

WatearthTM

Water Resources + Green Infrastructure



OPERATIONS & MAINTENANCE PLAN

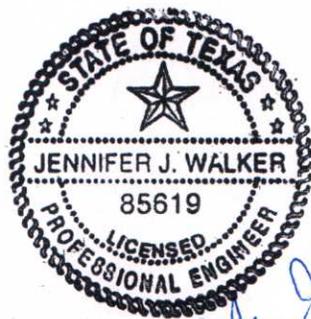
*for
City of Houston
Cottage Grove
Low Impact
Development project*

Prepared by:

**Watearth, Inc.
PO Box 10194,
Houston, Texas 77206-0194
TX Firm Registration 11279 #
713.208.1128
www.watearth.com**

For:

**City of Houston
611 Walker,
Houston, TX 77002**



*Jennifer J Walker
4/11/13*



COTTAGE GROVE LOW IMPACT DEVELOPMENT (LID) PROJECT OPERATIONS & MAINTENANCE FOR LID FACILITIES

The Cottage Grove LID Project is intended to showcase the benefits of post-construction stormwater Best Management Practices (BMPs) and LID tools. This project is sponsored by the City of Houston and partially funded by a grant from the Texas Commission on Environmental Quality (TCEQ). Watearth is excited to participate in this ground-breaking project.

The proposed LID improvements are located along Darling Street between TC Jester and Reinerman. Petty Street, which is one block north of and parallel to Darling Street, serves as a control section without improvements. Additionally, Larkin Street located one block south of and parallel to Darling Street is proposed to be improved from an open ditch section to a curb and gutter section served by storm sewer to provide an additional monitoring control.

The final plan and profile sheets are included in **Appendix A** and illustrate the location of the following LID facilities within the Cottage Grove LID Project:

- Four bioretention cells (rain gardens) located at northwest, northeast, southwest, southeast corners of intersection of Darling Street and Detering Street;
- Two bioretention cells (rain gardens) located at northwest and southwest corners of intersection of Darling Street and Reinerman;
- Ten Filterra[®] tree boxes located between TC Jester and Detering Street;
- 16 Filterra[®] tree boxes located between Detering Street and Reinerman.

The goals established for this project include:

- ✓ Demonstrate multiple LID features and post-construction BMPs
- ✓ Apply lessons learned to future City Capital Improvements Plan (CIP) and Rebuild Houston projects that include LID features and/or BMPs
- ✓ Drain all impervious areas within Darling Street between TC Jester and Reinerman through LID features to obtain water quality treatment
- ✓ Reduce proposed LID conditions peak flows within the Darling Street drainage system to existing conditions for the two-year and ten-year design storm events
- ✓ Minimize increase in runoff volume from the Darling Street drainage system during the two-year and ten-year design storm events by using LID
- ✓ Monitor hydrologic benefits of bioretention and Filterra[®] tree boxes as compared to a control section (monitoring to be performed by Rice University)

As a note of concern, it appears that due to rapid gentrification within this neighborhood, a significant sediment load is anticipated from adjacent new construction. Regular and on-going inspection and maintenance is recommended to enhance the long-term function and effectiveness of the LID facilities. O&M Fact Sheets are included in **Appendix B** and O&M Inspection Sheets are included in **Appendix C**. **Appendix D** includes the manufacturer's recommendations for the Filterra[®] system.



While this document is intended to be comprehensive with regards to O&M requirements and inspection time-frames, please refer to the following resources for additional information or any unanticipated issues encountered after construction:

Project Documents

1. Cottage Grove LID Project *Memorandum of Modeling Results* for detailed descriptions of each type of LID facility and anticipated performance;
2. Cottage Grove LID Construction Drawings and Specifications for design details and specifications;
3. Cottage Grove LID Project Landscape Specifications and Construction Drawings for additional details on plant lists and species-specific maintenance.
4. Cottage Grove LID Project Quality Assurance Project Plan (QAPP) for details on TCEQ grant compliance and implementation;
5. Cottage Grove LID Project Monitoring Plan by Rice University for additional information and details on water quality and flow monitoring from the project.

Regional Stormwater Criteria

1. July, 2012 (or latest version) City of Houston Public Works and Engineering *Infrastructure Design Manual* for additional information on City stormwater and LID design, inspection, and maintenance requirements;
2. April, 2011 (or latest version) Harris County *Low Impact Development & Green Infrastructure Design Criteria for Storm Water Management*.
3. December, 2010 (or latest version) Harris County Flood Control District *Policy, Procedure, & Criteria Manual* for additional information on regional criteria, design, and performance requirements.

O&M Resources

The following are a few of the outstanding O&M resources from around the U.S.:

1. 2008 (or latest version) City of Portland Stormwater Management Manual;
2. June, 2009 (or latest version) North Carolina Cooperative Extension *Low Impact Development A Guidebook for North Carolina*;
3. 2012 (or latest version) LID Technical Guidance Manual for Puget Sound;



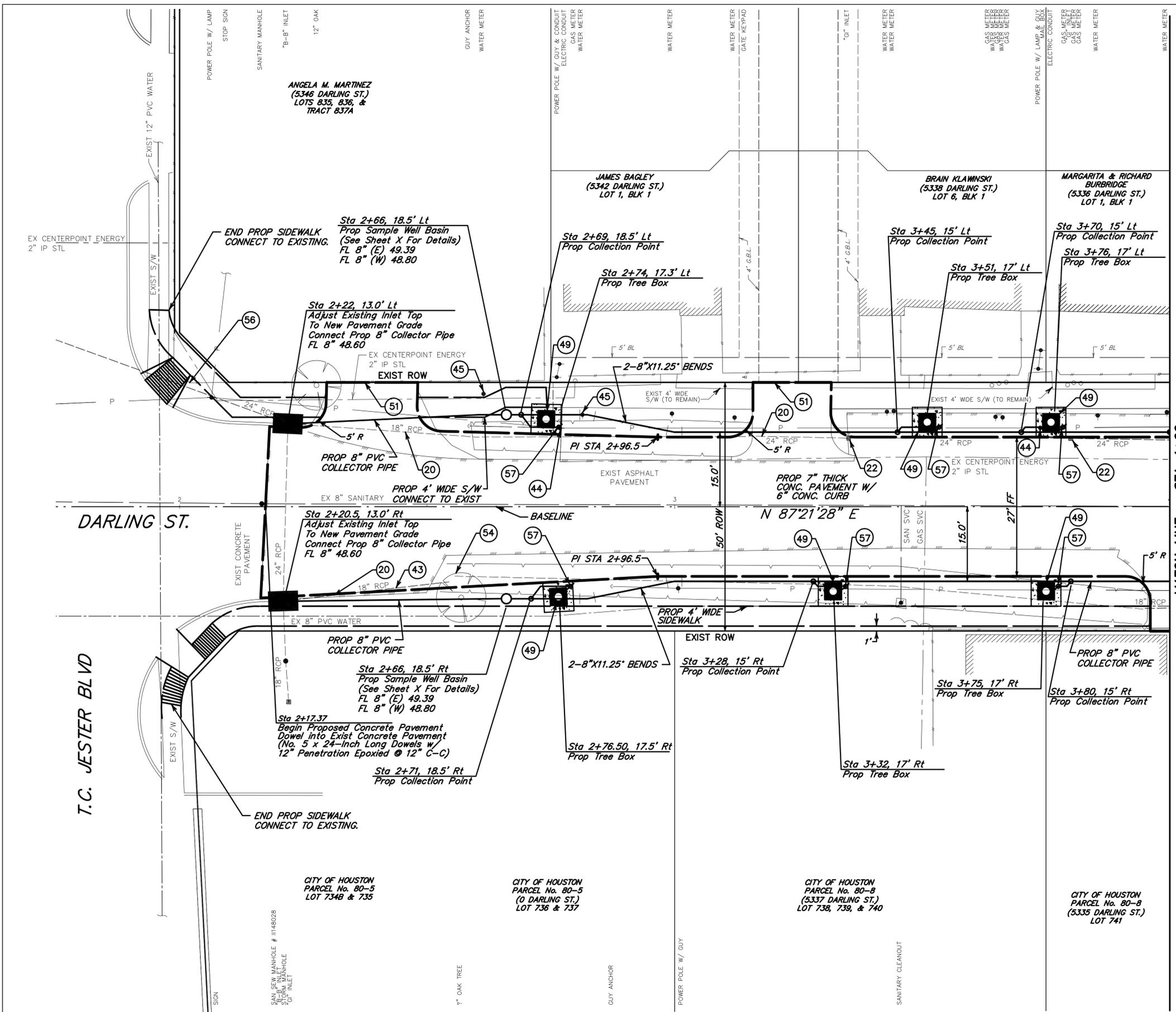
4. August 31, 2006 (or latest version) Alameda Countywide Clean Water Program C.3 Stormwater Technical Guidance;
5. U.S. Environmental Protection Agency (EPA) information on Integrated Pest Management (IPM) (www.epa.gov/opp00001/factsheets/ipm.htm) for general information on IPM;
6. University of California Statewide Integrated Pest Management Program (www.ipm.ucdavis.edu/) for additional general information on IPM specific;
7. USEPA Fact Sheet titled *Storm Water O&M Fact Sheet: Handling and Disposal of Residuals* (www.epa.gov/npdes/pubs/handdisp.pdf).

