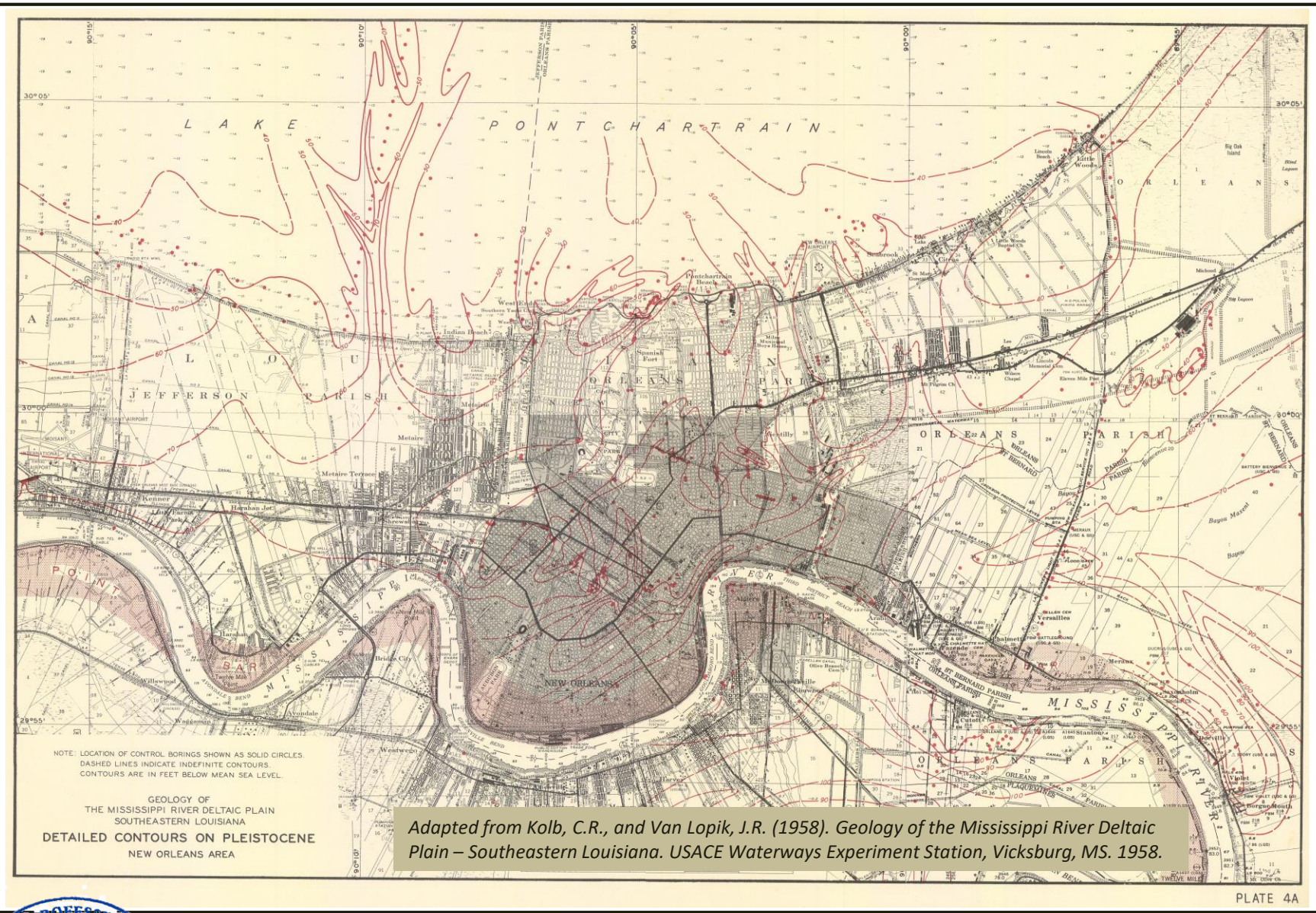

Adapted from Kolb, C.R., and Van Lopik, J.R. (1958). Geology of the Mississippi River Deltaic Plain – Southeastern Louisiana. USACE Waterways Experiment Station, Vicksburg, MS. 1958.

