DRAINAGE REPORT

Sea Level Rise Roadway and Drainage Pilot Project

Sands Subdivision - Big Pine Key

Prepared For:

Monroe County

Project No. 193618A

Prepared By:

WSP USA, Inc.

7650 Corporate Center Drive
Suite 300
Miami, FL 33126

December, 2021

WERNER J. REINEFELD
LICENSE
No. 63042
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

This item has been electronically signed and sealed by Werner J. Reinefeld, P.E., on 12.15.21 using Digital Signature.

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Werner J. Reinefeld, P.E., ENV SP
FL. License # 63042

100% SUBMITTAL

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Monroe County Sea Level Rise Pilot Project Drainage Improvements at Big Pine Key Florida

1 Purpose

This report is submitted in support to the proposed drainage system for the Monroe County Sea Level Rise Pilot Project Drainage Improvements project. The system includes the design of a gravity system and a pump station. The purpose of this report is to provide all the relevant information that has been used in the development of the drainage system for this project including the calculations performed in the preparation of the plans and the preparation of this report. This report is essentially self-contained and provides all the necessary information and calculations that have been performed during the design phase of the drainage system.

2 Introduction

Big Pine Key is a census-designated place and unincorporated community in Monroe County, Florida, United States, on an island of the same name in the Florida Keys. As of the 2000 census, the town had a total population of 5,032.

U.S. 1 crosses the key at mile markers 29.5—33, one of the few places on the keys where the road orients north-south (along the eastern edge of the Key).

Big Pine Key was the location of one of the stations of the Overseas Railroad.

According to the United States Census Bureau, the Big Pine key has a total area of 25.8 km^2 (9.9 mi^2), of which 25.3 km^2 (9.8 mi^2) is land and 0.5 km^2 (0.2 mi^2) (1.81%) is covered by water.

3 Existing Conditions

There is no existing drainage system; run-off percolates through the existing pervious areas, which once saturated, overspill to the surrounding canals.

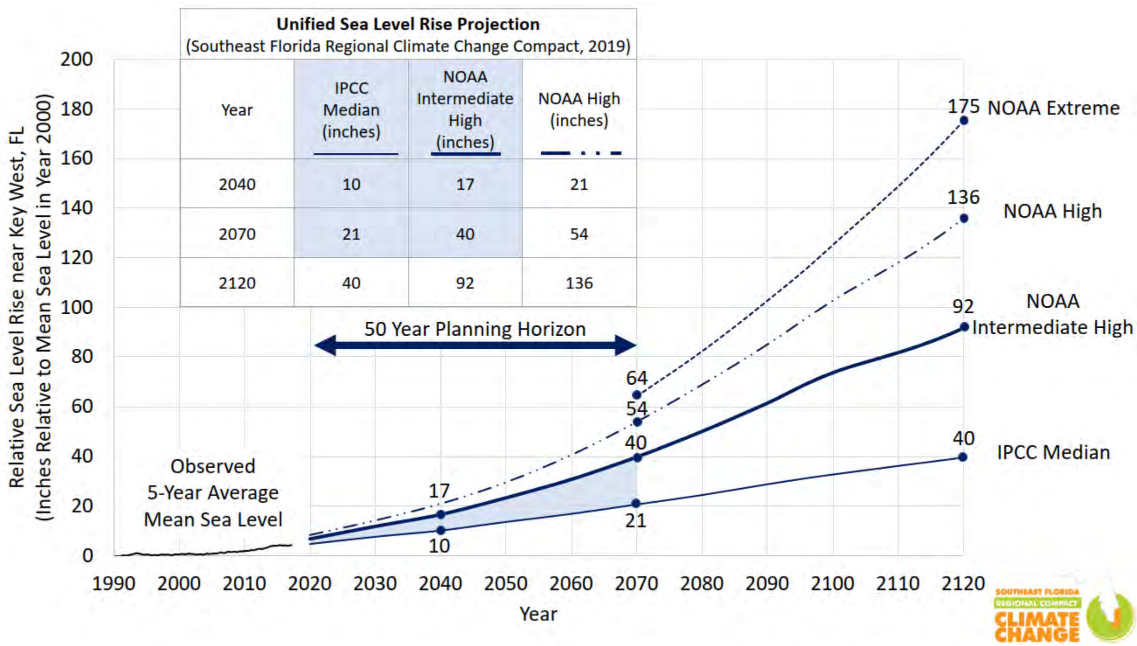
Regardless of the cause, the outstanding issue at this section is related to the flooding of the local roads even during minor storm events due to the lack of a positive drainage system that can evacuate the water from those rain events. Higher tide levels cause water to flood into local streets even in absence of rain events as it has been reported by the area residents.

4 Rules and Regulations/Regulatory Agency Coordination

In the early stages of the project the regulatory agencies were approached to receive feedback on the permitting requirements for this project.

Based on due diligence conducted for the design team with the agencies, the following are in essence the requirements and commitments for the project.

- Account for sea level rise on determination of present and future conditions for ground water, crown of the road and finish floor elevation.



- Provision of baffles at catch basin
- Provision of Treatment Units before getting into the ground.
- Maximum head applied to injection wells is at elevation 8.0 NAVD and the method to control the maximum head cannot be an electrical or mechanical device.

Upon meeting with regulatory agencies, it was agreed that the following permits would be required for the Big Pine Key project.

- Monroe County
- SFWMD
    - o ERP (Standard General Permit)
    - o Dewatering Permit

- FDEP
    - DEP Form 62-528.900(3), F.A.C.
        - FDEP to review and determine if acceptable for permitting issuance. 30 Days prior to begin construction, need to re-submit Page 1 of 4 with contractor information.

Refer to **Appendix D – Correspondence and Coordination** for meeting minutes and other documents related to coordination of this project with regulatory agencies.

5 Proposed Conditions

The main goal of this project is to alleviate the flooding issues experienced by the island. As part of the project some roadway reconstruction and milling and resurfacing operations are taking place.

The propose drainage system will consist of a gravity system including:

- Catch basins at swale areas
- Baffles at curb type inlets when runoff flows directly into
- Pipes for runoff conveyance
- Hydrodynamic separators/Treatment Units

In addition, given that the key project streets are landlocked, the County is proposing to construct a pump station with the following features:

- 2 Wet well pump stations with four engines
- Twelve injection wells

The gravity system will collect the runoff from the local streets and adjacent properties and will convey the runoff into a trunk line running along 3rd Street a.k.a as Father Tony Way to the proposed Pump Station located at the NW corner of Father Tony Way and C Avenue.

The proposed drainage system was divided into six different systems:

- 90-second detention to be provided at proposed swales.
- Excess of run-off to be collected by the gravity trunk lines
- Treatment Unit.
- Stormwater Pump Stations
- Pressurized Force Mains
- Injection wells

5.1 Design Criteria

The following Level of Service was used in the preparation of this report:

1. Tailwater
   a. The following tailwater conditions were used

Table 1 - Analysis of Tidal Water Levels for the Vaca Key Tide Gauge and Estimated Levels for Two Pilot Communities

Vaca Key	Twin Lakes	Sands	Twenty Year Record		Average Per Year	
Water Level (in, NAVD88)	Water Level (in, NAVD88)	Water Level (in, NAVD88)	Number of Floods (#)	Inundation (hr)	Number of Floods (#)	Inundation (days)
-1.3	-4.0	1.9	159	16,416	8.1	35
1.7	-1.0	4.9	45	3,600	2.3	7
4.7	2.0	7.9	12	744	0.6	1.5
7.7	5.0	10.9	2	120		

Note: The first column shows various water levels at the Vaca Key Tide Gauge. The next two columns show when flooding occurs in the community, but due to differences in elevation, topography, etc., flooding occurs at different levels. The negative values are in relation to the NAVD88 datum, where zero is a point approximately equal to the low point of the roadways in the two communities.

   Tributary Areas
   b. Average 20' behind R/W line
      i. In the infield area of the island where private lots are landlocked, the entire property is assumed to be a tributary to the road

2. Finish Floor Elevation
   a. Per Monroe County Stormwater Management Master Plan:

Subsection 11.8 identifies the Level of Service (LOS) standards for Monroe County. These are summarized as follows:

- Building floor elevations - 100-year, 3-day.
- Evacuation and emergency service routes - 100-year, 3-day.
- Arterial roads - 100-year, 3-day.
- Collector roads - 25-year, 3 day.
- Neighborhood roads - 5-year, 1 day.
- Urban sites - 5-year, 1-day.
- Rural sites - 3-year, 1-day.

As part of the LOS criteria, Subsection 11.8.1 states that off-site discharge rates are limited to predevelopment conditions. For water quality, the LOS criteria require development to "ensure that stormwater discharges will meet State water quality standards..." and identify the wet detention, dry detention and retention criteria required.

3. Miscellaneous Hydraulic/Drainage Parameters
    a. Pumped Wells/Pump Station
        i. 5 YR Storm (Rainfall Name FDOT- 24)
        ii. Average Water Table Elevation: -0.081 (initial stage for rain event routing)
        iii. Use of Mean High Water (MHW) for tailwater conditions
        iv. Results from model used as follows:

Design Storm	Comment
5 Year-24 Hour	Used to determine min. catch basin rim elevation
10 Year-24 Hour	Used to determine min. crown of road elevation
25 Year-24 Hour	Used to determine basin perimeter elevation.

    b. Maximum head at injection wells is elevation 8.0 NAVD (FDEP requirement)
    c. Minimum pipe size used was 15”
    d. Minimum Safety Factor of 1.5 (down forces/uplift forces) for pipes buoyancy condition. Buoyancy condition verified for the most unfavorable scenario, pipes empty and no anchor effect by inlets/manholes.

5.2 Land Use

The following table summarizes each drainage area under the post-development conditions. From the Land Use perspective, Pre-development conditions for the most part consist of the same since the main component of the project is to provide a drainage system.

Big Pine Key								
Basin	TOTAL AREA (AC)	TOTAL PER. AREA (AC)	Land Use (Pervious)*	TOTAL IMP. AREA (AC)	Land Use (Impervious)*	C_{IMP}	C_{PER}	C
1	1.75	1.08	Bare Earth - Sandy Soils	0.50	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.49
1A	0.43	0.30	Bare Earth - Sandy Soils	0.14	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54
2	20.39	13.06	Bare Earth - Sandy Soils	7.33	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.57
2A	3.00	1.92	Bare Earth - Sandy Soils	1.08	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.57
4	2.47	1.72	Bare Earth - Sandy Soils	0.76	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.53
5	0.96	0.64	Bare Earth - Sandy Soils	0.32	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.55
6	2.36	1.53	Bare Earth - Sandy Soils	0.83	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.56
7	0.24	0.16	Bare Earth - Sandy Soils	0.07	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54
8	0.58	0.36	Bare Earth - Sandy Soils	0.22	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.58
9	1.25	0.72	Bare Earth - Sandy Soils	0.53	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.60
10	1.56	0.99	Bare Earth - Sandy Soils	0.58	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.57
11	1.51	1.25	Bare Earth - Sandy Soils	0.26	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.45
12	1.79	1.29	Bare Earth - Sandy Soils	0.50	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.52
13	0.93	0.74	Bare Earth - Sandy Soils	0.20	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.48
14	1.13	0.77	Bare Earth - Sandy Soils	0.36	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54
15	0.79	0.55	Bare Earth - Sandy Soils	0.24	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.53
16	0.98	0.65	Bare Earth - Sandy Soils	0.34	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.56
16-1	1.90	0.18	Bare Earth - Sandy Soils	1.72	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.89
17	0.19	0.15	Bare Earth - Sandy Soils	0.04	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.48
18	0.37	0.29	Bare Earth - Sandy Soils	0.08	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.48
19	0.48	0.22	Bare Earth - Sandy Soils	0.25	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.67
20	0.34	0.17	Bare Earth - Sandy Soils	0.16	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.64
21	0.41	0.24	Bare Earth - Sandy Soils	0.17	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.59
22	0.80	0.53	Bare Earth - Sandy Soils	0.27	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.55
23	0.33	0.19	Bare Earth - Sandy Soils	0.14	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.60
24	0.62	0.35	Bare Earth - Sandy Soils	0.27	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.61
25	0.30	0.19	Bare Earth - Sandy Soils	0.10	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.56
26	0.57	0.34	Bare Earth - Sandy Soils	0.23	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.59
27	0.24	0.14	Bare Earth - Sandy Soils	0.10	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.60
28	0.96	0.92	Bare Earth - Sandy Soils	0.20	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54

Total Basin Area (AC.):	49.63
Total Pervious Area (AC.):	31.65
Total Impervious Area (AC):	17.97

* Based on Table T-4 Hydrology Handbook

5.3 Water Quality

One of the major constraints and in essence the origin of this project is the fact that the project is laying at very low elevation with some areas being below the high tides level. Local roads in many cases are lower than the adjacent properties, primarily the older structures, have low finish floor elevations. This factor makes it difficult to attain water quality by the typical methods of exfiltration trenches, detention ponds, etc. Exfiltration trenches would not be able to develop a head to exfiltrate water into the ground.

A combination of the following measures are intended to provided some level of water quality pre-treatment even though it is not possible to quantify.

- Pervious Swaled Areas - Collection points in the form of catch basin are located in pervious Swaled Areas. Estimated total swale volume is 1.97 Ac-Ft. Refer to Appendix B for detailed calculations.
- Baffles – Baffles are being provided at all collecting catch basins
- Injection Wells – Even though wells are not considered a mechanism to provide water quality, it was agreed with the agencies that the discharge into wells was preferable to the direct discharge into the bay. Injection Wells are discharging into the Biscayne Aquifer.
- Hydrodynamic separators/Treatment Units, The wet well is being provided with a Hydrodynamic Separator to remove large solids before water is pumped into the wells.

Refer to **Appendix B** for Water quality calculations and the table below for a summary.

Water Quality Criteria Summary Table		
Required Treatment Volume	6.2	Ac-Ft
Required Treatment Flow	3.13	CFS
BMP Treatment Unit Flow Capacity	25	CFS

Refer to **Appendix D – Correspondence and Coordination** for meeting minutes for coordination with regulatory agencies.

5.4 Water Quantity

The drainage system being proposed consists of a gravity system with a pump station discharging into twelve injection wells. All runoff will be routed to the proposed pump stations using a trunk line along Father Tony Way. The computer application Advanced Interconnected Pond Routing (AdICPR) V. 4 by Streamline Technologies, Inc. was used to perform the storm routing of the proposed system inclusive of the force main downstream from the pump station. The force main was modeled using rating curves for each segment. This application was utilized to determine the water stages at each of the inlets and manholes, and to verify the maximum maximum heads at the injection wells.

The design storm for this system is the 5 Year SCS Type II storm with duration of 24 hours. The results from the 5 Year storm was used to determine the minimum catch basin rim elevation. Peak flow for the design storm has been calculated as

71.68 CFS at the entrance of the treatment unit.

The drainage system was also analyzed using the South Florida Water Management 10-Year 24-Hour storm for determining the minimum elevation of the crown of the road.

The drainage system was also analyzed using the South Florida Water Management 25-Year 24-Hour storm for determining the basin perimeter elevations to ensure the system is self-contained. A summary of the storm events analyzed has been included in the ICPR results as part of Appendix B and in the table below. Water stages for the design storms remained below acceptable levels and the system functioned as intended.

Design Storm	Pre-development Stage Elevations (NAVD)	Post-development Stage Elevations (NAVD)	Design Elevations (NAVD)	Comment
5 Year-24 Hour	1.89	-0.08	0.41	Used to determine min. catch basin rim elevation
10 Year-24 Hour	2.03	0.44	1.12	Used to determine min. crown of road elevation
25 Year-24 Hour	2.16	1.02	3.50	Used to determine basin perimeter elevation.

Please refer to **Appendix B – Post-Development Conditions** of this report for the analysis Node Network Diagram, a schematic of the model used to simulate the proposed drainage system using AdICPR, and input and output information from AdICPR.

5.5 Pump Station Calculations and Injection Wells

For supporting data for the pump station and injection wells design refer to **Appendix C – Pump Station and Injection Wells.**

Injection Wells:

The following assumptions were used in the design of the injection wells:

- Solid pipe to extend only 60 feet into the ground since the key is surrounded by a salt water environment and the requirement of 10,000 PPM should be achieved at relatively shallow depths
- It was assumed a well capacity of 1,000 GPM/FT-Head

Amritt, Sarah H.

From: Najib Halwani <duke@jafferwells.com>
Sent: Friday, February 22, 2019 3:06 PM
To: Amritt, Sarah H.
Cc: Randy Habib; Reinefeld, Werner
Subject: RE: Well Capacities in Key Largo, FL & Big Pine Key, FL

Hi Sarah
Capacities in the Keys are in excess of 1000 GPM
Use 1000 GPM also note wells have to be constructed with SCHD 80 PVC casing inside a 30" DIA Hole with meat cement grout
Most wells have 60' of PVC casing and drill out to 120' BLS
Thanks
Duke

Najib B Halwani
President
AC Schultes Of Florida dba Jaffer Well Drilling
1451 SE 9 Ct
Hialeah FL 33010
Office 305 576 7363

- Maximum head of 8.0 NAVD when two pumps in operation and tailwater at MHW

The following table summarizes the maximum heads at the wells:

Table 3- Maximum Head at Wells

Simulation Rainfall	5 years- 24Hr.
IW1	4.47
IW2	3.50
IW3	2.91
IW4	2.59
IW5	2.43
IW6	2.06
IW7	1.87
IW8	1.78
IW9	1.72
IW10	1.58
IW11	1.53
IW12	1.52

APPENDIX A

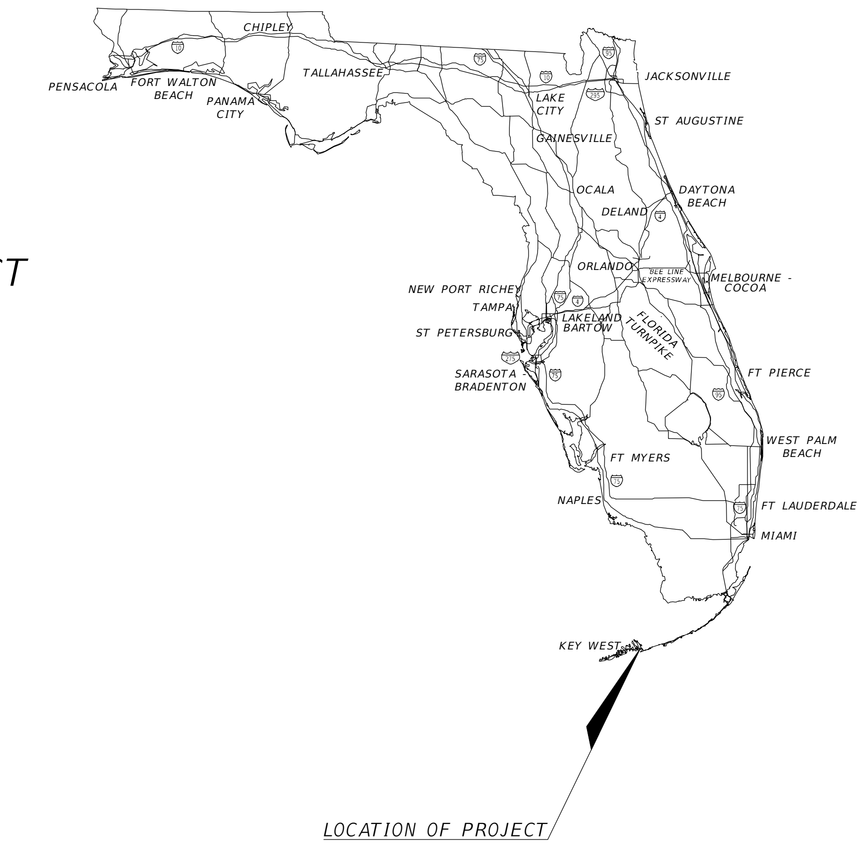
LOCATION
MAP

MONROE COUNTY
DEPARTMENT OF ENGINEERING

CONTRACT PLANS

SEA LEVEL RISE ROADWAY AND DRAINAGE PILOT PROJECT (BIG PINE KEY)

VOLUME B
SANDS SUBDIVISION - BIG PINE KEY



LOCATION OF PROJECT

INDEX OF SHEETS - VOLUME B

LOCATION OF PROJECT

N

0 1 2
Miles

PLANS PREPARED BY:

WSP USA
7650 CORPORATE CENTER DRIVE, SUITE 300
MIAMI, FLORIDA 33126
C.A. # 01462

NOTE: SCALE SHOWN ON DRAWINGS CORRESPONDS TO PLOT SIZE 11"X17". IF DRAWINGS ARE PLOTTED ON OTHER SIZE SHEET, ENGINEER OF RECORD DOES NOT WARRANT ACCURACY OF DRAWING SCALE.