APPENDICES

- Appendix A: Plan and Profile Sheets from Construction Drawings
- Appendix B: O&M Fact Sheets
- Appendix C: O&M Inspection Sheets
- Appendix D: Filtterra[®] Manufacturer's Maintenance Recommendations



APPENDIX A: PLAN AND PROFILE SHEETS FROM CONSTRUCTION DRAWINGS



TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT AT 713-207-2222.

PRIVATE UTILITY LINES SHOWN
 AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET R.O.W. OR EASEMENTS CALL THE LONE STAR NOTIFICATION 713-223-4567.

Date: _____
 CenterPoint Energy/Electric Facilities
 Signature indicates underground electric lines are properly shown. No approval for construction is given.

Date: _____
 Approved for SBC underground conduit facilities only. Signature valid for one year.

Date: _____
 CenterPoint Energy/Gas Facilities/ENTEX Incorporated
 (Gas service lines are not shown)

CABLE COMPANY

JC JONES & CARTER, INC.
 ENGINEERS • PLANNERS • SURVEYORS
 Texas Board of Professional Engineers Registration No. F-439
 6335 Gullfong Dr., Suite 100 Houston, Texas 77081 (713) 777-5337

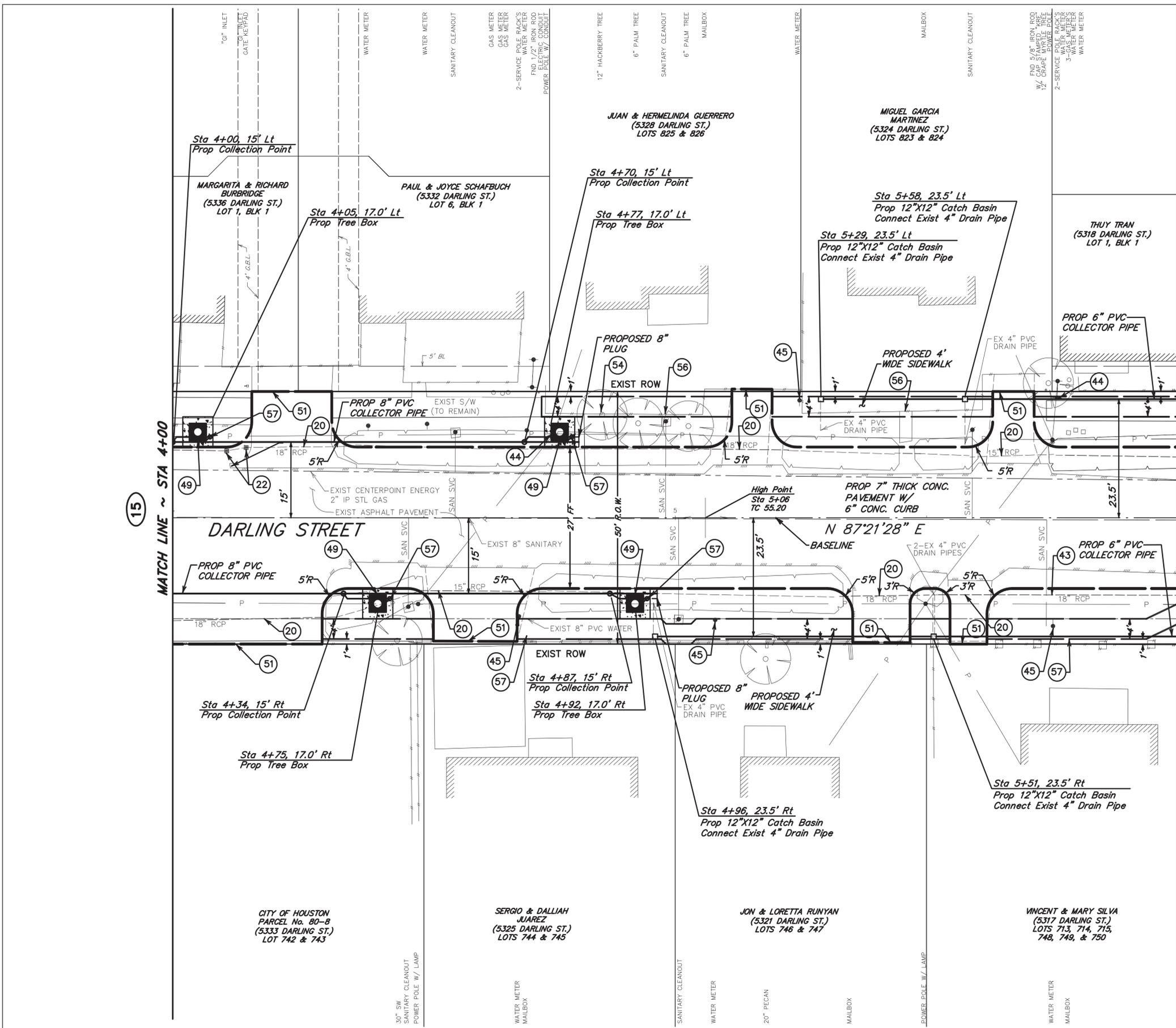
SURVEYED BY:
 GOTTEN SURVEYING COMPANY
 6335 GULLFONG DR., SUITE 103 HOUSTON, TEXAS 77081 (713) 981-0275

INTERIM REVIEW
 Not intended for construction bidding or permit purposes.
 Engineer: DAVID M. BARTON, P.E.
 P.E. Serial No.: 103416
 Date: APRIL 2013

CITY OF HOUSTON
 DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

COTTAGE GROVE LOW IMPACT DEVELOPMENT DEMONSTRATION PROJECT
DARLING ST - PLAN VIEW
 STA 1+75 TO 4+00

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
M-000297-0001-3	
DRAWING SCALE	
1"=10'	
CITY OF HOUSTON PM	
CHERYL HARRIS	
SHEET NO. 15 OF 64	



- TBM "A"**
Set Out "□" on B-B Inlet @ Northwest corner of intersection of T.C. Jester Blvd and Darling St.
Elevation = 53.46
- TBM "B"**
Found RR spike in third power pole West of Northwest corner of intersection of Detering St. and Darling St. on north side.
Elevation = 55.78
- TBM "C"**
Set 60D nail in power pole ±250' West of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 56.13
- TBM "D"**
Set 60D nail in power pole ±100' East of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 55.21

TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT AT 713-207-2222.