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APPROXIMATE DEPTH TO PLEISTOCENE DEPOSITS

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Vertical Datum: Feet below Mean Sea Level

FIGURE 4

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General Well Specifications

Monitoring network design is based on the objectives of the monitoring, these are informed by how the information will be used. For example, in some instances it maybe be based on surface water/groundwater interactions to understand the storage capacity of the soil, in other instances it maybe to understand the change in groundwater levels related to subsidence, sometimes monitoring networks are designed to inform models for decision-making. Different objectives affect the selection of borehole locations and depths when monitoring groundwater. All wells should be installed according to the practices detailed in the Louisiana Department of Environmental Quality (LDEQ) and the Louisiana Department of Transportation and Development (LDOTD) *Construction of Geotechnical Boreholes and Groundwater Monitoring Systems Handbook* (LDEQ, 2000).

Based on the current information provided by the City and other reports, it is thought that installing two monitoring wells per site could capture relevant groundwater processes that could aid the City in future water-related assessments and be absorbed into a full monitoring network. One shallow well, completed in pervious near-surface deposits, could aid in understanding the storage capacity of the soil (unsaturated zone). These wells could provide information on the infiltration of rain water in the urban areas of Greater New Orleans. A deeper well, completed in deeper pervious deposits, could also be installed and possibly provide data to help understand deeper groundwater processes that may affect local and regional subsidence, as well as groundwater flow and possible influence of the Mississippi River on groundwater levels and flow.

WELL PLACEMENT

Two monitoring wells per site, one shallow and one deeper, should be installed, unless otherwise stated. The specific location of each well at the site should be determined based on ground conditions at each site. Wells should be placed to minimize impacts to users of the parks, and to provide maximum protection to the wells themselves, especially from vehicles, potential spills, and other hazards. The influence of streets, underground infrastructure, surface water, drains, and trees on wells should be minimized. Therefore, wells should be installed in homogenous areas (soil, vegetation) at greatest distance as possible from draining features or trees. Well pairs should be located as close to each other as practicable, without interfering with one another during construction (nominally less than 10 feet). This will aid in placement of shared equipment (telemetry, e.g.) and operation and maintenance.

WELL CONSTRUCTION

Wells should be constructed using standard procedures and materials for 2-inch (nominal) inside dimeter PVC, with pre-packed screens. Factory-slotted screens and loose filter sand may be substituted for pre-packed screens if installation difficulties arise or significant cost savings can be achieved without loss of well performance. Standard specifications and instructions for all monitoring wells are included in Figures 5 and 6. Generalized cross sections for both shallow and deeper monitoring wells in each well pair are included in Figures 7 and 8. Wells should be installed and completed in accordance with *ASTM D6725/D6725M – 16 Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers* (ASTM, 2016a). Wells should be constructed in accordance with United States Environmental Protection Agency - Science and Ecosystem Support Division (USEPA-SESD) *Guidance 101 - Design and Installation of Monitoring Wells* (USEPA, 2013), *ASTM D5092/D5092M–16 Standard Practice for Design and Installation of Groundwater Monitoring Wells*

(ASTM, 2016b), and Natural Resources Conservation Service (NRCS), *Conservation Practice Standard: Monitoring Well, Code 353 (NRCS, 2010)*. In the event that direct-push equipment is not sufficient to install the monitoring wells to the specified completion depth, other well installation methods may be substituted. Acceptable alternate methods include (in order of preference) sonic drilling, direct push with auger, wet rotary drilling, and hollow-stem auger methods. All methods should preserve cores (preferred) or cuttings for contemporaneous sampling and description by a registered geologist.

WELL DEPTH DETERMINATION INFORMED BY SITE-SPECIFIC GEOLOGIC CONDITIONS

Each well in the well pair should be constructed to sample water from a specific depth below the surface. Due to the dynamic nature of the deltaic geology underlying the New Orleans area, it is anticipated that sedimentary units may be laterally inhomogeneous, vary in thickness, and possibly discontinuous. It is recommended that a licensed geologist be present during well construction, to keep a log of downhole hydrogeologic conditions and make recommendations based on site-specific conditions. This will ensure the optimized depth of the well, as well as the optimal placement and length of the screened interval for each individual well.

Shallow wells should be completed to a depth between 12 to 20 feet below surface, and screened in the bottom 4 to 12 feet, depending on local conditions and geology. These wells can be screened in near-surface units including fill, marsh, lacustrine, buried beach, prodelta, abandoned distributary, swamp, intradelta complex, and natural levee deposits.