90% SUBMITTAL 11/23/2021
NOT FOR CONSTRUCTION

GOVERNING STANDARD PLANS:
Florida Department of Transportation, FY 2021-22 Standard plans for Road and Bridge Construction and applicable Interim Revisions (Irs).

Standard Plans for Road Construction and associated Irs are available at the following website:
https://www.fdot.gov/design/standardplans

GOVERNING STANDARD SPECIFICATIONS:
Florida Department of Transportation, July, 2021 Standard Specifications for Road and Bridge Construction at the following website:
http://www.fdot.gov/programmanagement/Implemented/SpecBooks

PROJECT LENGTH IS BASED ON ℄ CONSTRUCTION

LENGTH OF PROJECT		
	LINEAR FEET	MILES
ROADWAY	3025	0.573
BRIDGES	0	0
NET LENGTH OF PROJECT	3025	0.573
EXCEPTIONS	0	0
GROSS LENGTH OF PROJECT	3025	0.573

ROADWAY PLANS
ENGINEER OF RECORD: WERNER REINEFELD, P.E.
P.E. NO.: 63042

MONROE COUNTY BOARD OF COMMISSIONERS:

EDDIE MARTINEZ	DISTRICT 3
MICHELLE COLDIRON (MAYOR)	DISTRICT 2
CRAIG CATES	DISTRICT 1
DAVID RICE (MAYOR PRO TEM)	DISTRICT 4
MIKE FORSTER	DISTRICT 5

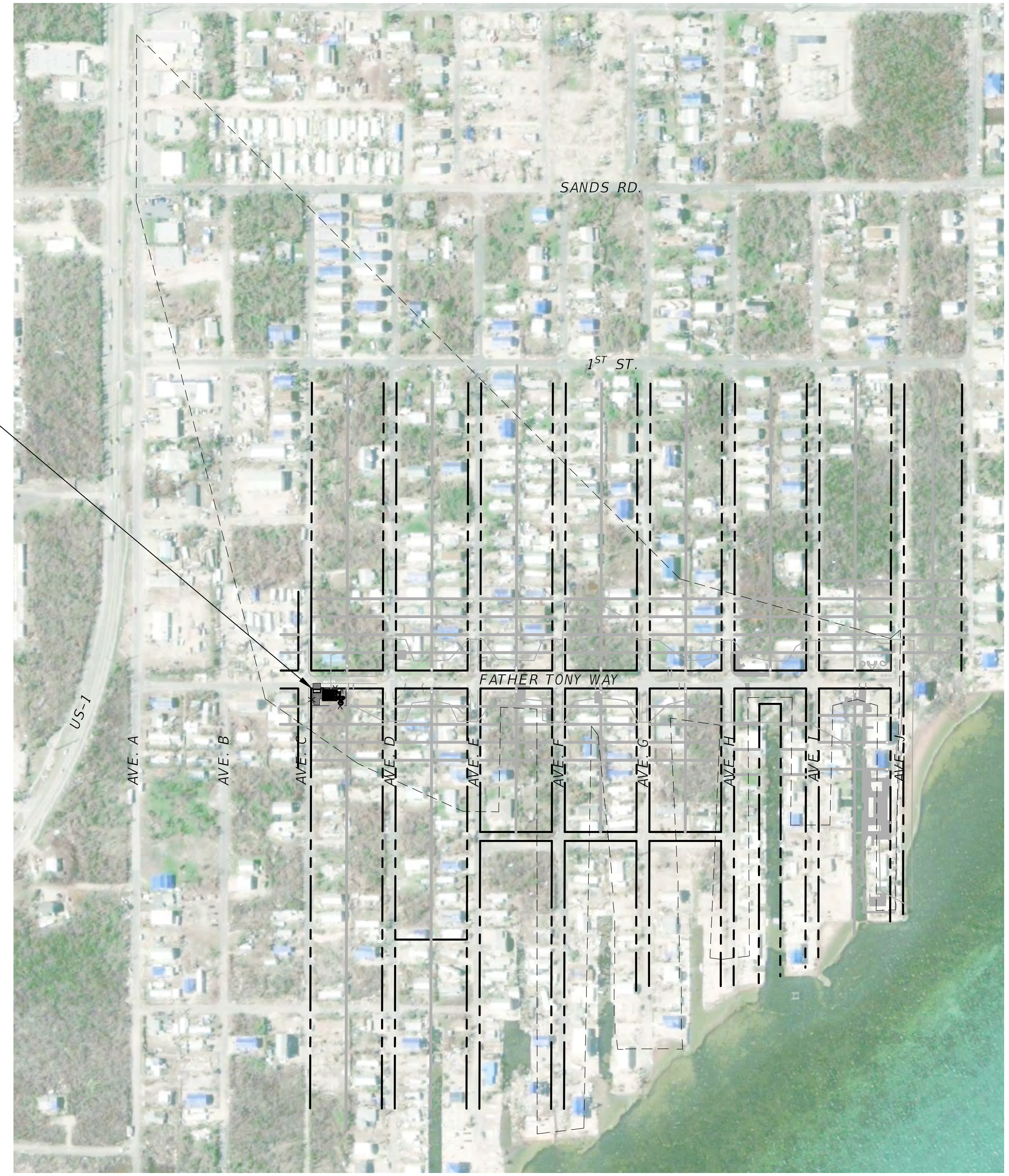
MONROE COUNTY PROJECT MANAGER: DEBRA LONDON

FISCAL YEAR	SHEET NO.
21	G-1B

AERIAL

Z 1" = 400'

PROPOSED PUMP STATION LOCATION



LEGEND:

DRAINAGE AREA

RIGHT OF WAY

PROPERTY LINE

THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE DIGITALLY SIGNED AND SEALED UNDER RULE 61G15-23.004, F.A.C.

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

WERNER REINEFELD, P.E.
P.E. LICENSE NUMBER 63042
WSP USA, 7650 CORPORATE CENTER DRIVE,
SUITE 300, MIAMI, FLORIDA 33126
CERTIFICATE OF AUTHORIZATION 01462

SEA LEVEL RISE ROADWAY AND DRAINAGE PILOT PROJECT
SANDS SUBDIVISION - BIG PINE KEY
MONROE COUNTY - DEPARTMENT OF ENGINEERING

DRAINAGE MAP

SHEET NO. PS-1B

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LAND USE MAP

Planning & Environmental Resources

8/20/2019, 9:00:07 AM

1:4,514

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

LUD - Zoning

- Resolutoin 217-1984
- ACCC
- AD - Airport District
- C1 - Commercial 1
- C2 - Commercial 2
- CD - Conservation District
- Commercial Fishing District
- DR - Destination Resort
- I - Industrial
- INC - Incorporated

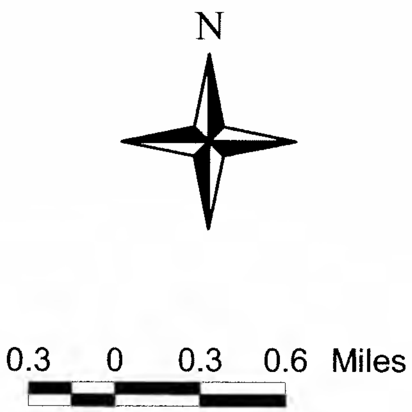
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

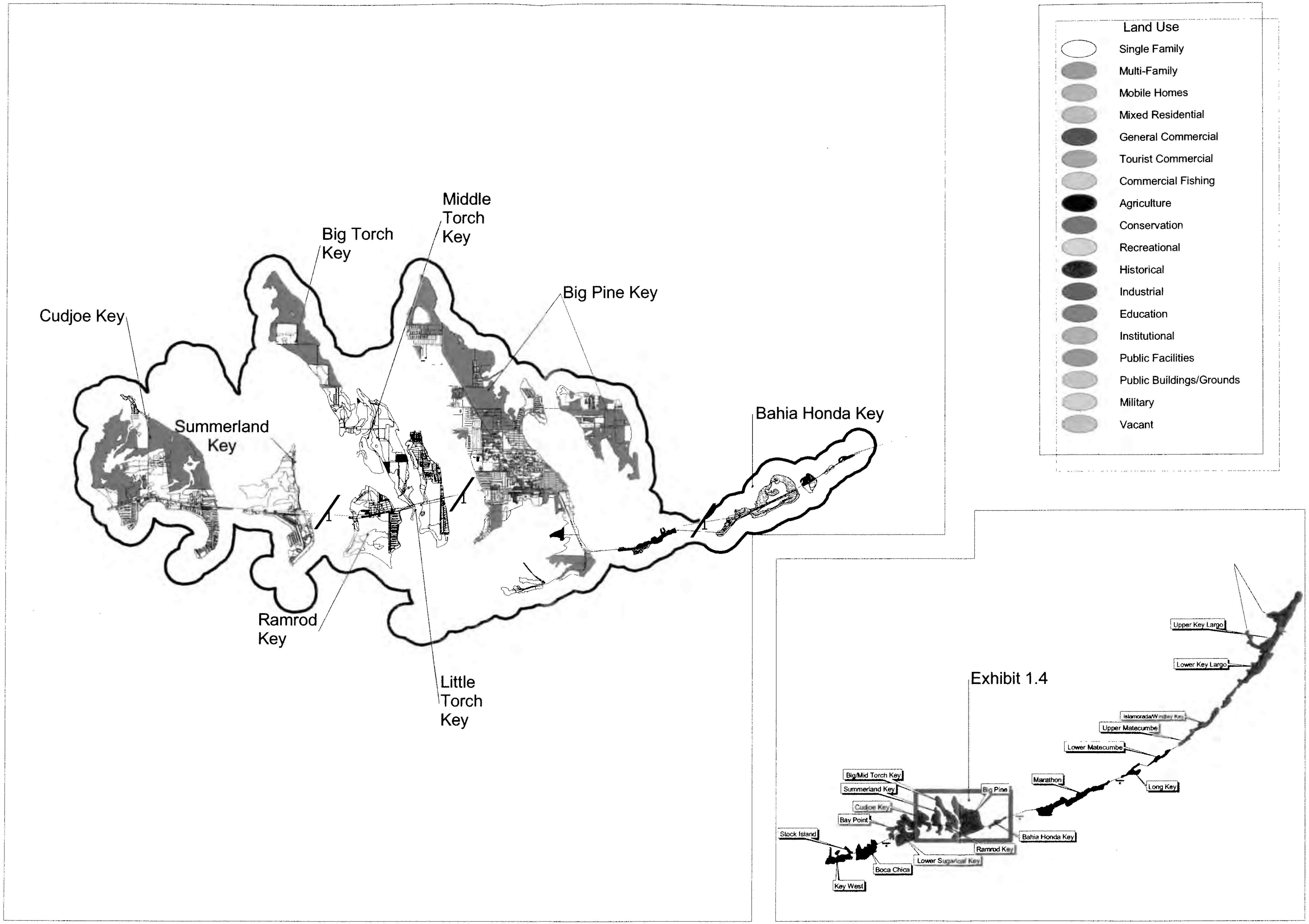
FDOR and Monroe Co PA, USDA FSA, DigitalGlobe, GeoEye |

Monroe County Stormwater Master Plan

Existing Land Use Map

Exhibit 1.4 of 1.10





KEITH & ASSOCIATES INC.
consulting engineers
301 EAST ATLANTIC BOULEVARD
POMPANO BEACH, FLORIDA 33060-6643
(954)788-3400 FAX (954)788-3500

Source: Monroe County Growth
anagement Division,
orida Dept of Transportation,
District 6, and GDT Inc.

SOILS USE
MAP

Table 2-13
Monroe County Stormwater Management Master Plan
Summary of Soils Data

Study Area	Description	Hydrologic Soils Group (1)								Total
		A		B		C		D		
		(ac)	(%)	(ac)	(%)	(ac)	(%)	(ac)	(%)	(ac)
1	Key West	0	0%	389	12%	0	0%	2,852	88%	3,241
2	Stock Island	0	0%	856	93%	0	0%	64	7%	920
3	Boca Chica Key	0	0%	1,930	44%	0	0%	2,456	56%	4,386
4	Bay Point Key	0	0%	107	7%	0	0%	1,427	93%	1,535
5	Lower Sugarloaf Key	0	0%	0	0%	0	0%	2,797	100%	2,797
6	Upper Sugarloaf Key	0	0%	529	10%	0	0%	4,764	90%	5,293
7	Cudjoe Key	0	0%	586	18%	0	0%	2,668	82%	3,253
8	Summerland Key	0	0%	322	33%	0	0%	653	67%	974
9	Ram Rod Key	0	0%	325	34%	0	0%	632	66%	957
10	Torch Keys	0	0%	291	10%	0	0%	2,622	90%	2,913
11	Big Pine Key	0	0%	825	11%	0	0%	6,678	89%	7,503
12	Bahia Honda	0	0%	185	42%	0	0%	255	58%	440
13	Marathon	0	0%	3,261	61%	0	0%	2,085	39%	5,345
14	Key Colony Beach	0	0%	306	100%	0	0%	0	0%	306
15	Long Key	0	0%	202	19%	0	0%	861	81%	1,063
16	Layton	0	0%	40	60%	0	0%	26	40%	66
17	Lower Matecumbe Key	0	0%	424	47%	0	0%	478	53%	903
18	Islamorada	0	0%	1,319	30%	0	0%	3,077	70%	4,396
19	Upper Matecumbe Key	0	0%	96	10%	0	0%	863	90%	959
20	Windley Key	0	0%	81	17%	0	0%	398	83%	479
21	Key Largo Lower	0	0%	2,027	18%	0	0%	9,235	82%	11,262
22	Key Largo Upper	0	0%	858	7%	0	0%	11,404	93%	12,263
	Totals or Average	0	0%	14,960	21%	0	0%	56,296	79%	71,256

Notes:

(1) The hydrologic soils group identifies the propensity of the soil type to infiltrate rainfall.
Group A - soils having a high infiltration rate when thoroughly wet; generally sands.
Group B - soils having a moderate infiltration rate when thoroughly wet; generally course sands.
Group C - soils having a slow infiltration rate when thoroughly wet; generally fine texture.
Group D - soils having a very slow infiltration rate when thoroughly wet; generally clayey.

Map Scale: 1:5,870 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monroe County, Keys Area, Florida
Survey Area Data: Version 11, Sep 17, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Dec 13, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
13	Keyvaca very gravelly loam, extremely stony	101.2	98.3%
100	Waters of the Atlantic Ocean	1.8	1.7%
Totals for Area of Interest		**103.0**	**100.0%**

SEASONAL HIGH
WATER TABLE

WSP

Tidal Datum inquiry results based on NOAA's online version of the Vdatum Software. Calculations for tidal datums at Shaw Drive in Key Largo and Fr. Tony Way in Big Pine Key.

Reference: NOAA, 2019. Online Vertical Datum Transformation, https://vdatum.noaa.gov/vdatumweb/vdatumweb?a=144501920190228, accessed 2/28/2019.

WSP Project No.: 193618A, Sea Level Rise Pilot, Monroe Co., Florida
By: J.Ramsden 2/28/2019

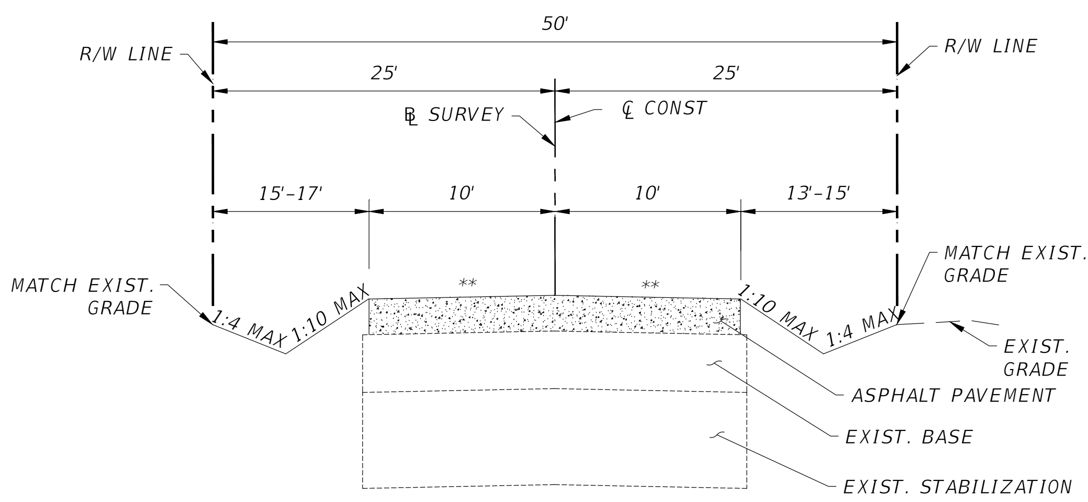
VDatum points Feb. 28, 2019	MHHW relative to NAVD88 (ft)	MHW relative to NAVD88 (ft)	LMSL relative to NAVD88 (ft)	Location Notes
Father Tony Way				
-81.343795, 24.675438	-0.097	-0.338	-0.737	Intersection of Fr. Tony Way and Ave. J
-81.340578, 24.673610	-0.084	-0.325	-0.752	In bay immediately north of east end of Ave. G
-81.343832, 24.672213	-0.086	-0.327	-0.746	Intersection of Fr. Tony Way and Ave. E
-81.343792, 24.674173	-0.096	-0.336	-0.741	Intersection of Fr. Tony Way and Ave. H
-81.339634, 24.672596	-0.081	-0.322	-0.758	In bay immediately east of midpoint between Avenues E & F
Average =	**-0.089**	**-0.330**	**-0.747**	

on of Vdatum (2/28/2019)

Intersection of Shaw Drive and Crane St. (lat., lon. and NGVD in (ft, NAVD88))			
25.000000	Lat. deg.	25.000000	25.000000
0.133333	Lat. min.	0.133333	0.133333
0.000006	Lat. sec.	0.000128	0.000128
25.133339	Lat. decimal deg.	25.133461	25.133461
80.000000	Lon. deg.	80.000000	80.000000
0.400000	Lon. min.	0.400000	0.400000
0.013689	Lon. sec.	0.012575	0.012575
80.413689	Lon. decimal deg.	80.412575	80.412575
-1.559	NGVD (ft, NAVD88) (via Vdatum (Feb. 28, 2019)		
-1.565	NGVD (ft, NAVD88) (via Corpscon Ver 6, 2016)		

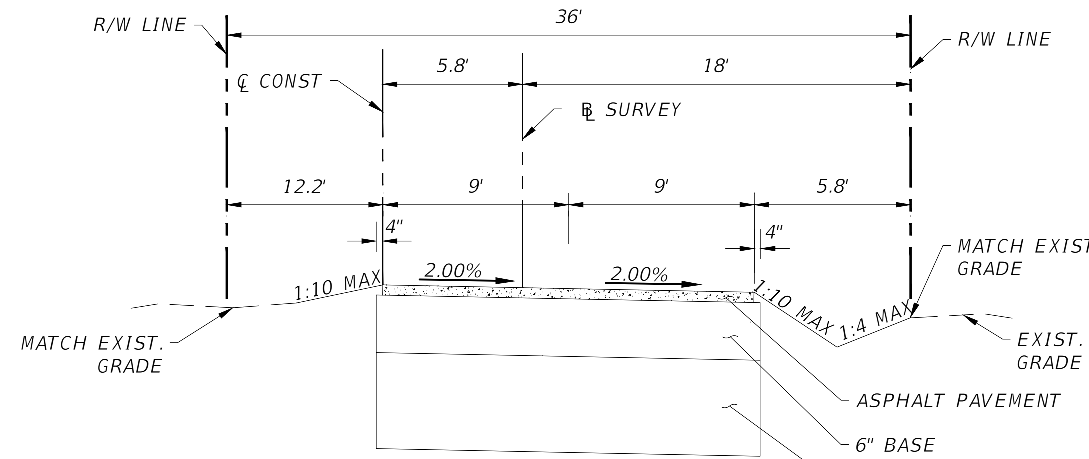
Intersection of FTW and Ave. E (lat., lon. and NGVD in (ft, NAVD88))	
24.000000	Lat. deg.
0.666667	Lat. min.
0.005550	Lat. sec.
24.672217	Lat. decimal deg.
81.000000	Lon. deg.
0.333333	Lon. min.
0.010500	Lon. sec.
81.343833	Lon. decimal deg.
-1.390	NGVD (ft, NAVD88) (via Vdatum (Feb. 28, 2019)
-1.391	NGVD (ft, NAVD88) (via Corpscon Ver 6, 2016)