PRIVATE UTILITY LINES SHOWN
AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET R.O.W. OR EASEMENTS CALL THE LONE STAR NOTIFICATION 713-223-4567.

Date: _____
CenterPoint Energy/Electric Facilities
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Date: _____
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Signature valid for one year.

Date: _____
CenterPoint Energy/Gas Facilities/ENTEX Incorporated
(Gas service lines are not shown)

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SURVEYED BY:
CS COTTON SURVEYING COMPANY
6335 GULLFONG DR., SUITE 103 HOUSTON, TEXAS 77081 (713) 981-0275

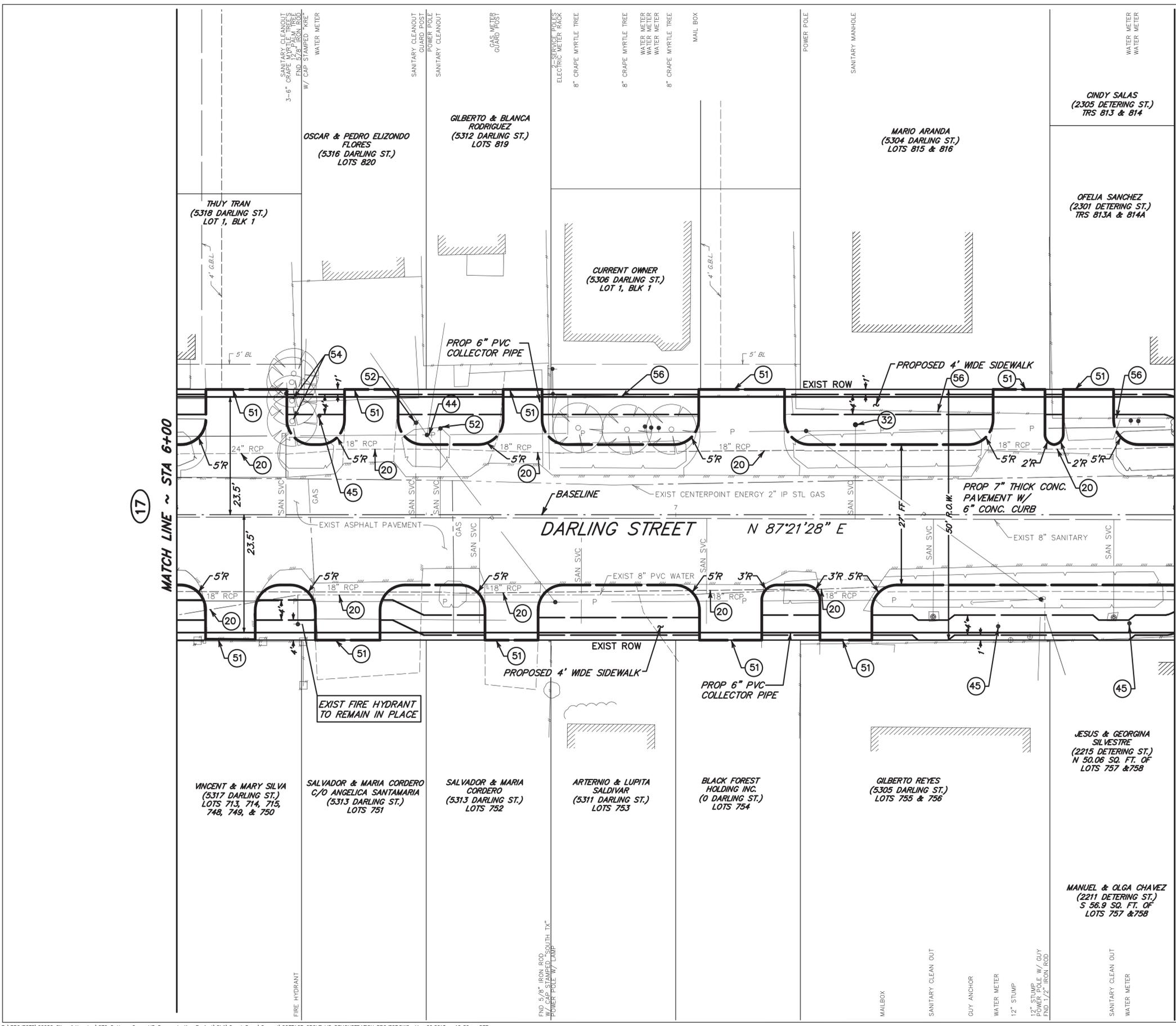
INTERIM REVIEW
Not intended for construction bidding or permit purposes.
Engineer: DAVID M. BARTON, P.E.
P.E. Serial No.: 103416
Date: MARCH 2013

FB NO. 2421 PG. 2-12

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

COTTAGE GROVE LOW IMPACT DEVELOPMENT DEMONSTRATION PROJECT
DARLING ST - PLAN VIEW
STA 4+00 TO 6+00

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
M-000297-0001-3	
DRAWING SCALE	
1"=10'	
CITY OF HOUSTON PM	
CHERYL HARRIS	
SHEET NO. 17 OF 62	



- TBM "A"**
Set Out "□" on B-B Inlet @ Northwest corner of intersection of T.C. Jester Blvd and Darling St.
Elevation = 53.46
- TBM "B"**
Found RR spike in third power pole West of Northwest corner of intersection of Detering St. and Darling St. on north side.
Elevation = 55.78
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Elevation = 56.13
- TBM "D"**
Set 60D nail in power pole ±100' East of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 55.21

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PRIVATE UTILITY LINES SHOWN
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Date: _____

CenterPoint Energy/Electric Facilities
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Date: _____

Approved for SBC underground conduit facilities only.
Signature valid for one year.

Date: _____

CenterPoint Energy/Gas Facilities/ENTEX Incorporated
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CABLE COMPANY

JC JONES & CARTER, INC.
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Texas Board of Professional Engineers Registration No. F-439
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SURVEYED BY:
GOTTSON SURVEYING COMPANY
6335 GULFTON DR., SUITE 103
HOUSTON, TEXAS 77081
(713) 981-0275