Deeper wells should be completed in pervious Holocene sand, sandy clay, clayey sand, and shell bay-sound deposits, as well as sand and clayey sand of Mississippi River point bar deposits. They should be generally between 50-100 feet deep below surface, and not penetrate deeper than the Pleistocene contact, as seen in Figure 4. They should be screened in the bottom 8-15 feet, depending on the character of the water-bearing unit and the length of prepacked screen segments being used.

WELL PROTECTION

Wells should be placed and protected according to the guidelines in *ASTM D5787–14 Standard Practice for Monitoring Well Protection* (ASTM, 2014). The well pair at each site should be installed as close to each other as reasonably practicable, but not less than two feet, to avoid any possible damage to the wells during installation. This is to maintain lateral consistency with spatial data, and to take advantage of common data telemetry and wellhead protection systems for both wells.

Standard Specifications and Instructions for All Monitoring Well Installations

1. **Laws and Regulations:** Monitoring wells shall be planned, designed, constructed, operated and maintained in a manner that meets all applicable local, State, Tribal, and Federal laws and regulations.
2. **Design:** The design of all components of the monitoring well shall conform to ASTM D5092 "Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers."
3. **Materials:** Materials used for the construction of monitoring wells shall be non-reactive with subsurface water and shall not leach substances into the subsurface water.
4. Materials shall be free of contaminants prior to installation.
5. Well screens shall be made by machine, and shall be constructed of 2-inch Inside Diameter x 5-foot length [nominal] sections with 65 mesh stainless steel screen, sand packed with 20x40 silica sand over .010" slotted Sch40 PVC Screen [or equivalent].
6. All joints shall be threaded. Glued or solvent- welded joints shall not be used.
7. Materials shall have adequate strength to withstand the forces of installation and well development.
8. Installation methods shall be in conformance with ASTM D5092 "Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers."
9. The equipment used shall be capable of creating a stable, open, vertical borehole for installation of the monitoring well.
10. **Well Protection:** Installation of measures to protect the monitoring well from damage from hazards such as frost action, surface drainage, animal or equipment traffic, and lack of visibility shall conform to ASTM D5092.
11. Positive surface drainage away from the well head shall be established.
12. Protection from natural or human caused damage shall be provided in conformance with ASTM D5787 "Standard Practice for Monitoring Well Protection."
13. A buffer zone with a minimum radius of 30 feet shall be established around each well head. The buffer zone shall be fenced or otherwise protected from access by motor vehicles and livestock.
14. Within the buffer zone there shall be no storage, handling, mixing, or application of fertilizers, pesticides or other agricultural chemicals or cleaning of equipment used in the handling or application of such items.
15. **Development:** The monitoring well shall be developed to improve the hydraulic connection between the target hydrogeologic unit and the well screen, to minimize the interference of sediment with water quality samples, and to restore the groundwater properties disturbed by the drilling process. The well is developed after the well is installed, including fill and sealing materials and well-head protection.
16. Well development shall ensure that only the targeted hydrogeologic unit contributes to the monitoring well and that the annular space is sealed to prevent cross contamination from other groundwater sources.
17. The well development method shall be selected from alternatives provided in ASTM D5521 "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers." The selection of the method shall be based on the physical characteristics of the target hydrogeologic unit and the drilling method used.

NOTES FOR ALL MONITORING WELL INSTALLATIONS	Prepared by: R. Clark August 16, 2018 **FIGURE 5**	THE WATER INSTITUTE OF THE GULF

Standard Specifications and Instructions for All Monitoring Well Installations

18. Installation of monitoring wells shall be reported as required by local, State, Tribal, and Federal laws and regulations.
19. **OPERATION AND MAINTENANCE:** Provisions shall be made for operation and maintenance requirements in keeping with the purpose of this standard. When no longer needed, close the well according to NRCS National Conservation Practice Standard 351 "Water Well Decommissioning."

All activities associated with this activity will be compliant with the Standards listed below:

ASTM D5092 / D5092M - 16
Standard Practice for Design and Installation of Groundwater Monitoring Wells