TYPICAL SECTIONS



TYPICAL SECTION - FATHER TONY WAY
MILLING, RESURFACING & OVERBUILD, NTS

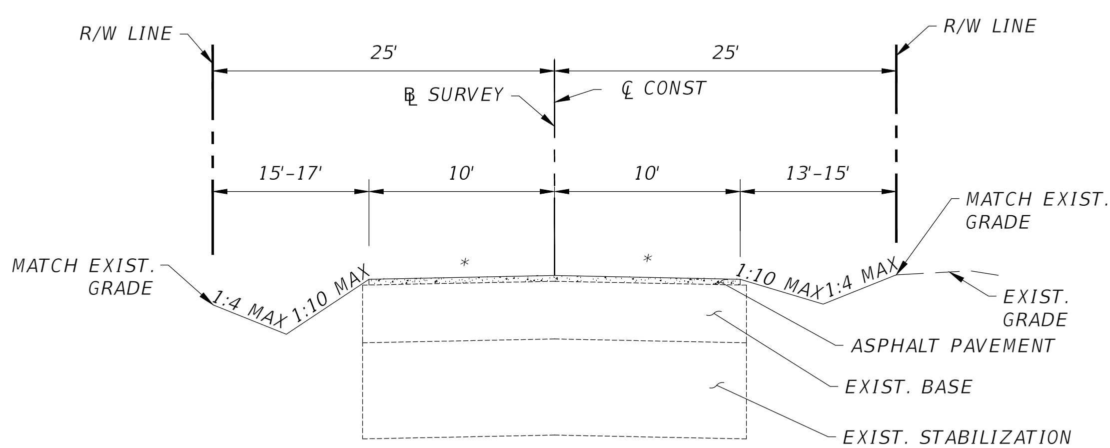
STA. 18+25.61 TO STA. 19+59.61
STA. 23+19.64 TO STA. 25+20.06



TYPICAL SECTION - AVE J
RECONSTRUCTION, NTS

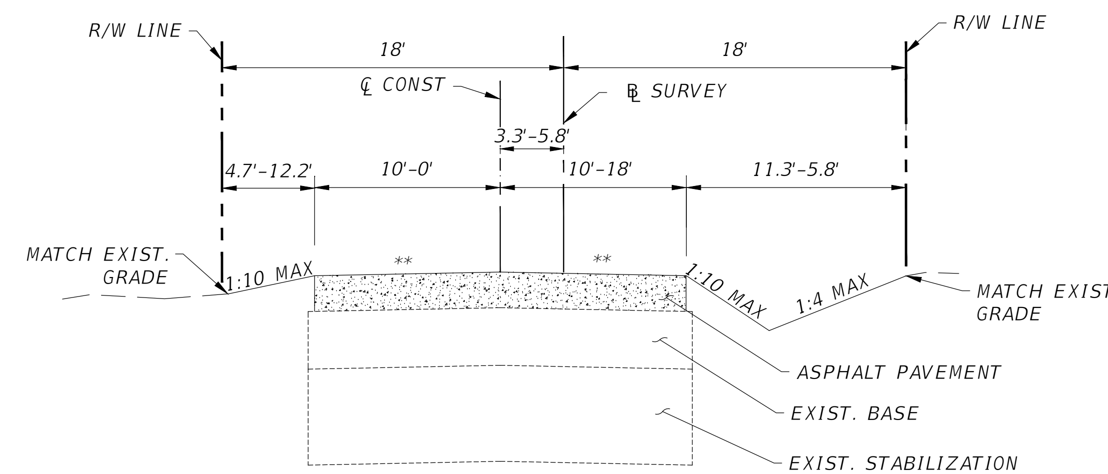
12" STABILIZED SUBGRADE LBR 40
6" (GROUP 4) LIME ROCK BASE
TYPE SP A.S STRUCTURAL COURSE ASPHALT 1"
TYPE SP (TRAFFIC A) 1"

STA. 11+29.15 TO STA. 12+22.06



TYPICAL SECTION - FATHER TONY WAY
MILLING & RESURFACING, NTS

STA. 10+65.23 TO STA. 18+25.61
STA. 19+59.61 TO STA. 23+19.64



TYPICAL SECTION - AVE J
MILLING, RESURFACING & OVERBUILD, NTS

STA. 10+00.41 TO STA. 11+29.15

* MATCH EXISTING
** VARIES - SEE PLAN SHEET

NOTES:

1. CONTRACTOR SHALL VERIFY EXISTING UNPAVED SHOULDER COMPOSITION PRIOR TO BIDDING. FINISH SHOULDER MATERIAL TO BE SOD OR NO 57 STONE.
2. ALL COUNTY ROW/SWALES TO BE 2 INCH 57 STONE UNLESS SOD EXISTS. IF SOD EXISTS, REPLACE WITH BAHIA.
3. IF SPECIALTY ROCK DRIVEWAY (FOR EXAMPLE RIVER ROCK OR GRANITE) EXIST TO THE ROAD BED, DO NOT DISTURB.

MILLING & RESURFACING:

4. VARIABLE MILLING (0"-2")
5. RESURFACE WITH 2" ASPHALT PAVEMENT (TYPE SP 9.5)
6. RE-GRADE SHOULDER TO SPECIFIED CROSS SLOPES.

REVISIONS

DATE	DESCRIPTION	DATE	DESCRIPTION

ANDRES CARDONA, P.E.
P.E. LICENSE NUMBER 63917
WSP USA, 7650 CORPORATE CENTER DRIVE,
SUITE 300, MIAMI, FLORIDA 33126
CERTIFICATE OF AUTHORIZATION 01462

SEA LEVEL RISE ROADWAY AND DRAINAGE PILOT PROJECT (KEY LARGO AND BIG PINE KEY)
MONROE COUNTY - DEPARTMENT OF ENGINEERING

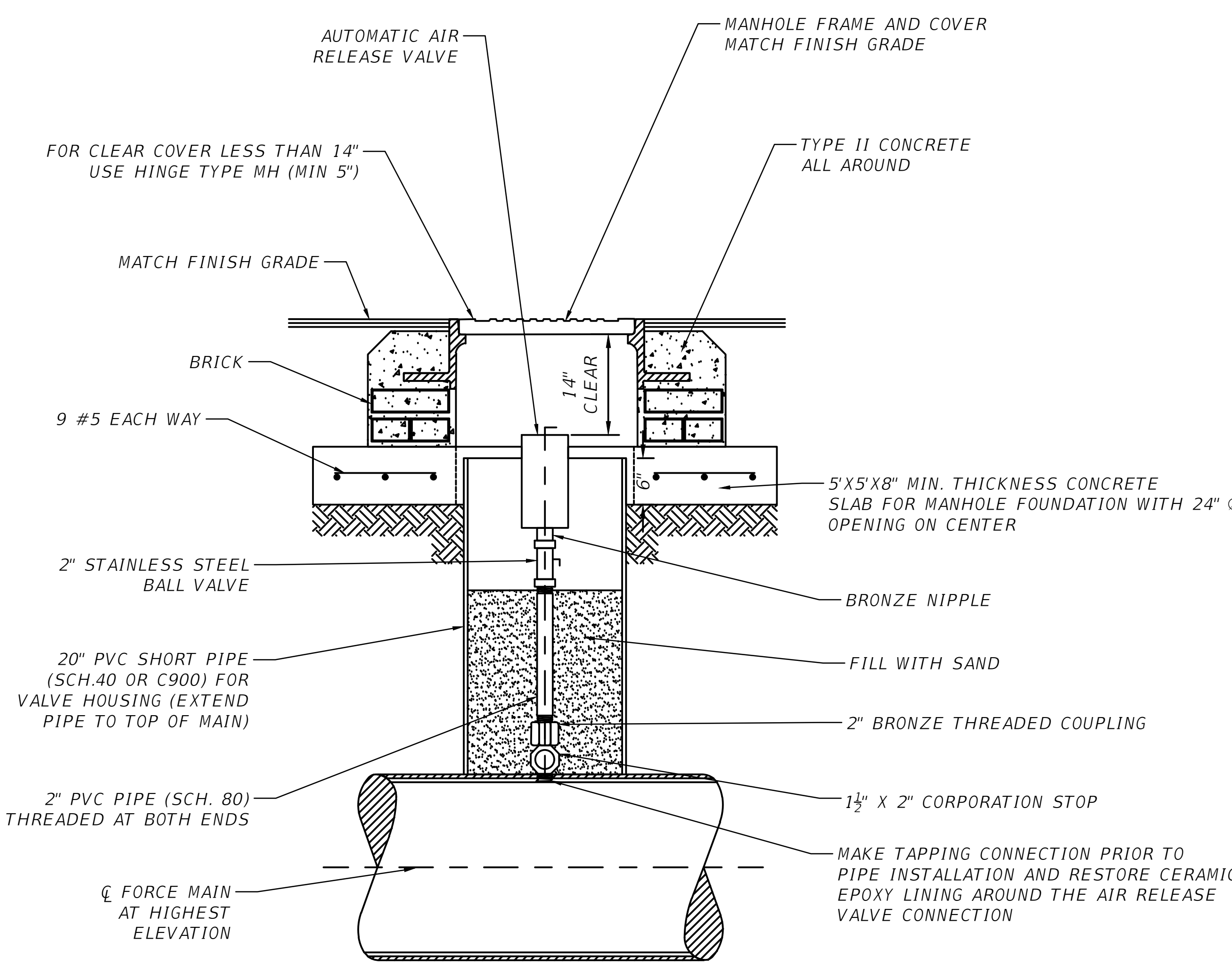
TYPICAL SECTIONS

SHEET NO. G-2B

BAFFLE
DETAIL

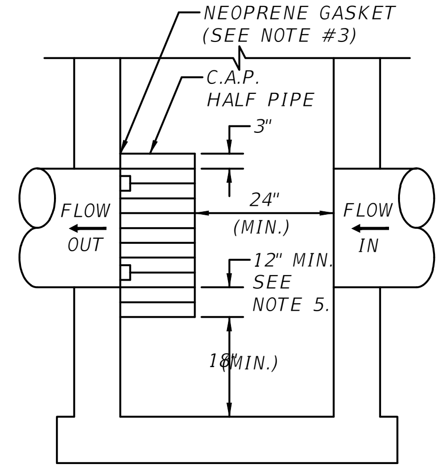
NOTES

1. METALLIC THREADS TO BE COATED WITH BITUMASTIC COATING.
2. ON ARV'S FOR SEWARGE INSTALL 1" BLOW-OFF VALVE AND ½" QUICK-DISCONNECT BACKFLUSHING CONNECTION WITH SHUT-OFF VALVE.
3. INSTALL TAPPING SADDLE FOR THICKNESS CLASS D.I. MAINS 4" & SMALLER, PRESSURE CLASS S.I. MAINS 8" & SMALLER, OR WHEN MAINS IS PVC, HEDPE, OR AC PIPE.

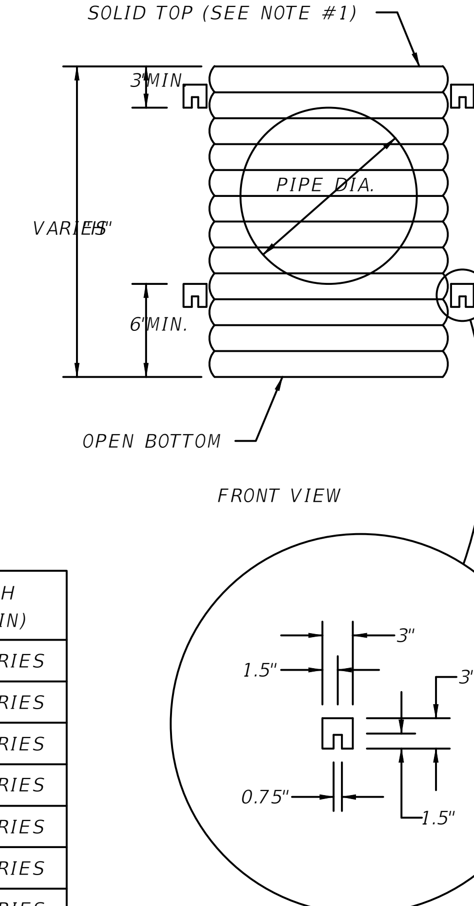


AUTOMATIC AIR RELEASE VALVE

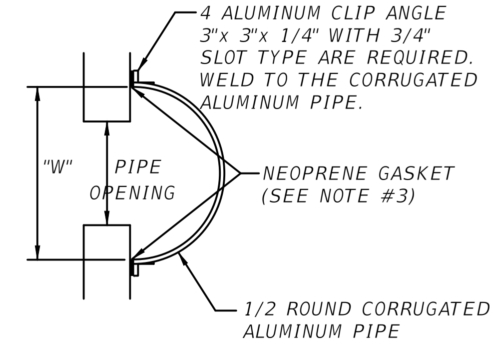
Scale: 1" : 2'



SIDE VIEW



FRONT VIEW



TOP VIEW

PIPE DIA.	W[1] (IN)	W[2] (IN)	T (GAUGE)	H (IN)
15"	21"	24"	16	VARIES
18"	24"	30"	16	VARIES
21"	30"	30"	16	VARIES
24"	30"	36"	16	VARIES
30"	36"	42"	14	VARIES
36"	42"	48"	14	VARIES
42"	48"	54"	14	VARIES
48"	54"	60"	14	VARIES
54"	60"	66"	14	VARIES

1. RECTANGULAR STRUCTURE
2. ROUND STRUCTURE

NOTES

1. ALUMINUM SHEET OF SAME THICKNESS (GAUGE) AS PIPE SHALL BE WELDED TO CLOSE OPENING AT THE TOP.
2. BAFFLE SHALL BE AS MANUFACTURED BY SOUTHERN CULVERT OR ENGINEER'S APPROVED EQUAL.
3. NEOPRENE GASKET (3/8" x 2") SHALL BE INSTALLED AT ALL BAFFLES ON THE SIDES AND AT THE TOP.
4. POLLUTION RETARDANT BAFFLE TO BE ATTACHED TO STRUCTURE W/ 3/8"x4" STAINLESS STEEL "RED HEADS".
5. MINIMUM INVERT ELEVATION ON POLLUTION RETARDANT BAFFLE TO BE 2.5' BELOW CONTROL ELEVATION.
6. ALL EXFILTRATION TRENCHES SHALL HAVE A POLLUTION RETARDANT BAFFLE AT EACH CONNECTION POINT TO A STRUCTURE (SEE EXFILTRATION TRENCH DETAIL).
7. FIBERGLASS BAFFLES ARE NOT PERMITTED.

POLLUTION RETARDANT BAFFLE (PRB) DETAIL

N.T.S.

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

WERNER REINEFELD, P.E.
P.E. LICENSE NUMBER 63042
WSP USA, 7650 CORPORATE CENTER DRIVE, SUITE 300, MIAMI, FLORIDA 33126
CERTIFICATE OF AUTHORIZATION 01462

SEA LEVEL RISE ROADWAY AND DRAINAGE PILOT PROJECT
SANDS SUBDIVISION - BIG PINE KEY
MONROE COUNTY - DEPARTMENT OF ENGINEERING

A.A.R.V._BAFFLE DETAIL

SHEET NO. PS-15B

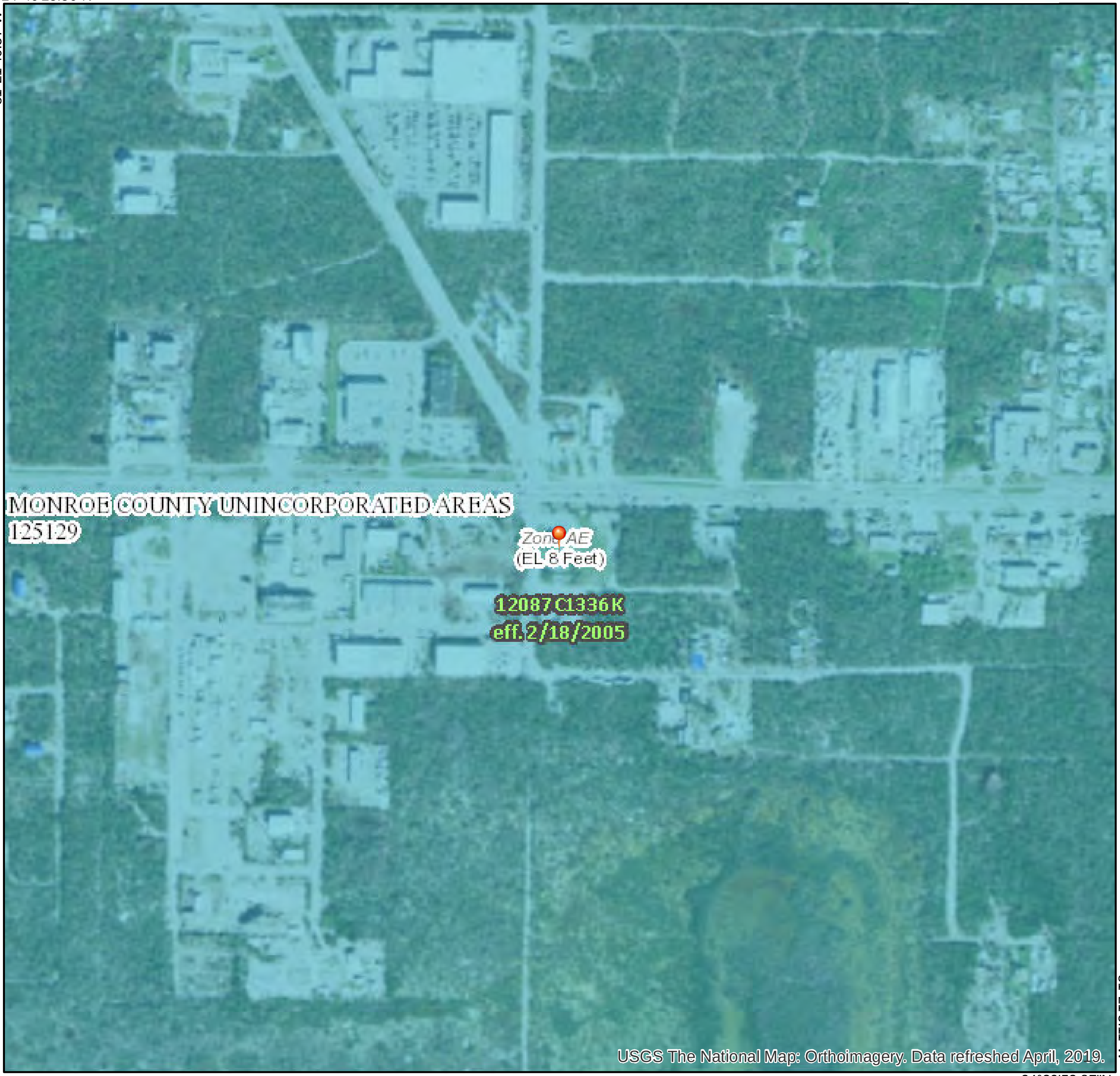
FEMA
FLOOD
MAPS

National Flood Hazard Layer FIRMette

FEMA

24°40'25.56"N

81°21'40.57"W



81°21'3.11"W

24°39'52.87"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/16/2019 at 11:17:05 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

FLOOD CRITERIA (MONROE COUNTY MAPS)

Planning & Environmental Resources

8/20/2019, 8:57:59 AM

Streets

FEMA Flood Zones

Current Parcels

US1 Mile Markers

1:4,514

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FDOR and Monroe Co PA, USDA FSA, DigitalGlobe, GeoEye |

RAINFALL DATA

Table 2-10
Monroe County Stormwater Management Master Plan
Summary of Rainfall and Air Temperature Data - Key West International Airport

Station Name	KEY WEST INTL AP				
Station ID	4570	Latitude	24:33:00	Start Year	1948
State	FLORIDA	Longitude	081:45:00	End Year	1998
County	MONROE	Elevation	4	Num Years	48

Precipitation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
# Days	1426	1299	1426	1380	1426	1380	1457	1457	1407	1457	1380	1426	16921
Avg Day	0.072	0.056	0.056	0.06	0.104	0.16	0.116	0.163	0.213	0.155	0.081	0.067	0.109
# Months	46	46	46	46	46	46	47	47	47	47	46	46	44
SDev Month	3.253	1.181	1.776	1.836	2.866	3.443	2.14	2.33	3.312	3.693	4.265	1.998	9.109
Min Month	0	0.06	0	0	0.34	0.33	0.44	2.23	1.7	0.74	0	0.07	19.99
Max Month	17.64	4.87	9.69	10.6	12.9	14.43	11.69	10.43	18.45	21.57	27.67	11.18	62.92
Avg Month	2.237	1.614	1.745	1.809	3.236	4.794	3.595	5.045	6.361	4.791	2.44	2.073	39.664
Skew Month	2.943	0.876	2.569	2.665	1.609	1.131	1.181	0.697	1.437	2.307	4.895	2.299	0.316
Kurt Month	11.989	3.192	10.269	12.002	4.745	3.395	5.326	2.065	5.513	9.875	26.8	9.925	3.033
M Min Year	1990	1959	1971	1959	1952	1994	1993	1991	1951	1972	1995	1981	1974
M Max Year	1983	1998	1987	1985	1960	1972	1970	1977	1963	1969	1980	1986	1969