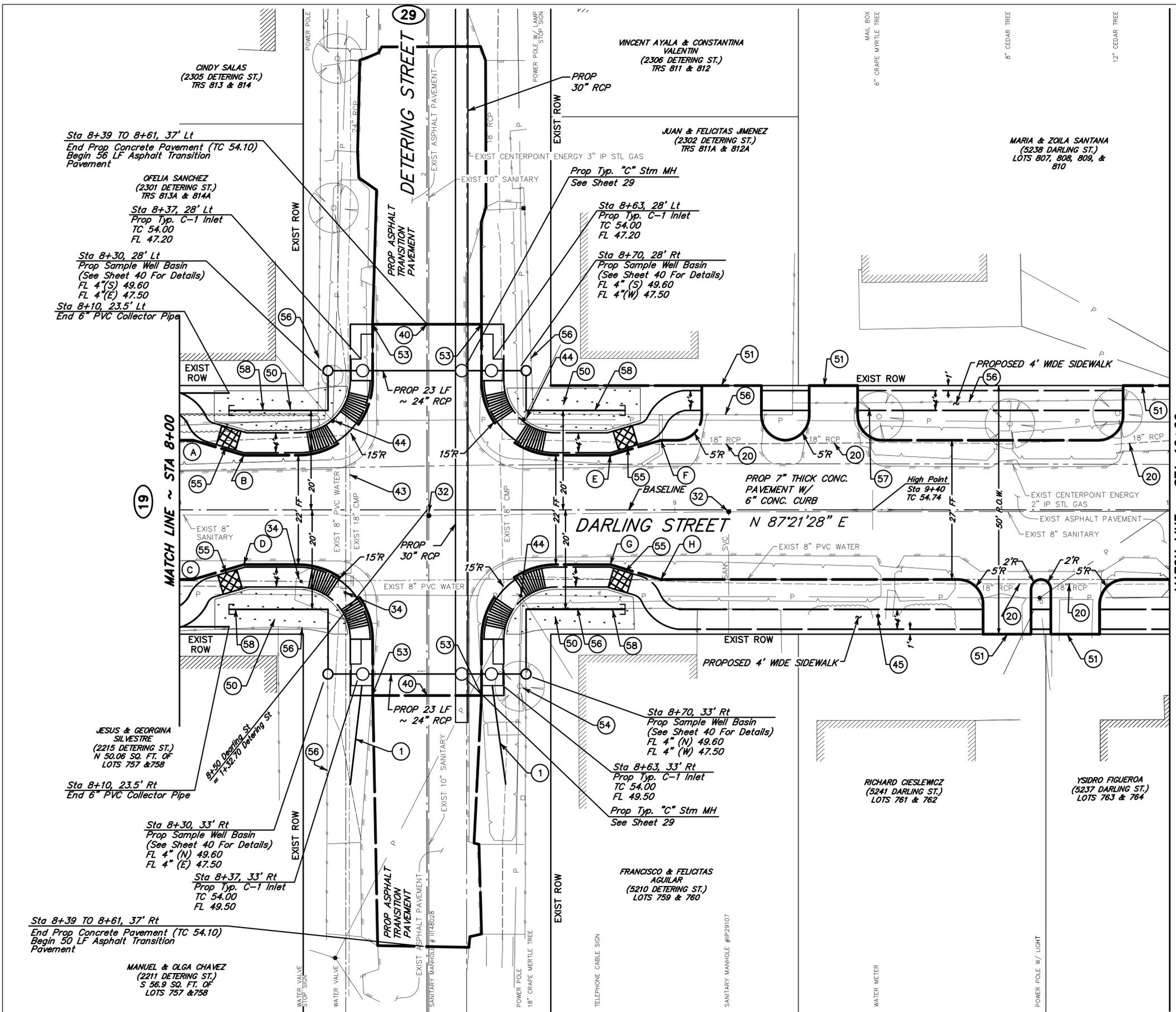
INTERIM REVIEW
Not intended for construction, bidding or permit purposes.
Engineer: DAVID M. BARTON, P.E.
P.E. Serial No.: 103416
Date: MARCH 2013

FB NO. 2421 PG. 2-12

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

COTTAGE GROVE LOW IMPACT DEVELOPMENT DEMONSTRATION PROJECT
DARLING ST - PLAN VIEW
STA 6+00 TO 8+00

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
M-000297-0001-3	
DRAWING SCALE	
1"=10'	
CITY OF HOUSTON PM	
CHERYL HARRIS	
SHEET NO. 19 OF 62	



POINT LOCATION DATA

POINT	Station	Frm @	TC ELEV
A	8+02.75	14' (Lt)	54.31
B	8+13.00	11' (Lt)	54.27
C	8+02.75	14' (Rt)	54.31
D	8+13.00	11' (Rt)	54.27
E	8+87.00	11' (Lt)	54.24
F	8+97.25	14' (Lt)	54.28
G	8+87.00	11' (Rt)	54.24
H	8+97.25	14' (Rt)	54.28

- TBM "A"**
Set Cut "C" on B-B Inlet @ Northwest corner of intersection of T.C. Jester Blvd and Darling St.
Elevation = 53.46
- TBM "B"**
Found RR spike in third power pole West of Northwest corner of intersection of Detering St. and Darling St. on north side.
Elevation = 55.78
- TBM "C"**
Set 60D nail in power pole ±250' West of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 56.13
- TBM "D"**
Set 60D nail in power pole ±100' East of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 55.21

TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT AT 713-207-2222.

PRIVATE UTILITY LINES SHOWN
AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET R.O.W. OR EASEMENTS CALL THE LONE STAR NOTIFICATION 713-223-4567.

Date: _____

CenterPoint Energy/Electric Facilities
Signature indicates underground electric lines are properly shown. No approval for construction is given.

Date: _____

Approved for SBC underground conduit facilities only.
Signature valid for one year.

Date: _____

CenterPoint Energy/Gas Facilities/ENTEX Incorporated
(Gas service lines are not shown)

CABLE COMPANY _____

JC JONES & CARTER, INC.
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Texas Board of Professional Engineers Registration No. F-439
6335 Gullfong Dr., Suite 100 Houston, Texas 77081 (713) 777-5337

SURVEYED BY:
CS COTTON SURVEYING COMPANY
6335 GULLFONG DR., SUITE 103 HOUSTON, TEXAS 77081 (713) 981-0275

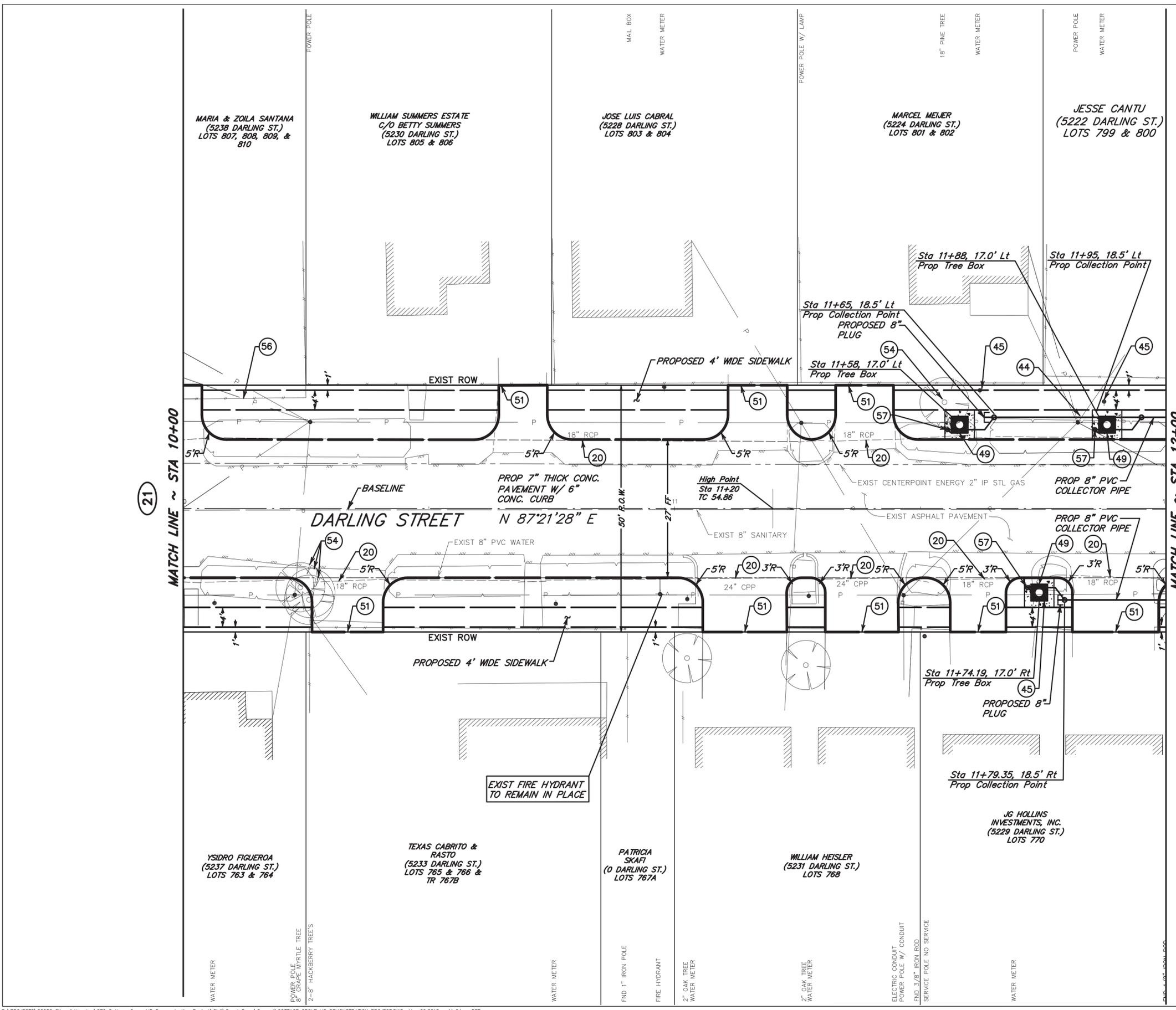
INTERIM REVIEW
Not intended for construction, bidding or permit purposes.
Engineer: DAVID M. BARTON, P.E.
P.E. Serial No.: 103416
Date: APRIL 2013