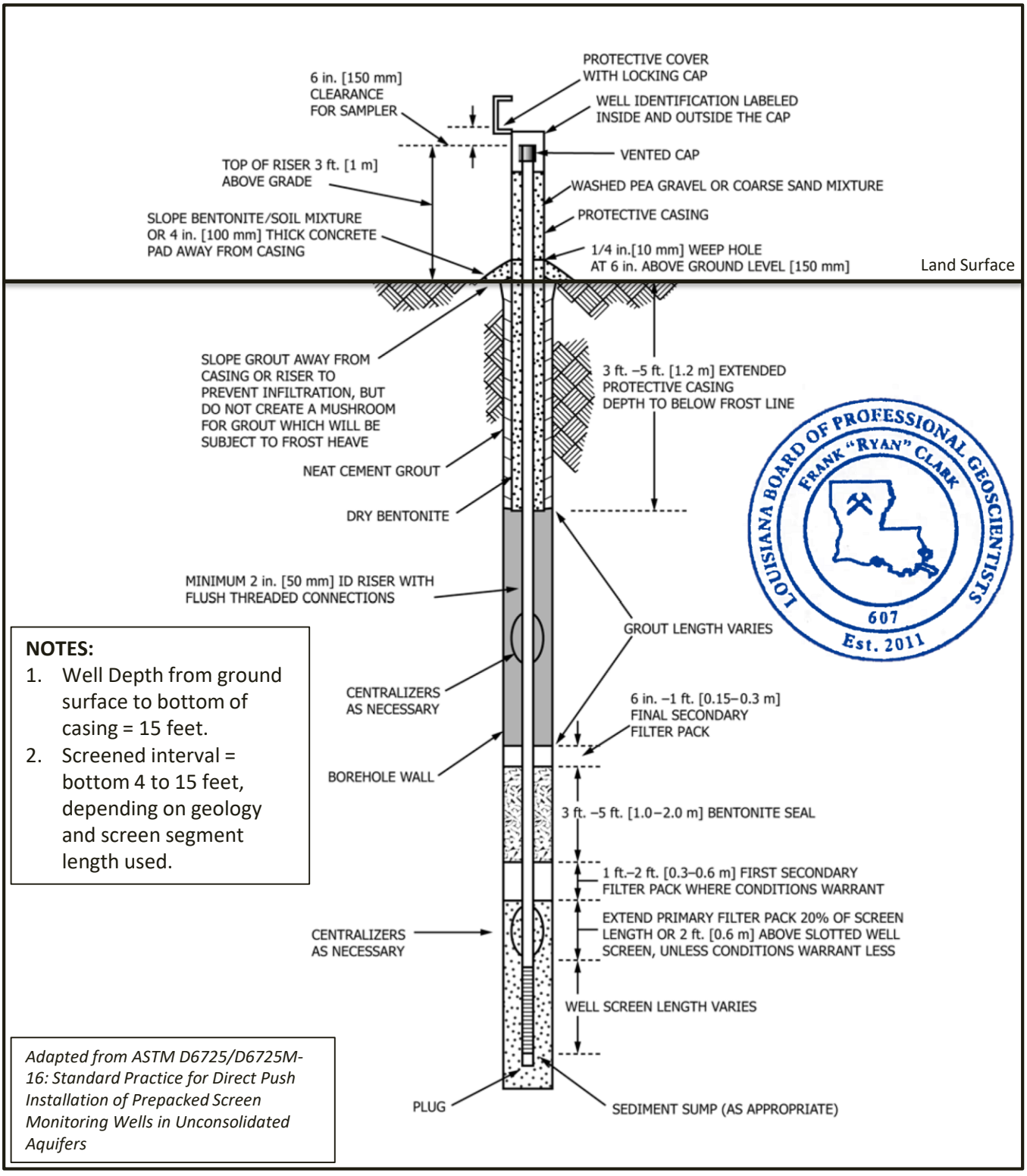
ASTM D5787 - 14
Standard Practice for Monitoring Well Protection

ASTM D6725 / D6725M - 16
Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers

Natural Resources Conservation Service (NRCS) Conservation Practice Standard
Monitoring Well Code 353 (September 2010)

Adapted in part from Natural Resources Conservation Service, Practice Standard: Monitoring Well, Code 353.

NOTES FOR ALL MONITORING WELL INSTALLATIONS	Prepared by: R. Clark August 16, 2018 **FIGURE 6**	THE WATER INSTITUTE OF THE GULF



NOTES:

1. Well Depth from ground surface to bottom of casing = 15 feet.
2. Screened interval = bottom 4 to 15 feet, depending on geology and screen segment length used.