Minimum Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
# Days	1425	1299	1426	1380	1418	1380	1457	1457	1406	1456	1373	1426	16903
Avg Day	64.994	65.539	68.758	72.112	75.723	78.343	79.482	79.179	78.272	75.498	71.265	66.612	73.053
# Months	46	46	46	46	46	46	47	47	47	47	46	46	44
SDev Month	3.408	3.502	2.575	2.383	1.442	1.195	1.299	0.802	0.917	1.293	2.288	2.857	0.94
Min Month	55.774	57.607	64.452	64.467	71.774	75.367	75.806	77.29	76.233	72.677	66.9	60.968	71.303
Max Month	72.903	72.821	73.032	76.467	78.742	80.633	82.581	80.742	80.2	78.097	76.533	72.387	74.8
Avg Month	64.995	65.589	68.758	72.112	75.719	78.343	79.482	79.179	78.276	75.5	71.259	66.612	72.978
Skew Month	-0.012	-0.067	-0.107	-0.742	-0.509	-0.203	-0.42	-0.24	-0.281	-0.099	-0.089	-0.031	0.279
Kurt Month	3.039	2.583	1.715	3.86	3.517	2.563	3.314	2.456	2.842	2.269	2.386	2.081	2.103
M Min Year	1981	1958	1960	1987	1992	1966	1950	1950	1950	1987	1962	1989	1951
M Max Year	1974	1959	1976	1982	1995	1981	1967	1969	1974	1959	1986	1971	1967

Table 2-10
Monroe County Stormwater Management Master Plan
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Station Name	KEY WEST INTL AP				
Station ID	4570	Latitude	24:33:00	Start Year	1948
State	FLORIDA	Longitude	081:45:00	End Year	1998
County	MONROE	Elevation	4	Num Years	48

Maximum Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
# Days	1417	1299	1426	1371	1426	1378	1451	1456	1396	1452	1380	1426	16878
Avg Day	74.935	75.727	78.652	81.777	85.208	87.964	89.395	89.564	88.194	84.584	80.049	76.115	82.746
# Months	46	46	46	46	46	46	47	47	47	47	46	46	44
SDev Month	2.911	3.067	2.251	1.703	1.287	1.412	1.055	1.098	1.065	1.3	2.001	2.343	0.948
Min Month	66.839	68.071	73.161	77.933	82.742	84.2	86.613	87.645	85.033	81.355	76.267	71.065	80.785
Max Month	80.455	81.357	82.355	85.133	88.323	90.267	91.258	92	90.733	87.129	84.667	80.516	84.516
Avg Month	74.97	75.72	78.652	81.79	85.208	87.962	89.39	89.564	88.193	84.578	80.049	76.115	82.662
Skew Month	-0.381	-0.292	-0.542	-0.072	0.186	-0.617	-0.291	0.265	-0.051	-0.048	0.072	-0.089	-0.184
Kurt Month	3.284	2.888	2.194	2.398	2.298	2.888	2.558	2.235	3.818	2.249	2.455	2.093	2.292
M Min Year	1981	1958	1969	1987	1970	1966	1984	1984	1984	1987	1962	1963	1966
M Max Year	1974	1949	1997	1982	1995	1994	1993	1990	1987	1960	1986	1978	1990

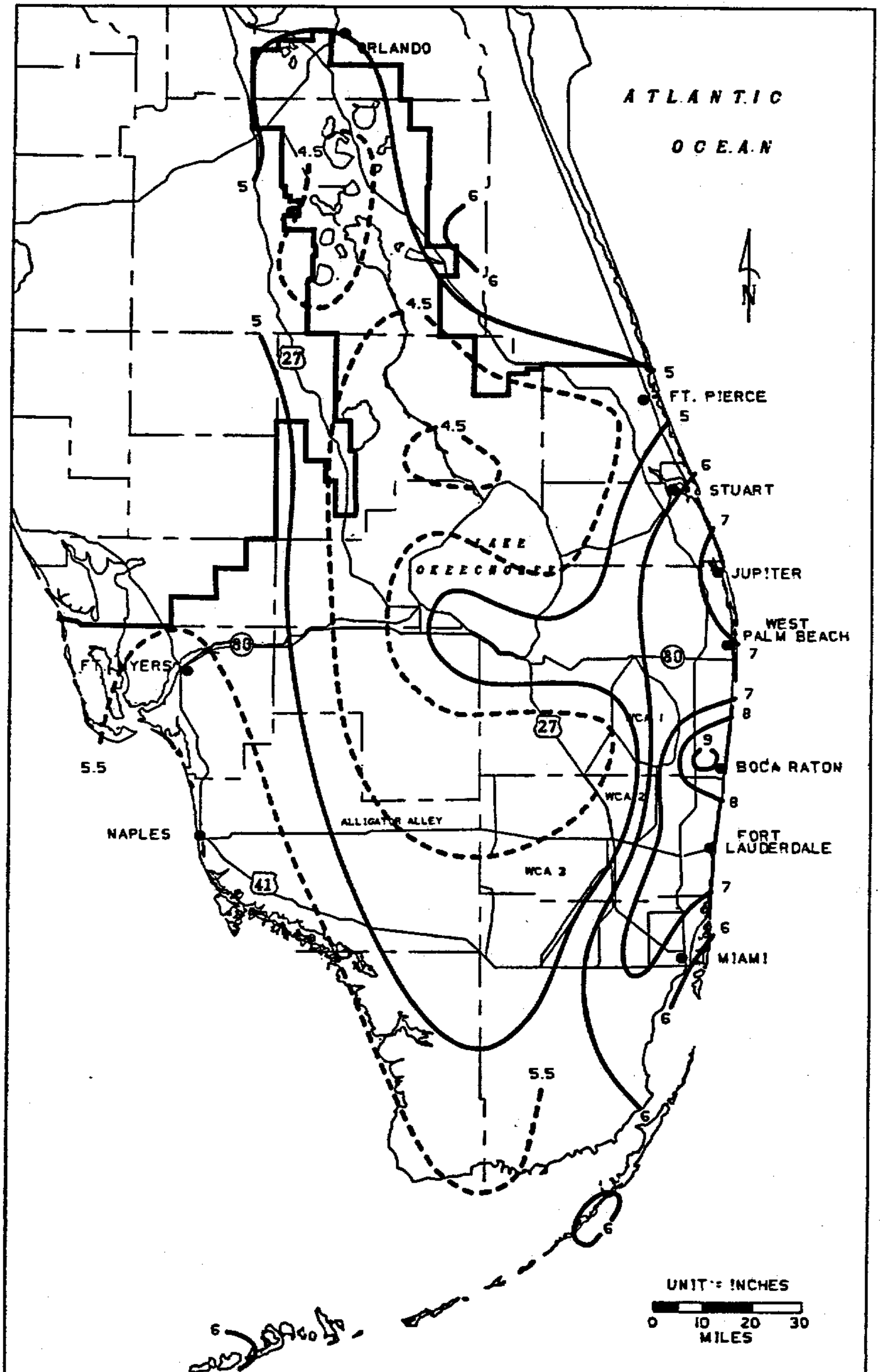
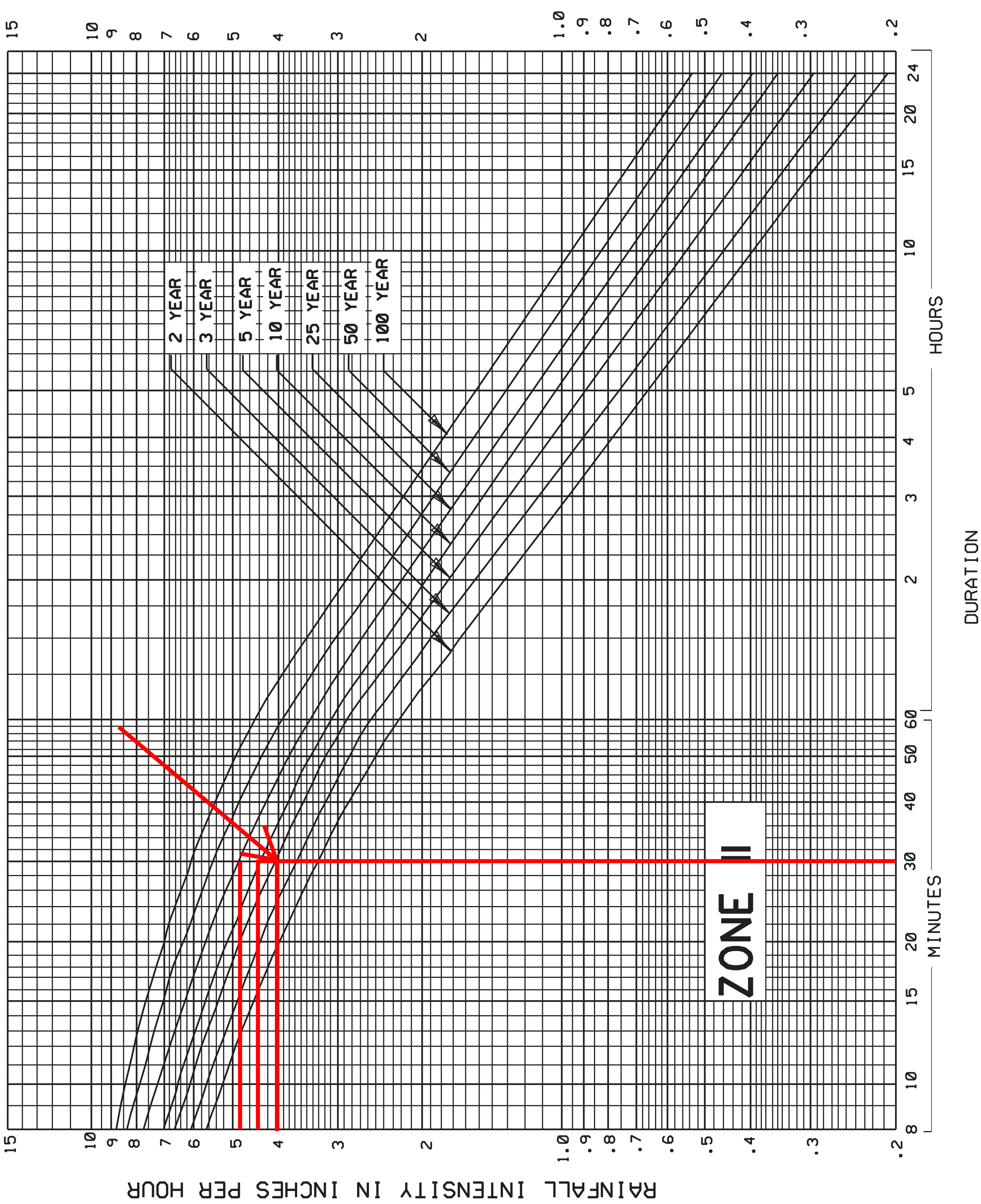


FIGURE C-3. 1-DAY RAINFALL: 5-YEAR RETURN PERIOD



RAINFALL INTENSITY-DURATION-FREQUENCY CURVES
ZONE 11

MANNING "N" VALUES

Table T-2
Manning's n Values for Street and Pavement Gutters

Type of Gutter or Pavement	Range of Manning's n
Concrete gutter, troweled finish	0.012
Asphalt pavement:	
Smooth texture	0.013
Rough texture	0.016
Concrete gutter with asphalt pavement:	
Smooth	0.013
Rough	0.015
Concrete pavement:	
Float finish	0.014
Broom finish	0.016
For gutters with small slopes, where sediment may accumulate increase above values of n by	0.002

Note: Estimates are by the Federal Highway Administration.

Reference: USDOT, FHWA, HDS-3 (1961)

RUN OFF
COEFFICIENTS

Table T-4
Runoff Coefficients For A Design Storm Return Period Of 10 Years Or Less[a]

Slope	Land Use	Sandy Soils Min.	Sandy Soils Max.	Clay Soils Min.	Clay Soils Max.
Flat (0-2%)	Woodlands	0.10	0.15	0.15	0.20
	Pasture, grass, and farmland [b]	0.15	0.20	0.20	0.25
	Bare Earth	0.30	0.50	0.50	0.60
	Rooftops and pavement	0.95	0.95	0.95	0.95
	Pervious pavements [c]	0.75	0.95	0.90	0.95
	SFR: 1/2-acre lots and larger	0.30	0.35	0.35	0.45
	Smaller lots	0.35	0.45	0.40	0.50
	Duplexes	0.35	0.45	0.40	0.50
	MFR: Apartments, townhouses, and condominiums	0.45	0.60	0.50	0.70
	Commercial and Industrial	0.50	0.95	0.50	0.95
Rolling (2-7%)	Woodlands	0.15	0.20	0.20	0.25
	Pasture, grass, and farmland [b]	0.20	0.25	0.25	0.30
	Bare Earth	0.40	0.60	0.60	0.70
	Rooftops and pavement	0.95	0.95	0.95	0.95
	Pervious pavements [c]	0.80	0.95	0.90	0.95
	SFR: 1/2-acre lots and larger	0.35	0.50	0.40	0.55
	Smaller lots	0.40	0.55	0.45	0.60
	Duplexes	0.40	0.55	0.45	0.60
	MFR: Apartments, townhouses, and condominiums	0.50	0.70	0.60	0.80
	Commercial and Industrial	0.50	0.95	0.50	0.95
Steep (7%+)	Woodlands	0.20	0.25	0.25	0.30
	Pasture, grass, and farmland [b]	0.25	0.35	0.30	0.40
	Bare Earth	0.50	0.70	0.70	0.80
	Rooftops and pavement	0.95	0.95	0.95	0.95
	Pervious pavements [c]	0.85	0.95	0.90	0.95
	SFR: 1/2-acre lots and larger	0.40	0.55	0.50	0.65
	Smaller lots	0.45	0.60	0.55	0.70
	Duplexes	0.45	0.60	0.55	0.70
	MFR: Apartments, townhouses, and condominiums	0.60	0.75	0.65	0.85
	Commercial and Industrial	0.60	0.95	0.65	0.95

[a] Weighted coefficient based on percentage of impervious surfaces and green areas must be selected for each site.

[b] Coefficients assume good ground cover and conservation treatment.

[c] Depends on depth and degree of permeability of underlying strata.

Note: SFR = Single Family Residential
MFR = Multi-Family Residential

Table T-5
Design Storm Frequency Factors For Pervious Area Runoff Coefficients *

Return Period (years)	Design Storm Frequency Factor, X_T
2 to 10	1.0 DESIGN FACTOR
25	1.1
50	1.2
100	1.25

Reference: Wright-McLaughlin Engineers (1969).

* DUE TO THE INCREASE IN THE DURATION TIME THAT THE PEAK OR NEAR PEAK DISCHARGE RATE IS RELEASED FROM STORMWATER MANAGEMENT SYSTEMS, THE USE OF THESE SHORT DURATION PEAK RATE DISCHARGE ADJUSTMENT FACTORS IS NOT APPROPRIATE FOR FLOOD ROUTING COMPUTATIONS.

Table T-6
Definitions Of Four SCS Hydrologic Soil Groups

Hydrologic Soil Group	Definition
A	Low Runoff Potential Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well-to-excessively-drained sands or gravels. These soils have a high rate of water transmission.
B	Moderately Low Runoff Potential Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep, to deep, moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
C	Moderately High Runoff Potential Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, soils with moderate fine to fine texture, or soils with moderate water tables. These soils have a slow rate of water transmission.
D	High Runoff Potential Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

PERVIOUS AREAS

Reference: USDA, SCS, NEH-4 (1972).

DESIGN SOIL GROUP (IMPERVIOUS AREAS)

SCS RUN OFF
CURVE NUMBER
TABLES

Table T-7
SCS Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Land Use

Land Use Description		Hydrologic Soil Group A	B	C	D
Cultivated Land[a]:					
Without conservation treatment		72	81	88	91
With conservation treatment		62	71	78	81
Pasture or range land:					
Poor condition		68	79	86	89
Good condition		39	61	74	80
Meadow: good condition		30	58	71	78
Wood or Forest Land:					
Thin stand, poor cover, no mulch		45	66	77	83
Good cover[b]		25	55	70	77
Open Spaces, Lawns, Parks, Golf Courses, Cemeteries:					
Good condition: grass cover on 75% or more of the area		39	61	74	80
Fair condition: grass cover on 50% to 75% of the area		49	69	79	84
Poor condition: grass cover on 50% or less of the area		68	79	86	89
Commercial and Business Areas (85% impervious)		89	92	94	95
Industrial Districts (72% impervious)		81	88	91	93
Residential[c]					
Average lot size	Average % Impervious[d]				
1/8 acre or less	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
Paved Parking Lots, Roofs, Driveways[e]:		98	98	98	98
Streets and Roads:					
Paved with curbs and storm sewers[e]		98	98	98	98
Gravel		76	85	89	91
Dirt		72	82	87	89
Paved with open ditches		83	89	92	93
Newly graded area (no vegetation established)[f]		77	86	91	94

[a] For a more detailed description of agricultural land use curve numbers, refer to Table T-8.
[b] Good cover is protected from grazing and litter and brush cover soil.
[c] Curve numbers are computed assuming the runoff from the house and driveway is directed toward the street with a minimum of roof water directed to lawns where additional infiltration could occur. Depends on depth and degree of permeability of underlying strata.
[d] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.
[e] In some warmer climates of the country, a curve number of 96 may be used.
[f] Use for temporary conditions during grading and construction.
Note: These values are for Antecedent Moisture Condition II, and $I_a = 0.2S$.

Reference: USDA, SCS, TR-55 (1984).

PRE-EXISTING CONDITIONS - INPUT DATA

Manual Basin: B1

Scenario: Scenario1
Node: N01
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 37.1000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
16.2500	Impervious	D			
31.4800	Pervious	D			

Comment:

Node: N01

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.41 ft

Stage [ft]	Area [ac]	Area [ft2]
-0.08	0.0001	4
0.41	0.0001	5
0.62	0.0001	5
3.60	47.7300	2079119

Comment:

Simulation: 10Y-24H

Scenario: Scenario1
Run Date/Time: 3/27/2020 3:58:28 PM
Program Version: ICPR4 4.04.00

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

Hydrology [sec]	Surface Hydraulics	Groundwater [sec]

		[sec]	
Min Calculation Time:	30.0000	0.0500	900.0000
Max Calculation Time:		30.0000	

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Groundwater

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	360.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:
Reference ET Folder:
Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1
Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1
Roughness Set:
Crop Coef Set:
Fillable Porosity Set:
Conductivity Set:
Leakage Set:

Tolerances & Options

Time Marching: SAOR
Max Iterations: 6
Over-Relax Weight Fact: 0.5 dec
dZ Tolerance: 0.0010 ft
Max dZ: 1.0000 ft
Link Optimizer Tol: 0.0001 ft

IA Recovery Time: 24.0000 hr
ET for Manual Basins: False
Manual Basin Rain Opt: Global
OF Region Rain Opt: Global
Rainfall Name: ~FDOT-24
Rainfall Amount: 7.00 in

Edge Length Option:	Automatic	Storm Duration:	37.0000 hr
Dflt Damping (2D):	0.0050 ft	Dflt Damping (1D):	0.0050 ft
Min Node Srf Area (2D):	100 ft2	Min Node Srf Area (1D):	100 ft2
Energy Switch (2D):	Energy	Energy Switch (1D):	Energy

Comment:

Simulation: 25Y-24H

Scenario: Scenario1
Run Date/Time: 3/27/2020 5:22:09 PM
Program Version: ICPR4 4.04.00

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

	Hydrology [sec]	Surface Hydraulics [sec]	Groundwater [sec]
Min Calculation Time:	30.0000	0.0500	900.0000
Max Calculation Time:		30.0000	

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Groundwater

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	360.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources	
Rainfall Folder:	
Reference ET Folder:	
Unit Hydrograph Folder:	

Lookup Tables	
Boundary Stage Set:	
Extern Hydrograph Set:	
Curve Number Set:	1
Green-Ampt Set:	
Vertical Layers Set:	
Impervious Set:	1
Roughness Set:	
Crop Coef Set:	
Fillable Porosity Set:	
Conductivity Set:	
Leakage Set:	

Tolerances & Options

Time Marching:	SAOR	IA Recovery Time:	24.0000 hr
Max Iterations:	6	ET for Manual Basins:	False
Over-Relax Weight Fact:	0.5 dec		
dZ Tolerance:	0.0010 ft	Manual Basin Rain Opt:	Global
Max dZ:	1.0000 ft	OF Region Rain Opt:	Global
Link Optimizer Tol:	0.0001 ft	Rainfall Name:	~FDOT-24
		Rainfall Amount:	8.00 in
Edge Length Option:	Automatic	Storm Duration:	37.0000 hr
Dflt Damping (2D):	0.0050 ft	Dflt Damping (1D):	0.0050 ft
Min Node Srf Area (2D):	100 ft2	Min Node Srf Area (1D):	100 ft2
Energy Switch (2D):	Energy	Energy Switch (1D):	Energy

Comment:

Simulation: 5Y-24H

Scenario:	Scenario1
Run Date/Time:	3/27/2020 6:23:49 PM
Program Version:	ICPR4 4.04.00

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

Hydrology [sec]	Surface Hydraulics	Groundwater [sec]

		[sec]	
Min Calculation Time:	30.0000	0.0500	900.0000
Max Calculation Time:		30.0000	

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Groundwater

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	360.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:
Reference ET Folder:
Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1
Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1
Roughness Set:
Crop Coef Set:
Fillable Porosity Set:
Conductivity Set:
Leakage Set:

Tolerances & Options

Time Marching: SAOR
Max Iterations: 6
Over-Relax Weight Fact: 0.5 dec
dZ Tolerance: 0.0010 ft
Max dZ: 1.0000 ft
Link Optimizer Tol: 0.0001 ft

IA Recovery Time: 24.0000 hr
ET for Manual Basins: False
Manual Basin Rain Opt: Global
OF Region Rain Opt: Global
Rainfall Name: ~FDOT-24
Rainfall Amount: 6.00 in

Edge Length Option:	Automatic	Storm Duration:	37.0000 hr
Dflt Damping (2D):	0.0050 ft	Dflt Damping (1D):	0.0050 ft
Min Node Srf Area (2D):	100 ft2	Min Node Srf Area (1D):	100 ft2
Energy Switch (2D):	Energy	Energy Switch (1D):	Energy

Comment:

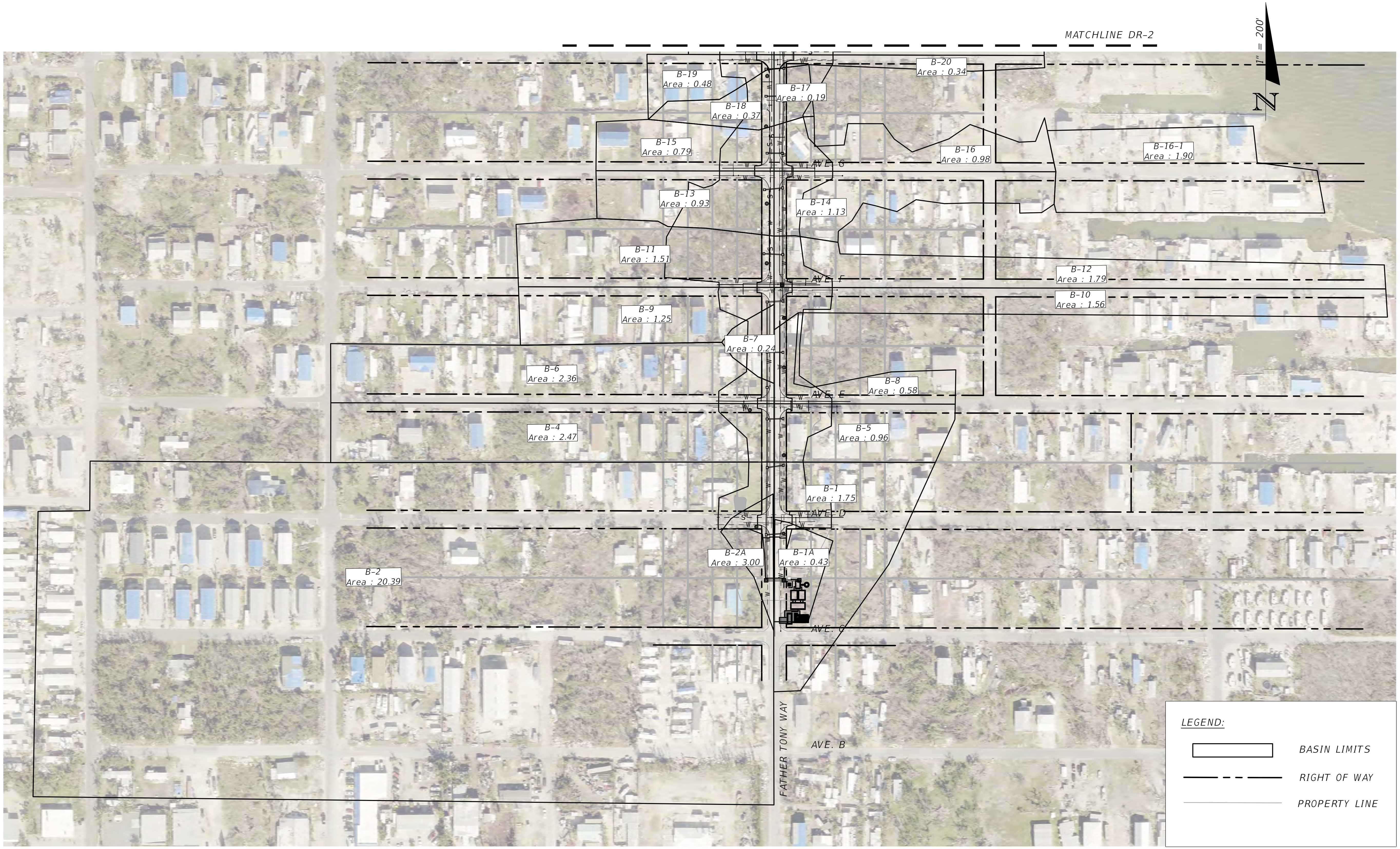
PRE-EXISTING CONDITIONS - NODE MAXIMUM

Node Max Conditions [Scenario1]

Node Name	Sim Name	Warning Stage [ft]	Max Stage [ft]	Min/Max Delta Stage [ft]	Max Total Inflow [cfs]	Max Total Outflow [cfs]	Max Surface Area [ft2]
N01	10Y-24H	0.41	2.03	0.0010	17.91	0.00	1060140
N01	25Y-24H	0.41	2.16	0.0010	21.01	0.00	1151583
N01	5Y-24H	0.41	1.89	0.0010	14.82	0.00	961411

APPENDIX B

DRAINAGE MAPS



REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION
07/19/19	60% SUBMITTAL - NOT FOR CONSTRUCTION		

UECRILEA RAERTNEFSSLON, P.E.
P.E. LICENSE NUMBER 68042
WSP USA, 7650 CORPORATE CENTER DRIVE,
SUITE 300, MIAMI, FLORIDA 33126
CERTIFICATE OF AUTHORIZATION 01462

wsp

SEA LEVEL RISE ROADWAY AND DRAINAGE PILOT PROJECT
TWIN LAKES SUBDIVISION - KEY LARGO
MONROE COUNTY - DEPARTMENT OF ENGINEERING

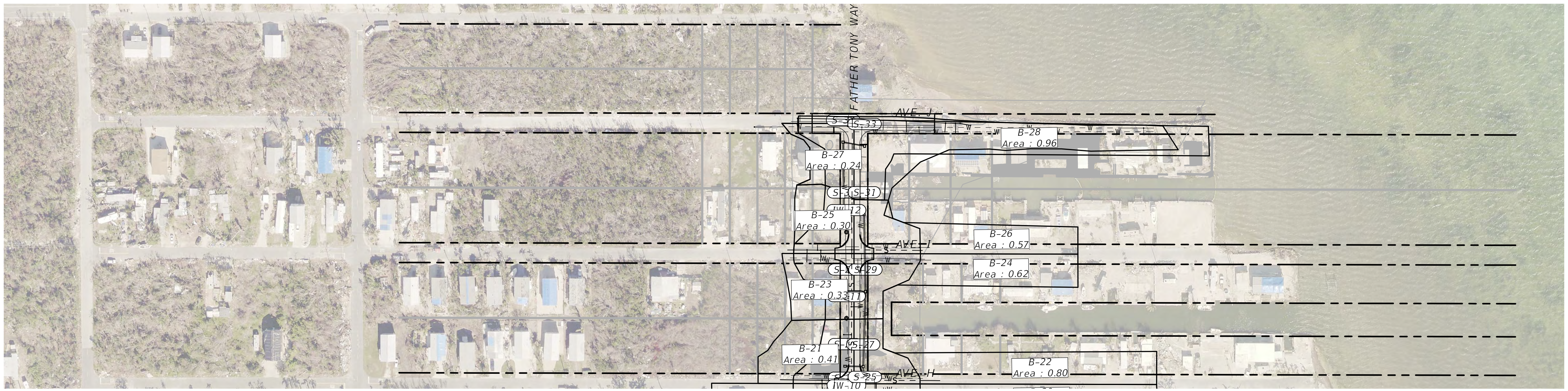
DRAINAGE MAP

SHEET NO.
DR-1

Schotanus, Stacie 5/4/2021 8:09:11 AM T:\Projects\193618A_Sea Level Rise Pilot\2_SheetFiles\DRMPRD02.dwg

1" = 200'

N



MATCHLINE DR-1

LEGEND:

(box symbol)	BASIN LIMITS
(dash-dot line)	RIGHT OF WAY
(thin line)	PROPERTY LINE

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION
07/19/19	60% SUBMITTAL - NOT FOR CONSTRUCTION		

[illegible], P.E.
P.E. LICENSE NUMBER 68042
WSP USA, 7650 CORPORATE CENTER DRIVE,
SUITE 300, MIAMI, FLORIDA 33126
CERTIFICATE OF AUTHORIZATION 01462

wsp

SEA LEVEL RISE ROADWAY AND DRAINAGE PILOT PROJECT
TWIN LAKES SUBDIVISION - KEY LARGO
MONROE COUNTY - DEPARTMENT OF ENGINEERING

DRAINAGE MAP

SHEET NO.
DR-2

Schotanus, Stacie 5/4/2021 8:09:25 AM T:\Projects\193618A_Sea Level Rise Pilot\2_SheetFiles\DRMPRD02.dwg

TABULATION
OF AREAS

Big Pine Key								
Basin	TOTAL AREA (AC)	TOTAL PER. AREA (AC)	Land Use (Pervious)*	TOTAL IMP. AREA (AC)	Land Use (Impervious)*	C_{IMP}	C_{PER}	C
1	1.75	1.08	Bare Earth - Sandy Soils	0.50	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.49
1A	0.43	0.30	Bare Earth - Sandy Soils	0.14	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54
2	20.39	13.06	Bare Earth - Sandy Soils	7.33	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.57
2A	3.00	1.92	Bare Earth - Sandy Soils	1.08	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.57
4	2.47	1.72	Bare Earth - Sandy Soils	0.76	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.53
5	0.96	0.64	Bare Earth - Sandy Soils	0.32	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.55
6	2.36	1.53	Bare Earth - Sandy Soils	0.83	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.56
7	0.24	0.16	Bare Earth - Sandy Soils	0.07	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54
8	0.58	0.36	Bare Earth - Sandy Soils	0.22	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.58
9	1.25	0.72	Bare Earth - Sandy Soils	0.53	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.60
10	1.56	0.99	Bare Earth - Sandy Soils	0.58	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.57
11	1.51	1.25	Bare Earth - Sandy Soils	0.26	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.45
12	1.79	1.29	Bare Earth - Sandy Soils	0.50	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.52
13	0.93	0.74	Bare Earth - Sandy Soils	0.20	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.48
14	1.13	0.77	Bare Earth - Sandy Soils	0.36	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54
15	0.79	0.55	Bare Earth - Sandy Soils	0.24	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.53
16	0.98	0.65	Bare Earth - Sandy Soils	0.34	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.56
16-1	1.90	0.18	Bare Earth - Sandy Soils	1.72	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.89
17	0.19	0.15	Bare Earth - Sandy Soils	0.04	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.48
18	0.37	0.29	Bare Earth - Sandy Soils	0.08	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.48
19	0.48	0.22	Bare Earth - Sandy Soils	0.25	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.67
20	0.34	0.17	Bare Earth - Sandy Soils	0.16	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.64
21	0.41	0.24	Bare Earth - Sandy Soils	0.17	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.59
22	0.80	0.53	Bare Earth - Sandy Soils	0.27	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.55
23	0.33	0.19	Bare Earth - Sandy Soils	0.14	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.60
24	0.62	0.35	Bare Earth - Sandy Soils	0.27	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.61
25	0.30	0.19	Bare Earth - Sandy Soils	0.10	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.56
26	0.57	0.34	Bare Earth - Sandy Soils	0.23	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.59
27	0.24	0.14	Bare Earth - Sandy Soils	0.10	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.60
28	0.96	0.92	Bare Earth - Sandy Soils	0.20	Rooftop/Pavement -Sandy Soils	0.95	0.35	0.54

Total Basin Area (AC.):	49.63
Total Pervious Area (AC.):	31.65
Total Impervious Area (AC):	17.97

* Based on Table T-4 Hydrology Handbook

WATER QUALITY CALCULATIONS

WSP USA

7650 Corporate Center Drive
Miami, FL 33126
(305) 514-3100

Date:	**March 27, 2020**
Project Name:	**Big Pine Key Pilot Project**
Project Number:	
Prepared By:	

WATER QUALITY CALCULATIONS (S.F.W.M.D. CRITERIA)

I. GIVEN:

A. ACREAGE:

1	buildings	0.00	ac.
2	roadways	17.50	ac.
3	buildings	0.00	ac.
7	green	32.13	ac.
11	buildings	0.00	ac.
	Total =	**49.63**	**ac.**

SUMMARY:

Total Pervious Area =	32.13	ac.	64.74%
Total Impervious Area =	17.50	ac.	35.26%
Total =	**49.63**	ac.	

II. DESIGN CRITERIA:

A. WATER QUALITY CRITERIA:

a. Pretreatment

1) Pretreatment Volume = r/w Tributary Areas x 0.5 in. 24.82 Ac.-in. or 2.07 Ac.-ft.

b. Water Quality

1) Compute the first inch of runoff from the developed project:
1 (in) x total site area (ac) x 1 (ft)/12 (in) = 4.14 Ac.-ft. or 49.63 Ac.-in.

2) Compute 2.5 inches x the percent of imperviousness:

a. Site area for impervious water quality calculations =
Site area - (lake/wetland water surface + roof surface) = 49.63 Ac.

b. Impervious area for water quality pervious/impervious =
Site area for impervious water quality - pervious area = 17.50 Ac.

c. Percentage of Imperviousness for Water Quality = 35.3%

d. For 2.5 inches times the percentage impervious = 0.88 in.

e. Compute volume required for water quality detention:
inches to be treated x (Total site - lake/wetland water surface) = 43.75 Ac.-in. or 3.65 Ac.-ft.

Total Volume ' 24.82 Ac.-in. + 49.63 Ac.-in. = 74.45 Ac.-in. or 6.20 Ac.-ft

Pretreatment and water quality volume shall be provided by the proposed Contech treatment units:

Total Volume in CFS: 74.45 Ac.-in x (43,560 SQFT/Ac.) x (1 ft./12 in) = 270,235.35 CF
270,235.35 CF / [24 hr. x (60 min. / 1 hr.) x (60 sec. / 1 min.) (duration of 1:5 and 1:10 storm event)] = 3.13 CFS

Treatment capacity of proposed Contech Treatment unit: 25 CFS > 3.13 CFS OK

Swale Volume
Volume Provided in Swales in Roadway= 0.40 Ac-Ft
Volume Provided in Swales in Property*= 1.61 Ac-Ft

Water Quality Criteria Summary Table		
Required Treatment Volume	6.20	Ac-Ft
Required Treatment Flow	3.13	CFS
BMP Treatment Unit Flow Capacity	25	CFS

*Assuming 10% of pervious total are swales within property limits

ICPR INPUT

Manual Basin: B-1

Scenario:	Scenario1
Node:	S-07
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	20.0000 min
Max Allowable Q:	0.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH256
Peaking Factor:	256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.5000	Impervious	D			
1.0800	Pervious	D			

Comment:

Manual Basin: B-10

Scenario:	Scenario1
Node:	S-14
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	15.0000 min
Max Allowable Q:	0.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH256
Peaking Factor:	256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.5800	Impervious	D			
0.9900	Pervious	D			

Comment:

Manual Basin: B-11

Scenario:	Scenario1
Node:	S-16
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	15.0000 min
Max Allowable Q:	0.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH256
Peaking Factor:	256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient	Reference ET

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2600	Impervious	D			
1.2500	Pervious	D			

Comment:

Manual Basin: B-12

Scenario: Scenario1
Node: S-17
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.5000	Impervious	D			
1.2900	Pervious	D			

Comment:

Manual Basin: B-13

Scenario: Scenario1
Node: S-18
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2000	Impervious	D			
0.7400	Pervious	D			

Comment:

Manual Basin: B-14

Scenario: Scenario1
Node: S-19
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.3600	Impervious	D			
0.7700	Pervious	D			

Comment:

Manual Basin: B-15

Scenario: Scenario1
Node: S-20
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2400	Impervious	D			
0.5500	Pervious	D			

Comment:

Manual Basin: B-16

Scenario: Scenario1
Node: S-21
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.3400	Impervious	D			
0.6500	Pervious	D			

Comment:

Manual Basin: B-16-1

Scenario: Scenario1
Node: S-21-1
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
1.7200	Impervious	D			
0.1800	Pervious	D			

Comment:

Manual Basin: B-17

Scenario: Scenario1
Node: S-23
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.0400	Impervious	D			
0.1500	Pervious	D			

Comment:

Manual Basin: B-18

Scenario:	Scenario1
Node:	S-22
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	15.0000 min
Max Allowable Q:	0.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH256
Peaking Factor:	256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.0800	Impervious	D			
0.2900	Pervious	D			

Comment:

Manual Basin: B-19

Scenario:	Scenario1
Node:	S-24
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	15.0000 min
Max Allowable Q:	0.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH256
Peaking Factor:	256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2500	Impervious	D			
0.2200	Pervious	D			

Comment:

Manual Basin: B-1A

Scenario:	Scenario1
Node:	S-05
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	20.0000 min
Max Allowable Q:	0.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH256
Peaking Factor:	256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.1400	Impervious	D			
0.3000	Pervious	D			

Comment:

Manual Basin: B-2

Scenario: Scenario1
Node: S-06
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 31.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
7.3300	Impervious	D			
13.0600	Pervious	D			

Comment:

Manual Basin: B-20

Scenario: Scenario1
Node: S-25
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.1600	Impervious	D			
0.1700	Pervious	D			

Comment:

Manual Basin: B-21

Scenario: Scenario1
Node: S-26
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.1700	Impervious	D			
0.2400	Pervious	D			

Comment:

Manual Basin: B-22

Scenario: Scenario1
Node: S-27
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2700	Impervious	D			
0.5300	Pervious	D			

Comment:

Manual Basin: B-23

Scenario: Scenario1
Node: S-28
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.1400	Impervious	D			
0.1900	Pervious	D			

Comment:

Manual Basin: B-24

Scenario: Scenario1
Node: S-29
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2700	Impervious	D			
0.3500	Pervious	D			

Comment:

Manual Basin: B-25

Scenario: Scenario1
Node: S-30
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.1000	Impervious	D			
0.1900	Pervious	D			

Comment:

Manual Basin: B-26

Scenario: Scenario1
Node: S-31
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2300	Impervious	D			
0.3400	Pervious	D			

Comment:

Manual Basin: B-27

Scenario: Scenario1
Node: S-32
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.1000	Impervious	D			
0.1400	Pervious	D			

Comment:

Manual Basin: B-28

Scenario: Scenario1
Node: S-33
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2000	Impervious	D			
0.7600	Pervious	D			

Comment:

Manual Basin: B-2A

Scenario: Scenario1
Node: S-04
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 20.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
1.0800	Impervious	D			
1.9200	Pervious	D			

Comment:

Manual Basin: B-4

Scenario: Scenario1
Node: S-08
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 20.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.7600	Impervious	D			
1.7200	Pervious	D			

Comment:

Manual Basin: B-5

Scenario: Scenario1
Node: S-09
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.3200	Impervious	D			
0.6400	Pervious	D			

Comment:

Manual Basin: B-6

Scenario: Scenario1
Node: S-10
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 20.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.8300	Impervious	D			
1.5300	Pervious	D			

Comment:

Manual Basin: B-7

Scenario: Scenario1
Node: S-11
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.0700	Impervious	D			
0.1600	Pervious	D			

Comment:

Manual Basin: B-8

Scenario: Scenario1
Node: S-12
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.2200	Impervious	D			
0.3600	Pervious	D			

Comment:

Manual Basin: B-9

Scenario: Scenario1
Node: S-13
Hydrograph Method: NRCS Unit Hydrograph
Infiltration Method: Curve Number
Time of Concentration: 15.0000 min
Max Allowable Q: 0.00 cfs
Time Shift: 0.0000 hr
Unit Hydrograph: UH256
Peaking Factor: 256.0

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name	Crop Coeficient Zone	Reference ET Station
0.5300	Impervious	D			
0.7200	Pervious	D			

Comment:

Node: GWT

Scenario: Scenario1
Type: Time/Stage
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.00 ft
Boundary Stage:

Year	Month	Day	Hour	Stage [ft]
0	0	0	0.0000	-0.08
0	0	0	25.0000	0.36

Comment:

Node: IS

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.50	0.0009	39
-1.50	0.0010	44
3.20	0.0011	48