FB NO. 2421 PG. 2-12

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

COTTAGE GROVE LOW IMPACT DEVELOPMENT DEMONSTRATION PROJECT
DARLING ST - PLAN VIEW
STA 8+00 TO 10+00

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
M-000297-0001-3	
DRAWING SCALE	
1"=10'	
CITY OF HOUSTON PM	
CHERYL HARRIS	
SHEET NO. 21 OF 64	



- TBM "A"**
Set Cut "□" on B-B Inlet @ Northwest corner of intersection of T.C. Jester Blvd and Darling St.
Elevation = 53.46
- TBM "B"**
Found RR spike in third power pole West of Northwest corner of intersection of Detering St. and Darling St. on north side.
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- TBM "C"**
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Elevation = 56.13
- TBM "D"**
Set 60D nail in power pole ±100' East of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 55.21



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PRIVATE UTILITY LINES SHOWN
AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET R.O.W. OR EASEMENTS CALL THE LONE STAR NOTIFICATION 713-223-4567.

Date: _____
CenterPoint Energy/Electric Facilities
Signature indicates underground electric lines are properly shown. No approval for construction is given.

Date: _____
Approved for SBC underground conduit facilities only.
Signature valid for one year.

Date: _____
CenterPoint Energy/Gas Facilities/ENTEX Incorporated
(Gas service lines are not shown)

CABLE COMPANY

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Texas Board of Professional Engineers Registration No. F-439
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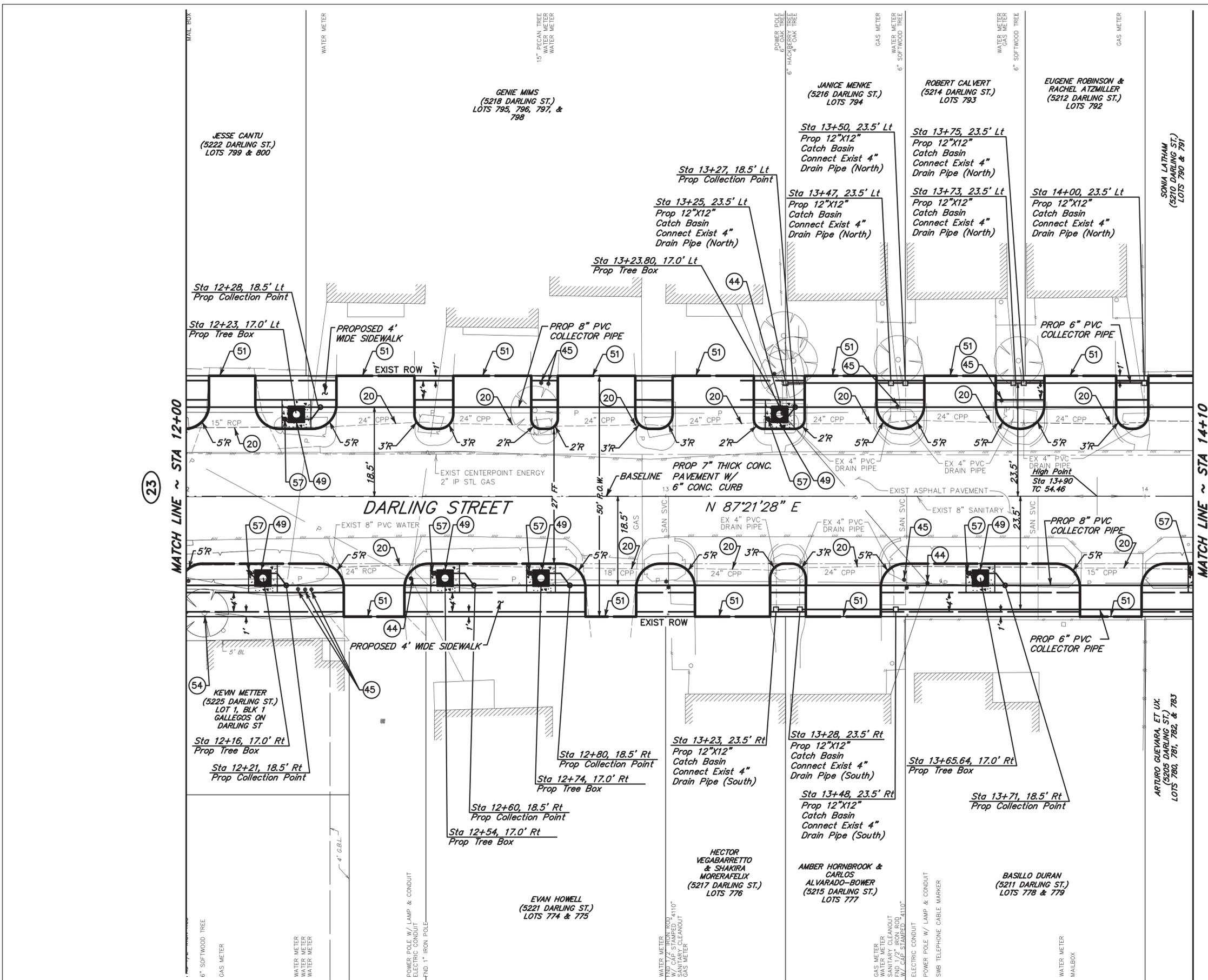
SURVEYED BY:
CS COTTON SURVEYING COMPANY
6335 GULFTON DR., SUITE 103 HOUSTON, TEXAS 77081 (713) 981-0275

INTERIM REVIEW
Not intended for construction, bidding or permit purposes.
Engineer: DAVID M. BARTON, P.E.
P.E. Serial No.: 103416
Date: MARCH 2013

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

COTTAGE GROVE LOW IMPACT DEVELOPMENT DEMONSTRATION PROJECT
DARLING ST – PLAN VIEW
STA 10+00 TO 12+00

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
M-000297-0001-3	
DRAWING SCALE	
1"=10'	
CITY OF HOUSTON PM	
CHERYL HARRIS	
SHEET NO. 23 OF 62	



- TBM "A"**
Set Cut "□" on B-B Inlet @ Northwest corner of intersection of T.C. Jester Blvd and Darling St.
Elevation = 53.46
- TBM "B"**
Found RR spike in third power pole West of Northwest corner of intersection of Detering St. and Darling St. on north side.
Elevation = 55.78
- TBM "C"**
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Elevation = 56.13
- TBM "D"**
Set 60D nail in power pole ±100' East of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 55.21

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PRIVATE UTILITY LINES SHOWN
AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET R.O.W. OR EASEMENTS CALL THE LONE STAR NOTIFICATION 713-223-4567.

Date: _____
CenterPoint Energy/Electric Facilities
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Date: _____
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Signature valid for one year.