Adapted from ASTM D6725/D6725M-16: Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers

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GENERALIZED WELL CROSS SECTION: SHALLOW/SURFACE WELLS

Vertical Datum: NGVD 29
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FIGURE 7

Drawing not to scale

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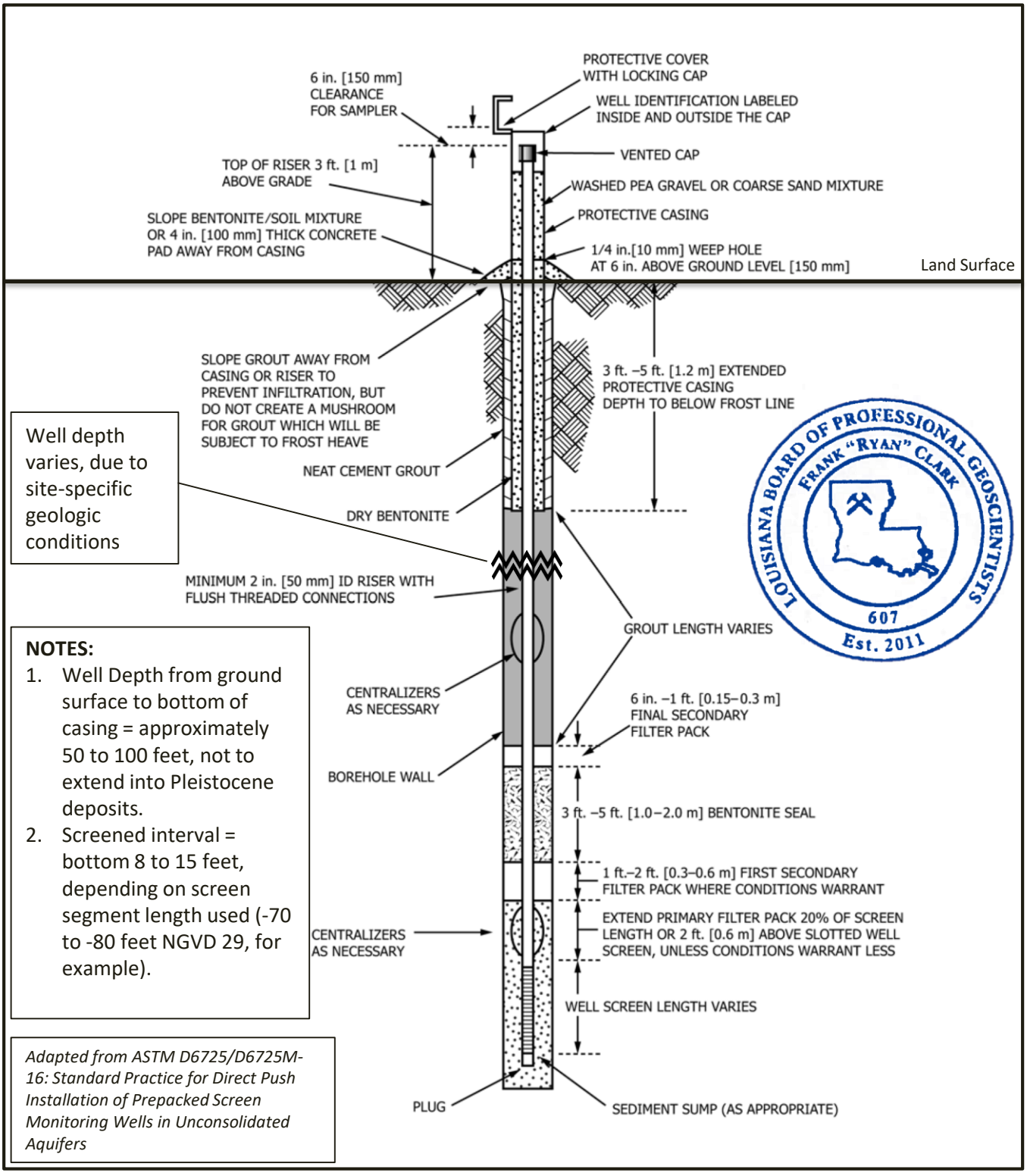

Well depth varies, due to site-specific geologic conditions

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NOTES:

1. Well Depth from ground surface to bottom of casing = approximately 50 to 100 feet, not to extend into Pleistocene deposits.
2. Screened interval = bottom 8 to 15 feet, depending on screen segment length used (-70 to -80 feet NGVD 29, for example).

Adapted from ASTM D6725/D6725M-16: Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers

GENERALIZED WELL CROSS SECTION: DEEP WELLS

Vertical Datum: NGVD 29
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August 16, 2018

FIGURE 8

Drawing not to scale

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ASTM (2014). D5787–14 Standard Practice for Monitoring Well Protection. October 2014.

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