Comment: INITIAL STAGE IS MEAN HIGH HIGH WATER FROM SPREADSHEET

Node: IS2

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.20	0.0009	39
-1.50	0.0010	44
3.20	0.0011	48

Comment:

Node: IW1

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW10

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW11

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5

Stage [ft]	Area [ac]	Area [ft2]
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW12

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW2

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW3

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW4

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW5

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4

Stage [ft]	Area [ac]	Area [ft2]
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW6

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW7

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW8

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: IW9

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -3.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-3.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Assumed 3' of cover, 2' ID pipe from tee to IW;
Surface El 2.0 NAVD
TOP of Pipe: -1 NAVD
Inv.: -3 NAVD
Warning Stage 8' Maximum allowable head

Node: J1

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 12.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0010	44

Stage [ft]	Area [ac]	Area [ft2]
12.00	0.0011	48

Comment: Warning Stage: Max 8' NAVD head over injection wells; added 4' for head loss

Node: S-01

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.20	0.0003	13
3.20	0.0003	14

Comment:

Node: S-02

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.60 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.19	0.0003	13
2.60	0.0003	14

Comment:

Node: S-03

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.60 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.19	0.0003	13
2.60	0.0003	14

Comment:

Node: S-04

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.40 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.15	0.0003	13
2.40	0.0003	14
5.40	3.0000	130680

Comment:

Node: S-05

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.40 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0003	13
2.40	0.0003	14
5.40	0.4300	18731

Comment:

Node: S-06

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.15	0.0003	13
2.20	0.0003	14
5.20	20.3900	888188

Comment:

Node: S-07

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.20	0.0003	13
2.20	0.0003	14
5.20	1.7500	76230

Comment:

Node: S-08

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.10	0.0003	13
2.00	0.0003	14
5.00	2.4700	107593

Comment:

Node: S-09

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 2.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.40	0.0003	13
2.00	0.0003	14
5.00	0.9600	41818

Comment:

Node: S-10

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.40 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.07	0.0003	13
1.40	0.0003	14
4.40	2.3600	102802

Comment:

Node: S-11

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.06	0.0003	13
1.20	0.0003	14
4.20	0.2400	10454

Comment:

Node: S-12

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.80	0.0003	13
1.20	0.0003	14
4.20	0.5800	25265

Comment:

Node: S-13

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.90 ft

Stage [ft]	Area [ac]	Area [ft2]
-8.07	0.0003	13
0.90	0.0003	14
3.90	1.2500	54450

Comment:

Node: S-14

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.10 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.95	0.0003	13
1.10	0.0003	14
4.10	1.5600	67954

Comment:

Node: S-15

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.78	0.0003	13
1.20	0.0003	14

Comment:

Node: S-16

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.17 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.20	0.0003	13
1.17	0.0003	14
4.17	1.5100	65776

Comment:

Node: S-17

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.80 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.65	0.0003	13
0.80	0.0003	14
3.50	1.7900	77972

Comment:

Node: S-18

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.85 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.20	0.0003	13
0.85	0.0003	14
3.85	0.9300	40511

Comment:

Node: S-19

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.85 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.40	0.0003	13
0.85	0.0003	14
3.70	1.1300	49223

Comment:

Node: S-20

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.87 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.90	0.0003	13
0.87	0.0003	14
3.87	0.7900	34412

Comment:

Node: S-21

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.85 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.29	0.0003	13
0.85	0.0003	14
3.85	0.9800	42689

Comment:

Node: S-21-1

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -4.20 ft
Warning Stage: 0.80 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.20	0.0003	13
0.80	0.0003	14
1.20	1.9000	82764

Comment:

Node: S-22

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.87 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.80	0.0003	13
0.87	0.0003	14
3.70	0.3700	16117

Comment:

Node: S-23

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.87 ft

Stage [ft]	Area [ac]	Area [ft2]
-7.00	0.0003	13
0.87	0.0003	14
3.87	0.1900	8276

Comment:

Node: S-24

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.05 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.40	0.0003	13
1.05	0.0003	14
3.70	0.4800	20909

Comment:

Node: S-25

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.87 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.89	0.0003	13
0.87	0.0003	14
3.30	0.3400	14810

Comment:

Node: S-26

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.88 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.70	0.0003	13
0.88	0.0003	14
3.80	0.4100	17860

Comment:

Node: S-27

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.05 ft

Stage [ft]	Area [ac]	Area [ft2]
-6.50	0.0003	13
1.05	0.0003	14
4.05	0.8000	34848

Comment:

Node: S-28

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.50	0.0003	13
1.00	0.0003	14
4.00	0.3300	14375

Comment:

Node: S-29

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 1.05 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.70	0.0003	13
1.05	0.0003	14
4.05	0.6200	27007

Comment:

Node: S-30

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.88 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.60	0.0003	13
0.88	0.0003	14
3.85	0.3000	13068

Comment:

Node: S-31

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.88 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.60	0.0003	13
0.88	0.0003	14
3.85	0.5700	24829

Comment:

Node: S-32

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.41 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.60	0.0003	13
0.41	0.0003	14
3.80	0.2400	10454

Comment:

Node: S-33

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -0.08 ft
Warning Stage: 0.42 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.10	0.0003	13
0.42	0.0003	14
3.70	0.9600	41818

Comment:

Node: TEE1

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE10

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE11

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE12

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE2

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert

Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE3

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE4

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE5

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

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Node: TEE6

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

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Node: TEE7

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

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Node: TEE8

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TEE9

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -5.00 ft
Warning Stage: 8.00 ft

Stage [ft]	Area [ac]	Area [ft2]
-5.00	0.0001	4
-1.00	0.0001	5
8.00	0.0001	5

Comment: Initial El. =Invert
Top of Pipe El.= -1
Warning Stage= 8 maximum head over the node before injection well

Node: TU

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -6.20 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-14.80	0.0018	78
3.20	0.0019	83

Comment: ASSUMED ELEV +3.2
INITIAL STAGE IS PERM. POOL ELEV.

Node: WW1

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -19.20 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-19.20	0.0020	87
3.20	0.0021	91

Comment:

Node: WW1A

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -19.20 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-19.20	0.0020	87
3.20	0.0021	91

Comment: ASSUME 3.2' RIM ELEV

Node: WW2

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: -19.20 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-19.20	0.0020	87
3.20	0.0021	91

Comment:

Node: WW2A

Scenario: Scenario1
Type: Stage/Area

Base Flow: 0.00 cfs
Initial Stage: -19.20 ft
Warning Stage: 3.20 ft

Stage [ft]	Area [ac]	Area [ft2]
-19.20	0.0020	87
3.20	0.0021	91

Comment:

Weir Link: IS-IS2

Scenario:	Scenario1	**Bottom Clip**	
From Node:	IS	Default:	0.00 ft
To Node:	IS2	Op Table:	
Link Count:	1	Ref Node:	
Flow Direction:	Both	**Top Clip**	
Damping:	0.0000 ft	Default:	0.00 ft
Weir Type:	Broad Crested Vertical	Op Table:	
Geometry Type:	Rectangular	Ref Node:	
Invert:	-1.50 ft	**Discharge Coefficients**	
Control Elevation:	-1.50 ft	Weir Default:	2.800
Max Depth:	3.70 ft	Weir Table:	
Max Width:	6.00 ft	Orifice Default:	0.600
Fillet:	0.00 ft	Orifice Table:	

Comment:

Pipe Link: IS-TU

		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.20 ft	Invert:	-6.20 ft
From Node:	IS	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	TU	**Geometry: Circular**		**Geometry: Circular**	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Both	**Bottom Clip**			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	8.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	**Top Clip**			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: IS2-WW1		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.20 ft	Invert:	-6.20 ft
From Node:	IS2	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	WW1	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	7.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: IS2-WW2		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.20 ft	Invert:	-6.20 ft
From Node:	IS2	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	WW2	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.50 ft	Max Depth:	2.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	8.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.50	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.50 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment: 4' PIPES

Rating Curve Link: IW10_GWT	
Scenario:	Scenario1
From Node:	IW10
To Node:	GWT
Link Count:	1
Flow Direction:	Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW11_GWT

Scenario: Scenario1
From Node: IW11
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW12_GWT

Scenario: Scenario1
From Node: IW12
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW1_GWT

Scenario: Scenario1
From Node: IW1
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW2_GWT

Scenario: Scenario1
From Node: IW2
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW3_GWT

Scenario: Scenario1
From Node: IW3
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW4_GWT

Scenario: Scenario1
From Node: IW4
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW5_GWT

Scenario: Scenario1
From Node: IW5
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW6_GWT

Scenario: Scenario1
From Node: IW6
To Node: GWT
Link Count: 1

Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW7_GWT

Scenario: Scenario1
From Node: IW7
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW8_GWT

Scenario: Scenario1
From Node: IW8
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Rating Curve Link: IW9_GWT

Scenario: Scenario1
From Node: IW9
To Node: GWT
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Injection Well	1.00		-0.55	

Comment:

Pipe Link: J1_TEE1	Upstream	Downstream

Scenario:	Scenario1	Invert:	-6.10 ft	Invert:	-9.60 ft
From Node:	J1	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE1	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	4.00 ft	Max Depth:	4.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	103.40 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment: Lenght upgraded 10% to account for fitting losses

Pipe Link: S-21-1_S-21		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.20 ft	Invert:	-4.20 ft
From Node:	S-21-1	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-21	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	958.00 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S01-IS		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.20 ft	Invert:	-6.20 ft
From Node:	S-01	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	IS	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	3.00 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft

Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S02-S01		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.19 ft	Invert:	-6.20 ft
From Node:	S-02	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-01	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	19.63 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S03-S02		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.18 ft	Invert:	-6.19 ft
From Node:	S-03	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-02	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	31.88 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S04-S03		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.15 ft	Invert:	-6.18 ft
From Node:	S-04	Manning's N:	0.0160	Manning's N:	0.0160

To Node:	S-03	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	88.81 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S05-S04		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-2.90 ft	Invert:	-3.00 ft
From Node:	S-05	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-04	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	33.66 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S06-S04		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.10 ft	Invert:	-6.15 ft
From Node:	S-06	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-04	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	133.21 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	

		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S07-S06		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.10 ft	Invert:	-3.20 ft
From Node:	S-07	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-06	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	30.92 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S08-S06		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.07 ft	Invert:	-6.10 ft
From Node:	S-08	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-06	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	95.91 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S09-S08		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.30 ft	Invert:	-3.40 ft
From Node:	S-09	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-08	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft

Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	29.69 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S10-S08		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.06 ft	Invert:	-6.07 ft
From Node:	S-10	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-08	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	62.01 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S11-S10		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-6.05 ft	Invert:	-6.06 ft
From Node:	S-11	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-10	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	71.20 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S12-S11		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.70 ft	Invert:	-4.80 ft
From Node:	S-12	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-11	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	30.15 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S13-S11		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.99 ft	Invert:	-6.07 ft
From Node:	S-13	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-11	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	99.54 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S14-S13		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.90 ft	Invert:	-5.95 ft
From Node:	S-14	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-13	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	29.40 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			

Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S15-S14		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.75 ft	Invert:	-5.78 ft
From Node:	S-15	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-14	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	29.95 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S16-S17		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.10 ft	Invert:	-5.20 ft
From Node:	S-16	Manning's N:	0.0160	Manning's N:	0.0130
To Node:	S-17	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	31.53 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S17-S15		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.60 ft	Invert:	-5.65 ft

From Node:	S-17	Manning's N:	0.0160	Manning's N:	0.0160
		Geometry: Circular		Geometry: Circular	
To Node:	S-15				
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	57.19 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S18-S19		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.10 ft	Invert:	-5.20 ft
From Node:	S-18	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-19	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	31.07 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S19-S17		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.29 ft	Invert:	-5.40 ft
From Node:	S-19	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-17	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	132.11 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	

Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S20-S21		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.80 ft	Invert:	-4.90 ft
From Node:	S-20	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-21	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	27.60 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S21-S19		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-5.00 ft	Invert:	-5.29 ft
From Node:	S-21	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-19	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	67.89 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S22-S23		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.70 ft	Invert:	-4.80 ft
From Node:	S-22	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-23	Geometry: Circular		Geometry: Circular	

Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	29.82 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S23-S21		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.89 ft	Invert:	-5.00 ft
From Node:	S-23	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-21	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	113.69 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S24-S25		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.30 ft	Invert:	-4.40 ft
From Node:	S-24	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-25	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	31.62 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S25-S23		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.83 ft	Invert:	-4.89 ft
From Node:	S-25	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-23	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	53.73 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S26-S27		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.60 ft	Invert:	-3.70 ft
From Node:	S-26	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-27	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	30.38 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S27-S25		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-4.45 ft	Invert:	-4.50 ft
From Node:	S-27	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-25	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			

Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	55.89 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S28-S29		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.40 ft	Invert:	-3.50 ft
From Node:	S-28	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-29	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	34.37 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S29-S27		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.60 ft	Invert:	-3.73 ft
From Node:	S-29	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-27	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	132.82 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: S30-S31		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.60 ft	Invert:	-3.60 ft
From Node:	S-30	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-31	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	28.34 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S31-S29		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.60 ft	Invert:	-3.60 ft
From Node:	S-31	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-29	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	137.09 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S32-S30		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.60 ft	Invert:	-3.60 ft
From Node:	S-32	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-30	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	129.09 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			

Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: S33-S32		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-3.10 ft	Invert:	-3.10 ft
From Node:	S-33	Manning's N:	0.0160	Manning's N:	0.0160
To Node:	S-32	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.25 ft	Max Depth:	1.25 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	30.00 ft	Op Table:		Op Table:	
FHWA Code:	0	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.25	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: TEE10_IW10		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.00 ft	Invert:	-9.00 ft
From Node:	TEE10	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW10	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	13.20 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: TEE10_TEE11		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.00 ft	Invert:	-9.00 ft

From Node:	TEE10	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE11	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	173.80 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE11_IW11		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.00 ft	Invert:	-9.00 ft
From Node:	TEE11	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW11	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	11.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE11_TEE12		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.00 ft	Invert:	-9.00 ft
From Node:	TEE11	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE12	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	167.20 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	

Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE12_IW12		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.00 ft	Invert:	-9.00 ft
From Node:	TEE12	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW12	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	11.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE1_IW1		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE1	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW1	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	13.20 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE1_TEE2		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE1	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE2	Geometry: Circular		Geometry: Circular	

Link Count:	1	Max Depth:	4.00 ft	Max Depth:	4.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	79.20 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE2_IW2		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE2	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW2	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	45.10 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE2_TEE3		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE2	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE3	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	4.00 ft	Max Depth:	4.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	154.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE3_IW3		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE3	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW3	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	17.60 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE3_TEE4		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE3	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE4	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	4.00 ft	Max Depth:	4.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	95.70 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE4_IW4		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE4	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW4	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			

Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	55.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: TEE4_TEE5		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-10.30 ft
From Node:	TEE4	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE5	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	4.00 ft	Max Depth:	4.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	90.20 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: TEE5_IW5		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.60 ft	Invert:	-9.60 ft
From Node:	TEE5	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW5	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	13.20 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: TEE5_TEE6		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-10.30 ft	Invert:	-10.30 ft
From Node:	TEE5	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE6	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	105.60 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: TEE6_IW6		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-10.30 ft	Invert:	-10.30 ft
From Node:	TEE6	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW6	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	14.30 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000
Comment:					

Pipe Link: TEE6_TEE7		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-10.30 ft	Invert:	-10.30 ft
From Node:	TEE6	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE7	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	118.80 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			

Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE7_IW7		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.80 ft	Invert:	-9.80 ft
From Node:	TEE7	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW7	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	16.50 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE7_TEE8		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-10.30 ft	Invert:	-10.30 ft
From Node:	TEE7	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE8	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	129.80 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE8_IW8		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-9.80 ft	Invert:	-9.80 ft

From Node:	TEE8	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW8	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	14.30 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE8_TEE9		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-10.30 ft	Invert:	-10.30 ft
From Node:	TEE8	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE9	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	3.00 ft	Max Depth:	3.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	168.30 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE9_IW9		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-10.30 ft	Invert:	-10.30 ft
From Node:	TEE9	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	IW9	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	11.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	

Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: TEE9_TEE10		Upstream		Downstream	
Scenario:	Scenario1	Invert:	-10.30 ft	Invert:	-9.00 ft
From Node:	TEE9	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	TEE10	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	2.00 ft	Max Depth:	2.00 ft
Flow Direction:	Positive	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	107.80 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	0.50	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	1.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 ft	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Weir Link: TU-IS2			
Scenario:	Scenario1	Bottom Clip	
From Node:	TU	Default:	0.00 ft
To Node:	IS2	Op Table:	
Link Count:	1	Ref Node:	
Flow Direction:	Both	Top Clip	
Damping:	0.0000 ft	Default:	0.00 ft
Weir Type:	Broad Crested Vertical	Op Table:	
Geometry Type:	Rectangular	Ref Node:	
Invert:	-6.20 ft	Discharge Coefficients	
Control Elevation:	-2.70 ft	Weir Default:	3.450
Max Depth:	5.80 ft	Weir Table:	
Max Width:	4.50 ft	Orifice Default:	0.710
Fillet:	0.00 ft	Orifice Table:	

Comment: GEOMETRY BASED ON CONTECH CUT SHEET/RIM ELEV ASSUMED +3.2/WEIR DISCHARGE/ORIFICE COEFF FROM FDOT MANUAL. Contech weir elevation 1.5' above top of the inlet

Rating Curve Link: WW1A_J1	
Scenario:	Scenario1
From Node:	WW1A
To Node:	J1

Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Flygt LL3400/706 3~890 2 Pumps	-8.20	WW1A	-18.20	WW1A

Comment:

Weir Link: WW1_WW1A_HORIZ

Scenario:	Scenario1
From Node:	WW1
To Node:	WW1A
Link Count:	1
Flow Direction:	Both
Damping:	0.0000 ft
Weir Type:	Horizontal
Geometry Type:	Rectangular
Invert:	-11.50 ft
Control Elevation:	-11.50 ft
Max Depth:	2.00 ft
Max Width:	12.00 ft
Fillet:	0.00 ft

Bottom Clip

Default:	0.00 ft
Op Table:	
Ref Node:	

Top Clip

Default:	0.00 ft
Op Table:	
Ref Node:	

Discharge Coefficients

Weir Default:	2.800
Weir Table:	
Orifice Default:	0.600
Orifice Table:	

Comment: elevation from the WW bottom to the horizontal baffle

Weir Link: WW1_WW1A_VERT

Scenario:	Scenario1
From Node:	WW1
To Node:	WW1A
Link Count:	1
Flow Direction:	Both
Damping:	0.0000 ft
Weir Type:	Broad Crested Vertical
Geometry Type:	Rectangular
Invert:	-3.40 ft
Control Elevation:	-3.40 ft
Max Depth:	5.60 ft
Max Width:	12.00 ft
Fillet:	0.00 ft

Bottom Clip

Default:	0.00 ft
Op Table:	
Ref Node:	

Top Clip

Default:	0.00 ft
Op Table:	
Ref Node:	

Discharge Coefficients

Weir Default:	2.800
Weir Table:	
Orifice Default:	0.600
Orifice Table:	

Comment:

Rating Curve Link: WW2A_J1

Scenario: Scenario1

From Node: WW2A
To Node: J1
Link Count: 1
Flow Direction: Both

Table	Elev On [ft]	Elev On Node	Elev Off [ft]	Elev Off Node
Flygt LL3400/706 3~890 2 Pumps	-7.20	WW2A	-18.20	WW2A

Comment:

Weir Link: WW2_WW2A_HORIZ

Scenario:	Scenario1	**Bottom Clip**	
From Node:	WW2	Default:	0.00 ft
To Node:	WW2A	Op Table:	
Link Count:	1	Ref Node:	
Flow Direction:	Both	**Top Clip**	
Damping:	0.0000 ft	Default:	0.00 ft
Weir Type:	Horizontal	Op Table:	
Geometry Type:	Rectangular	Ref Node:	
Invert:	-11.50 ft	**Discharge Coefficients**	
Control Elevation:	-11.50 ft	Weir Default:	2.800
Max Depth:	2.00 ft	Weir Table:	
Max Width:	12.00 ft	Orifice Default:	0.600
Fillet:	0.00 ft	Orifice Table:	

Comment:

Weir Link: WW2_WW2A_VERT

Scenario:	Scenario1	**Bottom Clip**	
From Node:	WW2	Default:	0.00 ft
To Node:	WW2A	Op Table:	
Link Count:	1	Ref Node:	
Flow Direction:	Both	**Top Clip**	
Damping:	0.0000 ft	Default:	0.00 ft
Weir Type:	Broad Crested Vertical	Op Table:	
Geometry Type:	Rectangular	Ref Node:	
Invert:	-3.40 ft	**Discharge Coefficients**	
Control Elevation:	-3.40 ft	Weir Default:	2.800
Max Depth:	5.60 ft	Weir Table:	
Max Width:	12.00 ft	Orifice Default:	0.600
Fillet:	0.00 ft	Orifice Table:	