Date: _____
CenterPoint Energy/Gas Facilities/ENTEX Incorporated
(Gas service lines are not shown)

CABLE COMPANY

JC JONES & CARTER, INC.
ENGINEERS • PLANNERS • SURVEYORS
Texas Board of Professional Engineers Registration No. F-439
6335 GULFTON DR., SUITE 100 HOUSTON, TEXAS 77081 (713) 777-5337

SURVEYED BY:
SCOTT SURVEYING COMPANY
6335 GULFTON DR., SUITE 103 HOUSTON, TEXAS 77081 (713) 981-0275

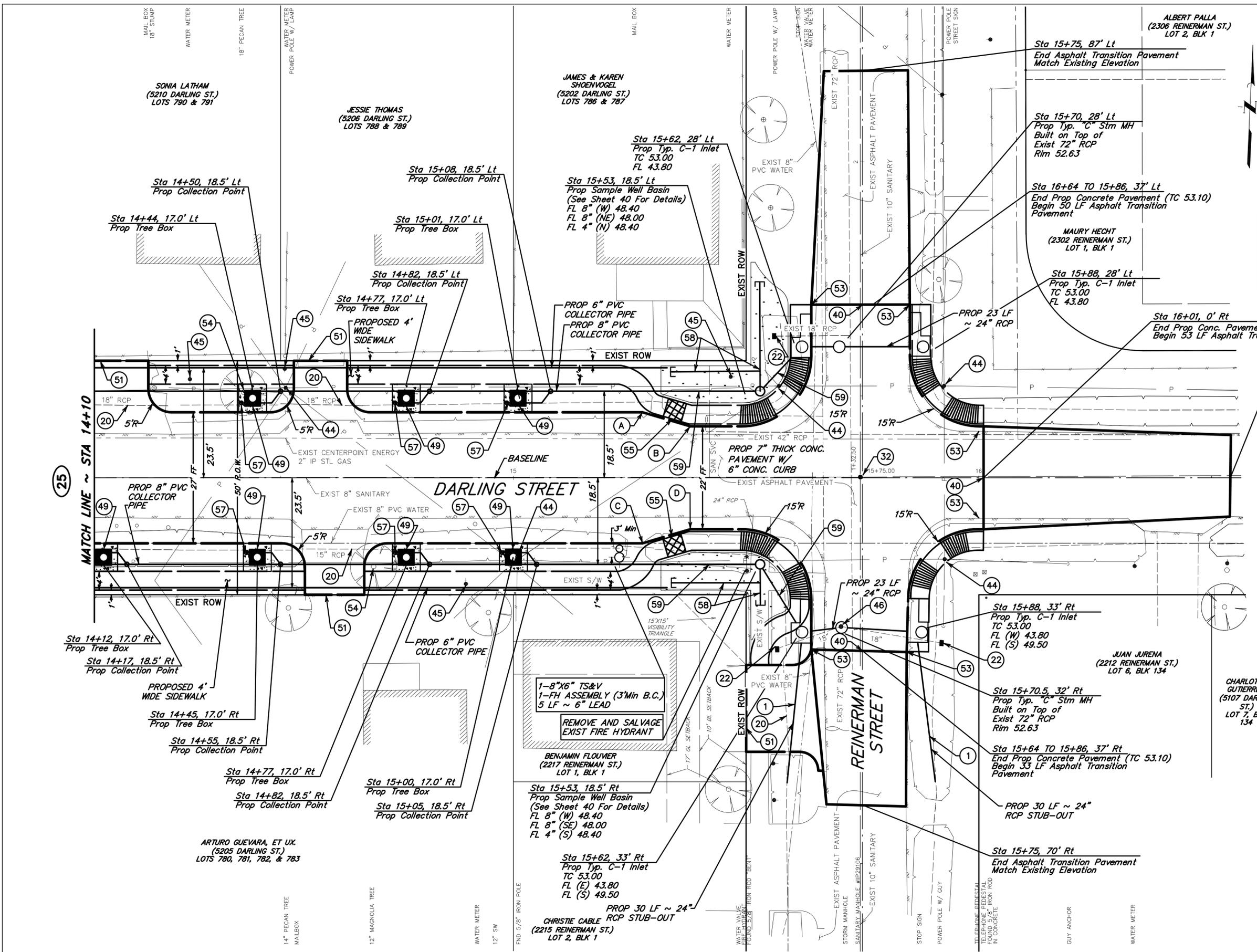
INTERIM REVIEW
Not intended for construction, bidding or permit purposes.
Engineer: DAVID M. BARTON, P.E.
P.E. Serial No.: 103416
Date: MARCH 2013

FB NO. 2421 PG. 2-12

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

COTTAGE GROVE LOW IMPACT DEVELOPMENT DEMONSTRATION PROJECT
DARLING ST - PLAN VIEW
STA 12+00 TO 14+10

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
M-000297-0001-3	
DRAWING SCALE	
1"=10'	
CITY OF HOUSTON PM	
CHERYL HARRIS	
SHEET NO. 25 OF 62	



- TBM "A"**
Set Cut "C" on B-B Inlet @ Northwest corner of intersection of T.C. Jester Blvd and Darling St.
Elevation = 53.46
- TBM "B"**
Found RR spike in third power pole West of Northwest corner of intersection of Detering St. and Darling St. on north side.
Elevation = 55.78
- TBM "C"**
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Elevation = 56.13
- TBM "D"**
Set 60D nail in power pole ±100' East of Northwest corner of intersection of Darling St. and Reinerman St.
Elevation = 55.21

POINT LOCATION DATA			
POINT	Station	Frm &	TC ELEV
A	15+27.75	14' (Lt)	53.44
B	15+38.00	11' (Lt)	53.37
C	15+27.75	14' (Rt)	53.44
D	15+38.00	11' (Rt)	53.37

Sta 16+54, 0' Rt
End Asphalt Transition Pavement
Match Existing Elevation

TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT AT 713-207-2222.

PRIVATE UTILITY LINES SHOWN
AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET R.O.W. OR EASEMENTS CALL THE LONE STAR NOTIFICATION 713-223-4567.

Date: _____
CenterPoint Energy/Electric Facilities
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Date: _____
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Signature valid for one year.

Date: _____
CenterPoint Energy/Gas Facilities/ENTEX Incorporated
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ENGINEERS • PLANNERS • SURVEYORS
Texas Board of Professional Engineers Registration No. F-439
6335 Gullfong Dr., Suite 100 Houston, Texas 77081 (713) 777-5337

SURVEYED BY:
CS BOTTOM SURVEYING COMPANY
6335 GULLFONG DR., SUITE 103 HOUSTON, TEXAS 77081 (713) 981-0275

INTERIM REVIEW
Not intended for construction bidding or permit purposes.
Engineer: DAVID M. BARTON, P.E.
P.E. Serial No.: 103416
Date: APRIL 2013

FB NO. 2421 PG. 2-12

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

COTTAGE GROVE LOW IMPACT DEVELOPMENT DEMONSTRATION PROJECT
DARLING ST - PLAN VIEW
STA 14+10 TO 16+60

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
M-000297-0001-3	
DRAWING SCALE	
1"=10'	
CITY OF HOUSTON PM	
CHERYL HARRIS	
SHEET NO. 27	OF 64