Comment:

Simulation: 10Y-24H

Scenario: Scenario1
Run Date/Time: 4/5/2021 2:40:19 PM
Program Version: ICPR4 4.04.00

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

	Hydrology [sec]	Surface Hydraulics [sec]	Groundwater [sec]
Min Calculation Time:	30.0000	0.0500	900.0000
Max Calculation Time:		30.0000	

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Groundwater

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	360.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:
Reference ET Folder:
Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1
Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1
Roughness Set:
Crop Coef Set:
Fillable Porosity Set:

Conductivity Set:	
Leakage Set:	

Tolerances & Options

Time Marching:	SAOR	IA Recovery Time:	24.0000 hr
Max Iterations:	6	ET for Manual Basins:	False
Over-Relax Weight Fact:	0.5 dec		
dZ Tolerance:	0.0010 ft	Manual Basin Rain Opt:	Global
Max dZ:	1.0000 ft	OF Region Rain Opt:	Global
Link Optimizer Tol:	0.0001 ft	Rainfall Name:	~FDOT-24
		Rainfall Amount:	7.00 in
Edge Length Option:	Automatic	Storm Duration:	37.0000 hr
Dflt Damping (2D):	0.0050 ft	Dflt Damping (1D):	0.0050 ft
Min Node Srf Area (2D):	100 ft2	Min Node Srf Area (1D):	100 ft2
Energy Switch (2D):	Energy	Energy Switch (1D):	Energy

Comment:

Simulation: 25Y-24H

Scenario:	Scenario1
Run Date/Time:	4/5/2021 2:45:14 PM
Program Version:	ICPR4 4.04.00

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

	Hydrology [sec]	Surface Hydraulics [sec]	Groundwater [sec]
Min Calculation Time:	30.0000	0.0500	900.0000
Max Calculation Time:		30.0000	

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Groundwater

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	360.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:
Reference ET Folder:
Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1
Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1
Roughness Set:
Crop Coef Set:
Fillable Porosity Set:
Conductivity Set:
Leakage Set:

Tolerances & Options

Time Marching: SAOR
Max Iterations: 6
Over-Relax Weight Fact: 0.5 dec
dZ Tolerance: 0.0010 ft
Max dZ: 1.0000 ft
Link Optimizer Tol: 0.0001 ft

Edge Length Option: Automatic

Dflt Damping (2D): 0.0050 ft
Min Node Srf Area (2D): 100 ft2
Energy Switch (2D): Energy

IA Recovery Time: 24.0000 hr
ET for Manual Basins: False

Manual Basin Rain Opt: Global
OF Region Rain Opt: Global
Rainfall Name: ~FDOT-24
Rainfall Amount: 8.00 in
Storm Duration: 37.0000 hr

Dflt Damping (1D): 0.0050 ft
Min Node Srf Area (1D): 100 ft2
Energy Switch (1D): Energy

Comment:

Simulation: 5Y-24H

Scenario: Scenario1
Run Date/Time: 4/5/2021 2:51:27 PM
Program Version: ICPR4 4.04.00

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

	Hydrology [sec]	Surface Hydraulics [sec]	Groundwater [sec]
Min Calculation Time:	30.0000	0.0500	900.0000
Max Calculation Time:		30.0000	

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	5.0000

Groundwater

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	360.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:
Reference ET Folder:
Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1
Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1
Roughness Set:
Crop Coef Set:
Fillable Porosity Set:

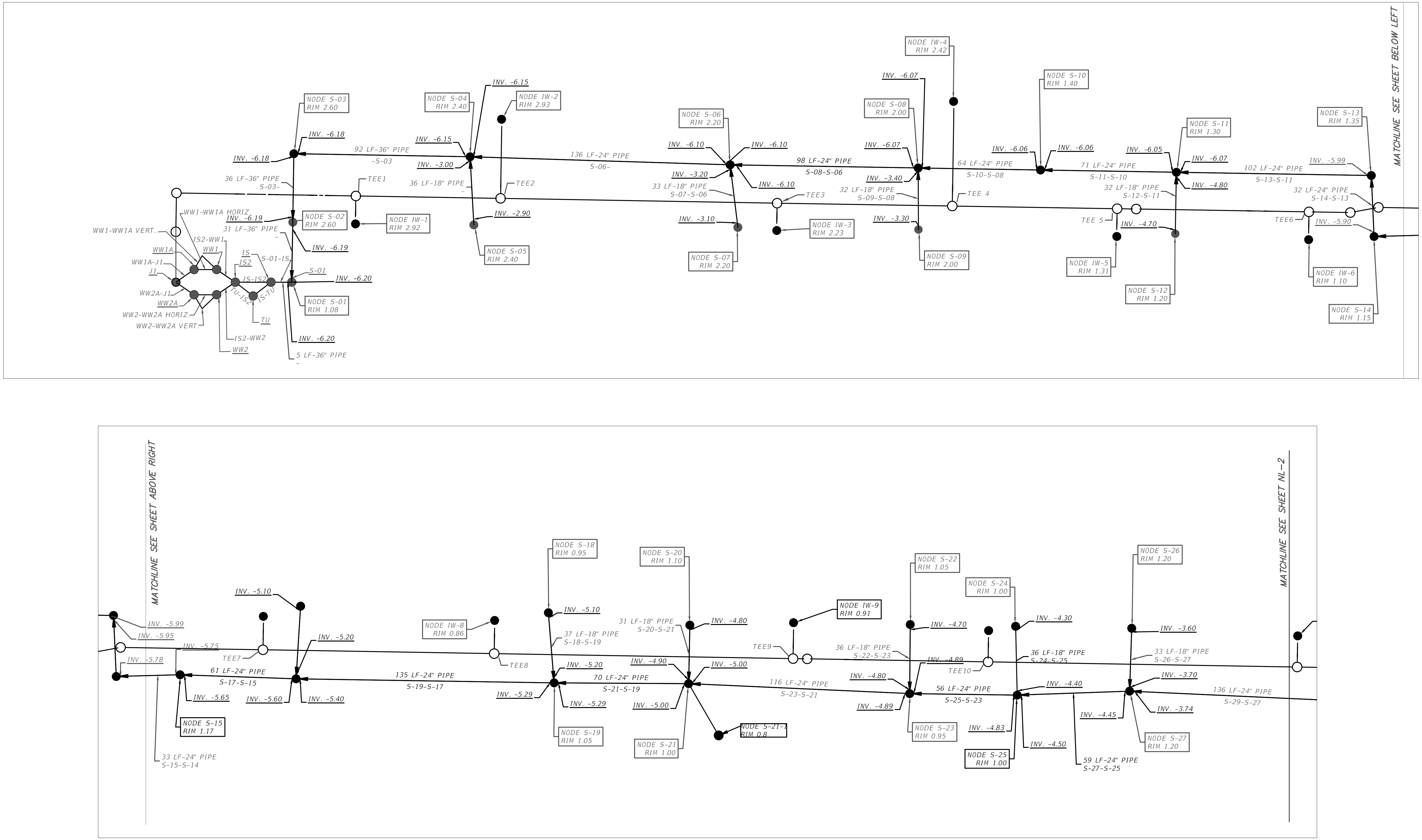
Conductivity Set:	
Leakage Set:	

Tolerances & Options

Time Marching:	SAOR	IA Recovery Time:	24.0000 hr
Max Iterations:	6	ET for Manual Basins:	False
Over-Relax Weight Fact:	0.5 dec		
dZ Tolerance:	0.0010 ft	Manual Basin Rain Opt:	Global
Max dZ:	1.0000 ft	OF Region Rain Opt:	Global
Link Optimizer Tol:	0.0001 ft	Rainfall Name:	~FDOT-24
		Rainfall Amount:	6.00 in
Edge Length Option:	Automatic	Storm Duration:	37.0000 hr
Dflt Damping (2D):	0.0050 ft	Dflt Damping (1D):	0.0050 ft
Min Node Srf Area (2D):	100 ft2	Min Node Srf Area (1D):	100 ft2
Energy Switch (2D):	Energy	Energy Switch (1D):	Energy

Comment:

NODE LINK
DIAGRAM



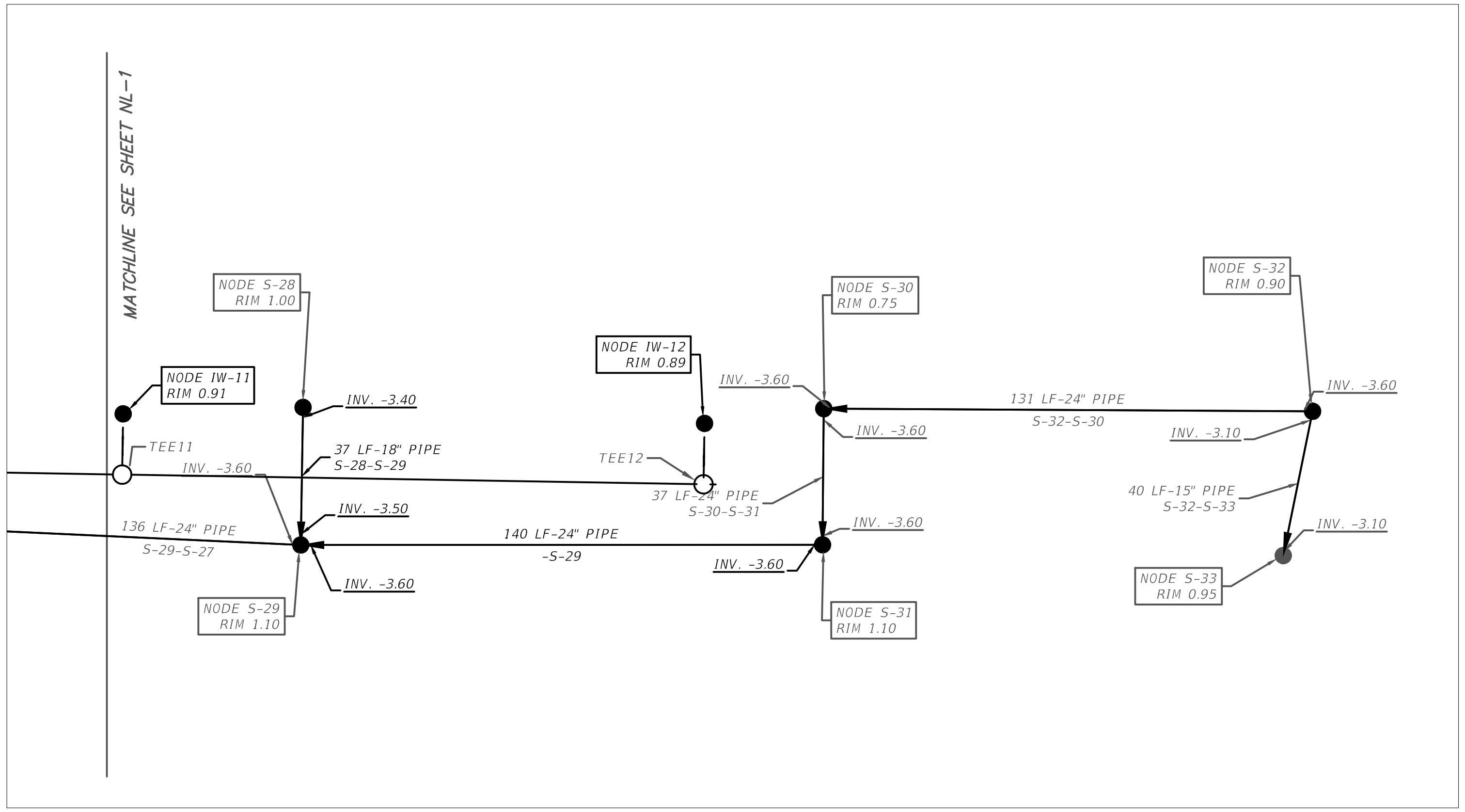
REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

CECILIA MARTENSSON, P.E.
P.E. LICENSE NUMBER 88644
WSP USA, 7650 CORPORATE CENTER DRIVE,
SUITE 300, MIAMI, FLORIDA 33126
CERTIFICATE OF AUTHORIZATION 01462

SEA LEVEL RISE ROADWAY AND DRAINAGE PILOT PROJECT
TWIN LAKES SUBDIVISION - KEY LARGO
MONROE COUNTY - DEPARTMENT OF ENGINEERING

NODAL LINK DIAGRAM

SHEET NO. NL-1



NODE	BASIN	TOTAL BASIN AREA (AC.)
S-04	B-2A	3.00
S-05	B-1A	0.43
S-06	B-2	20.39
S-07	B-1	1.75
S-08	B-4	2.47
S-09	B-5	0.96
S-10	B-6	2.36
S-11	B-7	0.24
S-12	B-8	0.58
S-13	B-9	1.25
S-14	B-10	1.56
S-16	B-11	1.51
S-17	B-12	1.79
S-18	B-13	0.93
S-19	B-14	1.13
S-20	B-15	0.79
S-21	B-16	0.98
S-21-1	B-16-1	1.9
S-22	B-18	0.37
S-23	B-17	0.19
S-24	B-19	0.48
S-25	B-20	0.34
S-26	B-21	0.41
S-27	B-22	0.80
S-28	B-23	0.33
S-29	B-24	0.62
S-30	B-25	0.30
S-31	B-26	0.57
S-32	B-27	0.24
S-33	B-28	0.96

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

CECILIA MARTENSSON, P.E.
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TWIN LAKES SUBDIVISION - KEY LARGO
MONROE COUNTY - DEPARTMENT OF ENGINEERING

NODAL LINK DIAGRAM

Schotanus, Stacie 5/4/2021 12:56:59 PM J:\193618A_Sea Level Rise Pilot\5.0 Project Data\5.10 Drainage\GIS\nodelinkcad_bpk TO PLOT.dwg

LINK MAX

Link Min/Max Conditions [Scenario1]

Link Name	Sim Name	Max Flow [cfs]	Min Flow [cfs]	Min/Max Delta Flow [cfs]	Max Us Velocity [fps]	Max Ds Velocity [fps]	Max Avg Velocity [fps]
IS-IS2	10Y-24H	24.74	0.00	11.88	3.21	3.21	3.21
IS-TU	10Y-24H	71.68	-0.14	-4.07	10.14	10.40	10.27
IS2-WW1	10Y-24H	71.15	0.00	-2.02	10.07	10.48	10.27
IS2-WW2	10Y-24H	50.46	0.00	-1.27	10.28	10.67	10.47
IW10_GWT	10Y-24H	1.51	0.00	0.05	0.00	0.00	0.00
IW11_GWT	10Y-24H	1.38	0.00	0.05	0.00	0.00	0.00
IW12_GWT	10Y-24H	1.36	0.00	0.05	0.00	0.00	0.00
IW1_GWT	10Y-24H	7.95	0.00	0.05	0.00	0.00	0.00
IW2_GWT	10Y-24H	5.87	0.00	0.05	0.00	0.00	0.00
IW3_GWT	10Y-24H	4.57	0.00	0.05	0.00	0.00	0.00
IW4_GWT	10Y-24H	3.84	0.00	0.05	0.00	0.00	0.00
IW5_GWT	10Y-24H	3.48	0.00	0.05	0.00	0.00	0.00
IW6_GWT	10Y-24H	2.64	0.00	0.05	0.00	0.00	0.00
IW7_GWT	10Y-24H	2.20	0.00	0.05	0.00	0.00	0.00
IW8_GWT	10Y-24H	1.97	0.00	0.05	0.00	0.00	0.00
IW9_GWT	10Y-24H	1.84	0.00	0.05	0.00	0.00	0.00
J1_TEE1	10Y-24H	111.20	0.00	7.04	8.85	8.85	8.85
S-21-1_S-21	10Y-24H	0.84	-4.41	0.02	-2.50	-4.33	-3.24
S01-IS	10Y-24H	47.11	-0.32	7.39	6.66	6.66	6.66
S02-S01	10Y-24H	35.56	-0.25	3.73	5.03	5.03	5.03
S03-S02	10Y-24H	27.63	-0.22	2.62	3.91	3.91	3.91
S04-S03	10Y-24H	21.75	-0.11	1.68	3.08	3.08	3.08
S05-S04	10Y-24H	5.40	0.00	0.17	3.06	3.06	3.06
S06-S04	10Y-24H	17.45	-0.01	-0.33	5.56	5.56	5.56
S07-S06	10Y-24H	2.37	0.00	0.06	1.34	1.34	1.34
S08-S06	10Y-24H	10.45	0.00	0.19	3.33	3.33	3.33
S09-S08	10Y-24H	1.45	0.00	-0.04	0.82	0.82	0.82
S10-S08	10Y-24H	8.47	0.00	-0.13	2.70	2.70	2.70
S11-S10	10Y-24H	7.76	0.00	-0.12	2.47	2.47	2.47
S12-S11	10Y-24H	0.91	0.00	0.05	0.51	0.51	0.51
S13-S11	10Y-24H	6.83	0.00	-0.10	2.17	2.17	2.17
S14-S13	10Y-24H	6.48	-0.10	0.15	2.06	2.06	2.06
S15-S14	10Y-24H	6.15	-0.32	-0.18	1.96	1.96	1.96
S16-S17	10Y-24H	0.60	0.00	0.05	0.34	0.34	0.34
S17-S15	10Y-24H	5.82	-0.56	0.11	1.85	1.85	1.85
S18-S19	10Y-24H	0.56	0.00	0.08	0.32	0.32	0.32
S19-S17	10Y-24H	5.19	-1.08	-0.08	1.65	1.65	1.65
S20-S21	10Y-24H	0.81	0.00	0.26	0.46	0.46	0.46
S21-S19	10Y-24H	4.57	-1.63	-0.37	1.46	1.46	1.46
S22-S23	10Y-24H	0.43	0.00	0.05	0.24	0.24	0.24
S23-S21	10Y-24H	4.38	0.00	0.32	1.39	1.39	1.39
S24-S25	10Y-24H	0.38	0.00	0.03	0.22	0.22	0.22
S25-S23	10Y-24H	3.63	0.00	0.13	1.15	1.15	1.15
S26-S27	10Y-24H	0.37	0.00	0.03	0.21	0.21	0.21
S27-S25	10Y-24H	2.89	0.00	0.10	0.92	0.92	0.92
S28-S29	10Y-24H	0.36	0.00	0.02	0.20	0.20	0.20

Link Name	Sim Name	Max Flow [cfs]	Min Flow [cfs]	Min/Max Delta Flow [cfs]	Max Us Velocity [fps]	Max Ds Velocity [fps]	Max Avg Velocity [fps]
S29-S27	10Y-24H	2.17	0.00	0.05	0.69	0.69	0.69
S30-S31	10Y-24H	1.17	0.00	-0.10	0.37	0.37	0.37
S31-S29	10Y-24H	1.45	0.00	0.06	0.46	0.46	0.46
S32-S30	10Y-24H	1.06	0.00	0.06	0.34	0.34	0.34
S33-S32	10Y-24H	0.85	0.00	0.02	0.69	0.69	0.69
TEE10_IW10	10Y-24H	1.98	0.00	0.11	0.63	0.63	0.63
TEE10_TEE11	10Y-24H	4.56	0.00	0.12	1.45	1.45	1.45
TEE11_IW11	10Y-24H	1.70	0.00	-0.11	0.54	0.54	0.54
TEE11_TEE12	10Y-24H	2.28	0.00	0.10	0.73	0.73	0.73
TEE12_IW12	10Y-24H	1.66	0.00	-0.10	0.53	0.53	0.53
TEE1_IW1	10Y-24H	18.07	0.00	1.21	5.75	5.75	5.75
TEE1_TEE2	10Y-24H	84.95	0.00	2.85	6.76	6.76	6.76
TEE2_IW2	10Y-24H	12.75	0.00	0.69	4.06	4.06	4.06
TEE2_TEE3	10Y-24H	64.97	0.00	1.98	5.17	5.17	5.17
TEE3_IW3	10Y-24H	9.67	0.00	0.65	3.08	3.08	3.08
TEE3_TEE4	10Y-24H	49.67	0.00	1.69	3.95	3.95	3.95
TEE4_IW4	10Y-24H	7.74	0.00	0.55	2.46	2.46	2.46
TEE4_TEE5	10Y-24H	37.31	0.00	-1.89	2.97	2.97	2.97
TEE5_IW5	10Y-24H	6.86	0.00	0.56	2.18	2.18	2.18
TEE5_TEE6	10Y-24H	27.06	0.00	1.29	3.83	3.83	3.83
TEE6_IW6	10Y-24H	4.78	0.00	0.41	1.52	1.52	1.52
TEE6_TEE7	10Y-24H	20.19	0.00	1.38	2.86	2.86	2.86
TEE7_IW7	10Y-24H	3.62	0.00	0.26	1.15	1.15	1.15
TEE7_TEE8	10Y-24H	15.04	0.00	-1.27	2.13	2.13	2.13
TEE8_IW8	10Y-24H	3.02	0.00	0.18	0.96	0.96	0.96
TEE8_TEE9	10Y-24H	10.77	0.00	0.97	1.52	1.52	1.52
TEE9_IW9	10Y-24H	2.71	0.00	0.14	0.86	0.86	0.86
TEE9_TEE10	10Y-24H	7.14	0.00	-0.17	2.27	2.27	2.27
TU-IS2	10Y-24H	58.64	-229.31	11.19	-8.79	-8.79	-8.79
WW1A_J1	10Y-24H	65.07	0.00	64.06	0.00	0.00	0.00
WW1_WW1A_HORIZ	10Y-24H	37.60	0.00	9.89	1.89	1.89	1.89
WW1_WW1A_VERT	10Y-24H	0.00	0.00	0.00	0.00	0.00	0.00
WW2A_J1	10Y-24H	65.68	0.00	64.66	0.00	0.00	0.00
WW2_WW2A_HORIZ	10Y-24H	36.90	0.00	11.05	1.87	1.87	1.87
WW2_WW2A_VERT	10Y-24H	0.00	0.00	0.00	0.00	0.00	0.00
IS-IS2	25Y-24H	24.74	0.00	11.88	3.21	3.21	3.21
IS-TU	25Y-24H	71.68	-0.14	-3.24	10.14	10.40	10.27
IS2-WW1	25Y-24H	71.15	0.00	-2.02	10.07	10.48	10.27
IS2-WW2	25Y-24H	50.46	0.00	-1.27	10.28	10.67	10.47
IW10_GWT	25Y-24H	1.59	0.00	0.05	0.00	0.00	0.00
IW11_GWT	25Y-24H	1.45	0.00	0.05	0.00	0.00	0.00
IW12_GWT	25Y-24H	1.42	0.00	0.05	0.00	0.00	0.00
IW1_GWT	25Y-24H	8.16	0.00	0.05	0.00	0.00	0.00