APPENDIX B: O&M FACT SHEETS



O&M FACT SHEET 1: RAIN GARDENS

What To Look For	What To Do as Required
Structural Components , including inlets and outlets/overflows, shall freely convey stormwater.	
➤ Clogged inlets or outlets	➤ Remove sediment and debris from catch basins, trench drains, curb inlets, and pipes to maintain at least 50% conveyance capacity at all times.
➤ Cracked drain pipes or grates	➤ Repair/seal cracks. Replace when repair is insufficient.
Vegetation shall cover minimum of 75% of ground surface.	
➤ Dead or strained vegetation	➤ Replant per original planting plan ¹ . Maintain minimum 75% vegetative cover.
➤ Grasses and vegetation	➤ Irrigate as needed for establishment during first 18 to 24 months after planting or replanting.
	➤ Remove and replace mulch annually (shredded hardwood mulch preferred) ² . Do not apply fertilizers, herbicides, or pesticides ³ .
	➤ Cut back vegetation if desired.
	➤ Prune other vegetation overgrowth.
➤ Weeds	➤ Prune to allow sight lines and foot traffic.
Sediment and Debris , including sediment and floatables removal and sediment disposal.	
➤ Sediment Loads	➤ Manually remove weeds. Remove all plant debris.
➤ Sediment/Debris Removal	➤ Inspect annually roadway and landscape areas that may contribute to sediment loading issues.
	➤ Record sediment accumulation in inspection logs. Check whether sedimentation has encroached on design volume by comparing actual maximum depth against design maximum depth.
➤ Manually remove and dispose of accumulated sediment and debris.	
Growing/Filter Medium , including soil and gravels, shall sustain healthy plant cover and infiltrate within 48 hours after end of rainfall event, without isolated ponding areas or pockets of ponding.	
➤ Gullies	➤ Fill, lightly compact, and install plant vegetation to disperse flow.
➤ Erosion	➤ Repair inlet gravel/rock or other erosion control elements.
➤ Slopes	➤ Stabilize 3:1 (i.e., maximum slope of 33%) slopes/banks with plantings from original planting plan.
➤ Ponding	➤ Record ponding in excess of 48 hours after end of rainfall event and/or sediment accumulation in inspection logs.
	➤ Rake, till or amend to restore infiltration rate ² .
	➤ Use compost and mulch without animal manure to avoid leaching of nutrients in stormwater facilities ² .

¹Refer to Landscape Specifications and Construction Drawings for project for additional details on plant lists.

²Use compost and mulch without manure or animal by-products to avoid leaching of contaminants into stormwater facilities.

³Do not use fertilizers, herbicides, or pesticides as these are water quality facilities and stormwater runoff typically contains contaminants (i.e., nitrogen, phosphorous, and hydrocarbons) that serve as nutrients for the vegetation. At a minimum, follow Integrated Pest Management (IPM) practices. See U.S. Environmental Protection Agency (EPA) website at www.epa.gov/opp00001/factsheets/ipm.htm for details.



O&M FACT SHEET 1: RAIN GARDENS

Inspection and Maintenance Schedules:

See Inspection Sheets.

Maintenance Records:

Inspect and maintain facilities to ensure proper function and aesthetic appearance. Record date, description, and contractor, or City staff for all structural repairs and facility clean-out activities in Inspection Sheets.

Replacement and Reconstruction:

Use adaptive management methods to determine reconstruction or replacement of the facilities.

Infiltration/Flow Control:

All facilities shall drain completely within 48 hours after end of rainfall event. Record time, date, and weather conditions when excessive ponding occurs or 48 hours is exceeded. Use practices specified under Growing/Filter Medium maintenance to restore capacity, if needed.

Pollution Prevention:

Implement Best Management Practices (BMPs) to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater. Clean out system immediately in the event of an oil or gasoline spill. See City's SWPPP for additional information. Use compost and mulch without manure and/or animal by-products to avoid leaching of contaminants in stormwater facilities.

Sediment Disposal:

Current research generally indicates that residuals are not hazardous wastes and can generally be disposed of in the same way as uncontaminated soil once dewatered. Refer to the USEPA Fact Sheet titled *Storm Water O&M Fact Sheet: Handling and Disposal of Residuals* (www.epa.gov/npdes/pubs/handdisp.pdf) for additional guidance on residual disposal.

Vectors (Mosquitoes & Rodents):

Comply with City of Houston Public Health Department vector control requirements. All facilities shall drain within 48 hours after end of rainfall event.

Access: Maintain ingress/egress, including access roads, to design standards.



O&M FACT SHEET 2: AMERICAST FILTERRA® UNIT (TREE BOX)¹

What To Look For	What To Do as Required
Structural Components , including inlets and outlets/overflows, shall freely convey stormwater.	
➤ Clogged inlets or outlets	➤ Remove sediment and debris from catch basins, trench drains, curb inlets, and pipes to maintain at least 50% conveyance capacity at all times.
➤ Cracked drain pipes or grates	➤ Repair/seal cracks. Replace when repair is insufficient.
Vegetation shall consist of one healthy tree or shrub per Filterra® unit.	
➤ Dead or strained vegetation	➤ Replant per original planting plan ² . Maintain minimum of one healthy tree or shrub per Filterra® unit.
➤ Trees and shrubs	➤ Irrigate as needed for establishment during first 18 to 24 months after planting or replanting.
	➤ Remove and replace mulch annually (shredded hardwood mulch preferred) ³ . Do not apply fertilizers, herbicides, or pesticides ⁴ .
	➤ Cut back vegetation if desired.
➤ Weeds	➤ Prune to allow sight lines and foot traffic.
➤ Weeds	➤ Manually remove weeds. Remove all plant debris.
Sediment and Debris , including sediment and floatables removal and sediment disposal.	
➤ Sediment Loads	➤ Inspect annually roadway and landscape areas that may contribute to sediment loading issues.
➤ Sediment/Debris Removal	➤ Record sediment accumulation in inspection logs. Check whether sedimentation has encroached on design volume by comparing actual maximum depth against design maximum depth.
	➤ Manually remove and dispose of accumulated sediment and debris.
Growing/Filter Medium , including soil and gravels, shall sustain healthy plant cover and infiltrate within 48 hours after end of rainfall event, without isolated ponding areas or pockets of ponding.	
➤ Erosion	➤ Repair inlet gravel/rock or other erosion control elements.
➤ Ponding	➤ Record ponding in excess of 48 hours after end of rainfall event and/or sediment accumulation in inspection logs.
	➤ Rake, till or amend to restore infiltration rate ³ .
	➤ Use compost and mulch without animal manure to avoid leaching of nutrients in stormwater facilities ³ .

¹See Appendix C for manufacturer’s recommendations for O&M activities and inspection procedures summarized in this Fact Sheet. Note that the first year of maintenance is included in the cost of the system and provided by Americast.

²Refer to Landscape Specifications and Construction Drawings for project for additional details on plant lists.

³Use compost and mulch without manure or animal by-products to avoid leaching of contaminants into stormwater facilities.

⁴Do not use fertilizers, herbicides, or pesticides as these are water quality facilities and stormwater runoff typically contains contaminants (i.e., nitrogen, phosphorous, and hydrocarbons) that serve as nutrients for the vegetation. At a minimum, follow Integrated Pest Management (IPM) practices. See U.S. Environmental Protection Agency (EPA) website at www.epa.gov/opp00001/factsheets/ipm.htm for details.



O&M FACT SHEET 2: AMERICAST FILTERRA® UNIT (TREE BOX)

Inspection and Maintenance Schedules:

See Inspection Sheets.

Maintenance Records:

Inspect and maintain facilities to ensure proper function and aesthetic appearance. Record date, description, and contractor, or City staff for all structural repairs and facility clean-out activities in Inspection Sheets.

Replacement and Reconstruction:

Use adaptive management methods to determine reconstruction or replacement of the facilities.

Infiltration/Flow Control:

All facilities shall drain completely within 48 hours after end of rainfall event. Record time, date, and weather conditions when excessive ponding occurs or 48 hours is exceeded. Use practices specified under Growing/Filter Medium maintenance to restore capacity, if needed.

Pollution Prevention:

Implement Best Management Practices (BMPs) to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater. Clean out system immediately in the event of an oil or gasoline spill. See City's SWPPP for additional information. Use compost and mulch without manure and/or animal by-products to avoid leaching of contaminants in stormwater facilities.

Sediment Disposal:

Current research generally indicates that residuals are not hazardous wastes and can generally be disposed of in the same way as uncontaminated soil once dewatered. Refer to the USEPA Fact Sheet titled *Storm Water O&M Fact Sheet: Handling and Disposal of Residuals* (www.epa.gov/npdes/pubs/handdisp.pdf) for additional guidance on residual disposal.

Vectors (Mosquitoes & Rodents):

Comply with City of Houston Public Health Department vector control requirements. All facilities shall drain within 48 hours after end of rainfall event.

Access: Maintain ingress/egress, including access roads, to design standards.



APPENDIX C: O&M INSPECTION SHEETS



RAIN GARDENS INSPECTION SHEET

Location: Darling Street between TC Jester and Reinerman

Inspection/Maintenance Notes:

Date (Month/Day/Year): _____

Note: *Do not use fertilizers or pesticides/herbicides in Rain Gardens.*



Photo courtesy of Watearth (Copyright 2010 – 2013)

	Item	Activity	When	Names (Print)	Comments
Inspection					
<input type="checkbox"/>	1	Inspect for structural issues (cracked drain pipes or grates, etc.)	One time each fall/winter and spring/summer		
<input type="checkbox"/>	2	Inspect for clogged inlets or outlets (pipes)	After major rainfall event or one time each fall/winter and		
	3	Inspect for contributing sediment load from roadway and/or adjacent landscape	Ongoing		
<input type="checkbox"/>	4	Check for erosion, debris, and sediment accumulation	Ongoing/measure quarterly		
<input type="checkbox"/>	5	Inspect for weeds and dead/strained vegetation	Ongoing		
<input type="checkbox"/>	6	Check for ponded water in excess of three days after major rainfall events	After major rainfall event or minimum of twice annually		
Maintenance					
<input type="checkbox"/>	8	Make any structural repairs	As-needed		
<input type="checkbox"/>	9	Improve filter medium as needed	As-needed		
<input type="checkbox"/>	10	Clear inlets and outlet/overflows to maintain conveyance	As-needed		
<input type="checkbox"/>	11	Replant exposed soil and replace dead plants	Fall or spring		
<input type="checkbox"/>	12	Irrigate as needed for establishment during first 18 to 24 months after planting or replanting.	Spring through early fall		
<input type="checkbox"/>	13	Remove trash, litter, sediment, and debris	Ongoing		
<input type="checkbox"/>	14	Manually remove weeds and plant debris (DO NOT USE HERBICIDES AS THEY IMPACT WATER QUALITY)	Ongoing		
<input type="checkbox"/>	15	Prune vegetation overgrowth if straggly or dried out. Use only hand tools. No weed-whackers or gas-powered equipment.	Late winter/early spring		
<input type="checkbox"/>	16	Remove and replace mulch annually (shredded hardwood mulch preferred; DO NOT USE BARK OR DYED MULCH)	Late spring (April or May)		



AMERICAST FILTERRA® UNIT (TREE BOX) INSPECTION SHEET

Location: Darling Street between TC Jester and Reinerman

Inspection/Maintenance Notes:

Date (Month/Day/Year): _____



Photo courtesy of Americast (www.filterra.com)

Note: *Do not use fertilizers or pesticides/herbicides in Filterra® Unit (Tree Box).*

Item	Activity	When	Names (Print)	Comments
Inspection				
<input type="checkbox"/>	1	Inspect for structural issues (cracked drain pipes or grates, etc.)	One time each fall/winter and spring/summer	
<input type="checkbox"/>	2	Inspect for clogged inlets or outlets (pipes)	After major rainfall event or one time each fall/winter and	
<input type="checkbox"/>	3	Inspect for contributing sediment load from roadway and/or adjacent landscape	Ongoing	
<input type="checkbox"/>	4	Check for erosion, debris, and sediment accumulation	Ongoing/measure quarterly	
<input type="checkbox"/>	5	Inspect for weeds and dead/strained vegetation	Ongoing	
<input type="checkbox"/>	6	Check for ponded water in excess of 48 hours after major rainfall events	After major rainfall event or minimum of twice annually	
Maintenance				
<input type="checkbox"/>	8	Make any structural repairs	As-needed	
<input type="checkbox"/>	9	Improve filter medium as needed	As-needed	
<input type="checkbox"/>	10	Clear inlets and outlet/overflows to maintain conveyance	As-needed	
<input type="checkbox"/>	11	Remove and replace dead trees and shrubs	Fall or spring	
<input type="checkbox"/>	12	Irrigate as needed for establishment during first 18 to 24 months after planting or replanting.	Spring through early fall	
<input type="checkbox"/>	13	Remove trash, litter, sediment, and debris	Ongoing	
<input type="checkbox"/>	14	Manually remove weeds and plant debris (DO NOT USE HERBICIDES AS THEY IMPACT WATER QUALITY)	Ongoing	
<input type="checkbox"/>	15	Prune vegetation overgrowth if straggly or dried out. Use only hand tools. No weed-whackers or gas-powered equipment.	Late winter/early spring	
<input type="checkbox"/>	16	Remove and replace mulch annually (shredded hardwood mulch preferred; DO NOT USE BARK OR DYED MULCH)	Late spring (April or May)	



APPENDIX D: FILERRA® MANUFACTURER’S MAINTENANCE RECOMMENDATIONS

Maintenance Services

for
Filterra® Stormwater Bioretention
Filtration Systems



- Extended Maintenance Service
- Maintenance Training for your
Landscape Contractor or Local DPW



Corporate Headquarters
11352 Virginia Precast Road
Ashland, VA 23005
Toll Free: (866) 349-3458
Fax: (804) 798-8400

E-mail: design@filterra.com
www.filterra.com

Filterra® - Americast
11352 Virginia Precast Road
Ashland, VA 23005

Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP Maintenance Agreement.



Maintenance Includes

Filterra maintenance includes:

- Unit inspection
- Debris, trash & mulch removal & disposal
- Filter media evaluation
- Plant health evaluation
- Replacement of mulch
- Updated and stored records of performed maintenance

- Avoid legal challenges from your jurisdiction's maintenance enforcement program.
- Prolong the expected lifespan of your Filterra media.
- Avoid more costly media replacement.
- Help reduce pollutant loads leaving your property.



Why use Filterra Services?

- As the manufacturer we have performed 1,000's of maintenance visits.
- Filterra will schedule visits and keep maintenance records for you.
- Cost effective, multi-year plans available.
- Backed by Filterra's technical department.
- Use only Filterra approved materials.



Training Includes

- Site visit by Filterra personnel.
- Full maintenance demonstration on a single unit.
- Instructional DVD.
- *Maintenance Instruction Manual* complete with color photos.
- Maintenance forms for keeping your own records.

Please complete all sections, detach and return to Filterra® or call 866-349-3458

Project Name: _____

Site Address: _____

Contact Information: _____

Name: _____

Company Name (if applicable): _____

Phone: _____ E-mail: _____

- Owner
- Owner Representative
- Current Occupant
- Home Owner Association

I am interested in:

- Extended Maintenance
- Maintenance Training

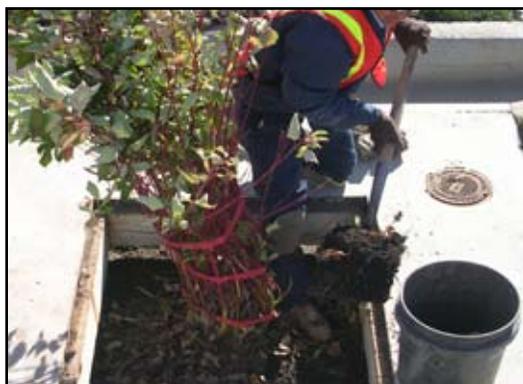
Filterra® Maintenance Steps



1. Inspection of Filterra and surrounding area



2. Removal of tree grate and erosion control stones



3. Removal of debris, trash and mulch



4. Mulch replacement



5. Clean area around Filterra



6. Complete paperwork and record plant height and width

For additional information please contact your local Filterra sales representative.
Eastern Zone: 866-349-3458, Western Zone: 877-345-1450.