Link Name	Sim Name	Max Flow [cfs]	Min Flow [cfs]	Min/Max Delta Flow [cfs]	Max Us Velocity [fps]	Max Ds Velocity [fps]	Max Avg Velocity [fps]
IW2_GWT	25Y-24H	6.01	0.00	0.05	0.00	0.00	0.00
IW3_GWT	25Y-24H	4.70	0.00	0.05	0.00	0.00	0.00
IW4_GWT	25Y-24H	3.96	0.00	0.05	0.00	0.00	0.00
IW5_GWT	25Y-24H	3.60	0.00	0.05	0.00	0.00	0.00
IW6_GWT	25Y-24H	2.75	0.00	0.05	0.00	0.00	0.00
IW7_GWT	25Y-24H	2.29	0.00	0.05	0.00	0.00	0.00
IW8_GWT	25Y-24H	2.05	0.00	0.05	0.00	0.00	0.00
IW9_GWT	25Y-24H	1.91	0.00	0.05	0.00	0.00	0.00
J1_TEE1	25Y-24H	111.41	0.00	7.04	8.87	8.87	8.87
S-21-1_S-21	25Y-24H	1.92	-4.41	0.02	-2.50	-4.33	-3.24
S01-IS	25Y-24H	47.11	-0.28	7.39	6.66	6.66	6.66
S02-S01	25Y-24H	35.56	-0.13	3.73	5.03	5.03	5.03
S03-S02	25Y-24H	27.63	0.00	-2.77	3.91	3.91	3.91
S04-S03	25Y-24H	21.75	0.00	-2.44	3.08	3.08	3.08
S05-S04	25Y-24H	5.40	0.00	0.17	3.06	3.06	3.06
S06-S04	25Y-24H	18.98	0.00	0.39	6.04	6.04	6.04
S07-S06	25Y-24H	2.37	0.00	0.15	1.34	1.34	1.34
S08-S06	25Y-24H	10.45	0.00	-0.23	3.33	3.33	3.33
S09-S08	25Y-24H	1.45	-0.41	-0.41	0.82	0.82	0.82
S10-S08	25Y-24H	8.47	0.00	0.30	2.70	2.70	2.70
S11-S10	25Y-24H	7.76	0.00	0.29	2.47	2.47	2.47
S12-S11	25Y-24H	0.91	0.00	0.05	0.51	0.51	0.51
S13-S11	25Y-24H	7.03	0.00	0.25	2.24	2.24	2.24
S14-S13	25Y-24H	6.64	-0.10	0.39	2.11	2.11	2.11
S15-S14	25Y-24H	6.15	-0.32	0.42	1.96	1.96	1.96
S16-S17	25Y-24H	1.39	0.00	0.70	0.79	0.79	0.79
S17-S15	25Y-24H	6.14	-0.56	0.31	1.95	1.95	1.95
S18-S19	25Y-24H	0.56	0.00	0.11	0.32	0.32	0.32
S19-S17	25Y-24H	5.19	-1.08	0.20	1.65	1.65	1.65
S20-S21	25Y-24H	0.81	-0.68	-0.44	0.46	0.46	0.46
S21-S19	25Y-24H	4.57	-1.63	-0.37	1.46	1.46	1.46
S22-S23	25Y-24H	0.43	0.00	0.05	0.24	0.24	0.24
S23-S21	25Y-24H	4.38	0.00	0.32	1.39	1.39	1.39
S24-S25	25Y-24H	0.38	-0.03	-0.04	0.22	0.22	0.22
S25-S23	25Y-24H	3.63	0.00	1.15	1.15	1.15	1.15
S26-S27	25Y-24H	0.37	0.00	0.02	0.21	0.21	0.21
S27-S25	25Y-24H	2.89	-0.21	-0.30	0.92	0.92	0.92
S28-S29	25Y-24H	0.36	0.00	-0.02	0.20	0.20	0.20
S29-S27	25Y-24H	2.17	0.00	-0.08	0.69	0.69	0.69
S30-S31	25Y-24H	1.10	-0.31	0.19	0.35	0.35	0.35
S31-S29	25Y-24H	1.45	-0.08	-0.09	0.46	0.46	0.46
S32-S30	25Y-24H	0.98	-0.42	-0.07	0.31	0.31	0.31
S33-S32	25Y-24H	0.79	-0.33	0.03	0.64	0.64	0.64
TEE10_IW10	25Y-24H	2.03	0.00	0.12	0.65	0.65	0.65
TEE10_TEE11	25Y-24H	4.56	0.00	0.12	1.45	1.45	1.45
TEE11_IW11	25Y-24H	1.75	0.00	-0.10	0.56	0.56	0.56
TEE11_TEE12	25Y-24H	2.28	0.00	0.10	0.73	0.73	0.73

Link Name	Sim Name	Max Flow [cfs]	Min Flow [cfs]	Min/Max Delta Flow [cfs]	Max Us Velocity [fps]	Max Ds Velocity [fps]	Max Avg Velocity [fps]
TEE12_IW12	25Y-24H	1.71	0.00	-0.10	0.54	0.54	0.54
TEE1_IW1	25Y-24H	18.18	0.00	-1.27	5.79	5.79	5.79
TEE1_TEE2	25Y-24H	85.27	0.00	2.85	6.79	6.79	6.79
TEE2_IW2	25Y-24H	12.81	0.00	0.69	4.08	4.08	4.08
TEE2_TEE3	25Y-24H	65.16	0.00	1.99	5.19	5.19	5.19
TEE3_IW3	25Y-24H	9.77	0.00	0.65	3.11	3.11	3.11
TEE3_TEE4	25Y-24H	49.86	0.00	1.69	3.97	3.97	3.97
TEE4_IW4	25Y-24H	7.86	0.00	0.55	2.50	2.50	2.50
TEE4_TEE5	25Y-24H	37.62	0.00	1.84	2.99	2.99	2.99
TEE5_IW5	25Y-24H	6.97	0.00	0.56	2.22	2.22	2.22
TEE5_TEE6	25Y-24H	27.29	0.00	1.32	3.86	3.86	3.86
TEE6_IW6	25Y-24H	4.86	0.00	0.41	1.55	1.55	1.55
TEE6_TEE7	25Y-24H	20.32	0.00	1.38	2.87	2.87	2.87
TEE7_IW7	25Y-24H	3.69	0.00	0.26	1.17	1.17	1.17
TEE7_TEE8	25Y-24H	15.13	0.00	-1.27	2.14	2.14	2.14
TEE8_IW8	25Y-24H	3.08	0.00	0.18	0.98	0.98	0.98
TEE8_TEE9	25Y-24H	10.84	0.00	0.97	1.53	1.53	1.53
TEE9_IW9	25Y-24H	2.76	0.00	0.15	0.88	0.88	0.88
TEE9_TEE10	25Y-24H	7.19	0.00	-0.17	2.29	2.29	2.29
TU-IS2	25Y-24H	58.64	-229.31	11.19	-8.79	-8.79	-8.79
WW1A_J1	25Y-24H	65.07	0.00	64.06	0.00	0.00	0.00
WW1_WW1A _HORIZ	25Y-24H	38.09	0.00	9.88	1.91	1.91	1.91
WW1_WW1A _VERT	25Y-24H	0.00	0.00	0.00	0.00	0.00	0.00
WW2A_J1	25Y-24H	65.68	0.00	64.66	0.00	0.00	0.00
WW2_WW2A _HORIZ	25Y-24H	37.29	0.00	10.96	1.88	1.88	1.88
WW2_WW2A _VERT	25Y-24H	0.00	0.00	0.00	0.00	0.00	0.00
IS-IS2	5Y-24H	24.74	0.00	11.88	3.21	3.21	3.21
IS-TU	5Y-24H	71.68	-0.17	3.16	10.14	10.40	10.27
IS2-WW1	5Y-24H	71.15	0.00	-2.02	10.07	10.48	10.27
IS2-WW2	5Y-24H	50.46	0.00	-1.27	10.28	10.67	10.47
IW10_GWT	5Y-24H	1.40	0.00	0.05	0.00	0.00	0.00
IW11_GWT	5Y-24H	1.28	0.00	0.05	0.00	0.00	0.00
IW12_GWT	5Y-24H	1.26	0.00	0.05	0.00	0.00	0.00
IW1_GWT	5Y-24H	7.83	0.00	0.05	0.00	0.00	0.00
IW2_GWT	5Y-24H	5.67	0.00	0.05	0.00	0.00	0.00
IW3_GWT	5Y-24H	4.36	0.00	0.05	0.00	0.00	0.00
IW4_GWT	5Y-24H	3.63	0.00	0.05	0.00	0.00	0.00
IW5_GWT	5Y-24H	3.29	0.00	0.05	0.00	0.00	0.00
IW6_GWT	5Y-24H	2.47	0.00	0.05	0.00	0.00	0.00
IW7_GWT	5Y-24H	2.04	0.00	0.05	0.00	0.00	0.00
IW8_GWT	5Y-24H	1.83	0.00	0.05	0.00	0.00	0.00
IW9_GWT	5Y-24H	1.71	0.00	0.05	0.00	0.00	0.00
J1_TEE1	5Y-24H	110.90	0.00	7.04	8.83	8.83	8.83

Link Name	Sim Name	Max Flow [cfs]	Min Flow [cfs]	Min/Max Delta Flow [cfs]	Max Us Velocity [fps]	Max Ds Velocity [fps]	Max Avg Velocity [fps]
S-21-1_S-21	5Y-24H	0.72	-4.41	0.02	-2.50	-4.33	-3.24
S01-IS	5Y-24H	47.11	-1.15	7.39	6.66	6.66	6.66
S02-S01	5Y-24H	35.56	-0.18	3.73	5.03	5.03	5.03
S03-S02	5Y-24H	27.63	-0.15	2.66	3.91	3.91	3.91
S04-S03	5Y-24H	21.75	0.00	-2.37	3.08	3.08	3.08
S05-S04	5Y-24H	5.40	-0.01	0.17	3.06	3.06	3.06
S06-S04	5Y-24H	14.75	-0.01	-0.39	4.69	4.69	4.69
S07-S06	5Y-24H	2.37	-0.53	0.52	1.34	1.34	1.34
S08-S06	5Y-24H	10.45	0.00	0.27	3.33	3.33	3.33
S09-S08	5Y-24H	1.46	-0.66	0.75	1.15	1.06	1.10
S10-S08	5Y-24H	8.47	0.00	0.18	2.70	2.70	2.70
S11-S10	5Y-24H	7.76	0.00	0.11	2.47	2.47	2.47
S12-S11	5Y-24H	0.91	-1.05	-0.62	-0.59	-0.59	-0.59
S13-S11	5Y-24H	6.83	0.00	-0.41	2.17	2.17	2.17
S14-S13	5Y-24H	6.48	-3.28	-3.28	2.06	2.06	2.06
S15-S14	5Y-24H	6.15	-0.32	1.37	1.96	1.96	1.96
S16-S17	5Y-24H	1.41	0.00	0.70	0.80	0.80	0.80
S17-S15	5Y-24H	5.82	-0.56	0.13	1.85	1.85	1.85
S18-S19	5Y-24H	1.12	0.00	0.59	0.64	0.64	0.64
S19-S17	5Y-24H	5.19	-1.08	0.10	1.65	1.65	1.65
S20-S21	5Y-24H	0.87	0.00	0.47	0.49	0.49	0.49
S21-S19	5Y-24H	4.57	-1.63	-0.37	1.46	1.46	1.46
S22-S23	5Y-24H	0.43	0.00	0.05	0.24	0.24	0.24
S23-S21	5Y-24H	4.38	0.00	0.32	1.39	1.39	1.39
S24-S25	5Y-24H	0.38	0.00	0.20	0.22	0.22	0.22
S25-S23	5Y-24H	3.63	0.00	-0.36	1.15	1.15	1.15
S26-S27	5Y-24H	0.37	-0.04	0.07	0.21	0.21	0.21
S27-S25	5Y-24H	2.89	0.00	0.40	0.92	0.92	0.92
S28-S29	5Y-24H	0.36	-0.59	-0.33	-0.46	-0.53	-0.49
S29-S27	5Y-24H	2.17	0.00	-0.23	0.69	0.69	0.69
S30-S31	5Y-24H	1.08	0.00	0.12	0.34	0.34	0.34
S31-S29	5Y-24H	1.45	0.00	0.08	0.46	0.46	0.46
S32-S30	5Y-24H	0.72	0.00	-0.09	0.23	0.23	0.23
S33-S32	5Y-24H	0.39	0.00	0.16	0.39	0.39	0.39
TEE10_IW10	5Y-24H	1.89	0.00	0.12	0.60	0.60	0.60
TEE10_TEE11	5Y-24H	4.56	0.00	0.12	1.45	1.45	1.45
TEE11_IW11	5Y-24H	1.63	0.00	-0.13	0.52	0.52	0.52
TEE11_TEE12	5Y-24H	2.28	0.00	0.10	0.73	0.73	0.73
TEE12_IW12	5Y-24H	1.59	0.00	0.08	0.51	0.51	0.51
TEE1_IW1	5Y-24H	17.96	0.00	-1.39	5.72	5.72	5.72
TEE1_TEE2	5Y-24H	85.07	0.00	2.88	6.77	6.77	6.77
TEE2_IW2	5Y-24H	12.65	0.00	0.69	4.03	4.03	4.03
TEE2_TEE3	5Y-24H	65.10	0.00	1.98	5.18	5.18	5.18
TEE3_IW3	5Y-24H	9.65	0.00	0.65	3.07	3.07	3.07
TEE3_TEE4	5Y-24H	49.73	0.00	1.77	3.96	3.96	3.96
TEE4_IW4	5Y-24H	7.74	0.00	0.55	2.46	2.46	2.46
TEE4_TEE5	5Y-24H	37.34	0.00	-1.68	2.97	2.97	2.97

Link Name	Sim Name	Max Flow [cfs]	Min Flow [cfs]	Min/Max Delta Flow [cfs]	Max Us Velocity [fps]	Max Ds Velocity [fps]	Max Avg Velocity [fps]
TEE5_IW5	5Y-24H	6.84	0.00	0.56	2.18	2.18	2.18
TEE5_TEE6	5Y-24H	26.90	0.00	-1.11	3.81	3.81	3.81
TEE6_IW6	5Y-24H	4.72	0.00	0.41	1.50	1.50	1.50
TEE6_TEE7	5Y-24H	20.00	0.00	1.38	2.83	2.83	2.83
TEE7_IW7	5Y-24H	3.53	0.00	0.26	1.12	1.12	1.12
TEE7_TEE8	5Y-24H	14.88	0.00	-1.27	2.11	2.11	2.11
TEE8_IW8	5Y-24H	2.92	0.00	0.18	0.93	0.93	0.93
TEE8_TEE9	5Y-24H	10.65	0.00	0.97	1.51	1.51	1.51
TEE9_IW9	5Y-24H	2.61	0.00	0.14	0.83	0.83	0.83
TEE9_TEE10	5Y-24H	7.06	0.00	-0.17	2.25	2.25	2.25
TU-IS2	5Y-24H	58.64	-229.31	11.19	-8.79	-8.79	-8.79
WW1A_J1	5Y-24H	65.07	0.00	64.06	0.00	0.00	0.00
WW1_WW1A _HORIZ	5Y-24H	36.77	0.00	9.92	1.87	1.87	1.87
WW1_WW1A _VERT	5Y-24H	0.00	0.00	0.00	0.00	0.00	0.00
WW2A_J1	5Y-24H	65.68	0.00	64.66	0.00	0.00	0.00
WW2_WW2A _HORIZ	5Y-24H	36.26	0.00	10.93	1.85	1.85	1.85
WW2_WW2A _VERT	5Y-24H	0.00	0.00	0.00	0.00	0.00	0.00

NODE MAXIMUM
STAGES

Node Max Conditions [Scenario1]

Node Name	Sim Name	Warning Stage [ft]	Max Stage [ft]	Min/Max Delta Stage [ft]	Max Total Inflow [cfs]	Max Total Outflow [cfs]	Max Surface Area [ft2]
GWT	10Y-24H	1.00	0.36	0.0000	33.61	0.00	0
IS	10Y-24H	3.20	-0.08	0.0393	47.11	95.55	100
IS2	10Y-24H	3.20	-0.08	0.1657	58.87	350.92	100
IW1	10Y-24H	8.00	4.52	0.0074	18.07	7.95	100
IW10	10Y-24H	8.00	1.63	0.0009	1.98	1.51	100
IW11	10Y-24H	8.00	1.58	0.0010	1.70	1.38	100
IW12	10Y-24H	8.00	1.57	0.0010	1.66	1.36	100
IW2	10Y-24H	8.00	3.59	0.0048	12.75	5.87	100
IW3	10Y-24H	8.00	3.01	0.0033	9.67	4.57	100
IW4	10Y-24H	8.00	2.68	0.0025	7.74	3.84	100
IW5	10Y-24H	8.00	2.52	0.0022	6.86	3.48	100
IW6	10Y-24H	8.00	2.14	0.0015	4.78	2.64	100
IW7	10Y-24H	8.00	1.94	0.0011	3.62	2.20	100
IW8	10Y-24H	8.00	1.84	0.0009	3.02	1.97	100
IW9	10Y-24H	8.00	1.78	0.0008	2.71	1.84	100
J1	10Y-24H	12.00	7.31	0.0478	130.53	111.20	231
S-01	10Y-24H	3.20	-0.08	0.0105	35.56	47.11	100
S-02	10Y-24H	2.60	-0.08	0.0058	27.63	35.56	100
S-03	10Y-24H	2.60	-0.08	0.0042	21.75	27.63	100
S-04	10Y-24H	2.40	-0.08	0.0032	18.81	21.75	100
S-05	10Y-24H	2.40	-0.08	0.0027	0.17	5.40	100
S-06	10Y-24H	2.20	-0.08	0.0012	17.46	17.45	100
S-07	10Y-24H	2.20	-0.08	0.0012	0.62	2.37	100
S-08	10Y-24H	2.00	-0.08	0.0007	9.38	10.45	100
S-09	10Y-24H	2.00	-0.08	0.0007	0.38	1.45	100
S-10	10Y-24H	1.40	0.04	0.0006	7.76	8.47	100
S-11	10Y-24H	1.20	0.19	0.0005	7.22	7.76	100
S-12	10Y-24H	1.20	0.19	0.0005	0.23	0.91	100
S-13	10Y-24H	0.90	0.36	0.0004	6.62	6.83	100
S-14	10Y-24H	1.10	0.43	0.0004	6.19	6.48	100
S-15	10Y-24H	1.20	0.49	0.0003	5.82	6.15	100
S-16	10Y-24H	1.17	0.58	0.0003	0.58	0.60	100
S-17	10Y-24H	0.80	0.57	0.0003	5.65	5.82	100
S-18	10Y-24H	0.85	0.66	0.0003	0.36	0.56	100
S-19	10Y-24H	0.85	0.66	0.0005	4.88	5.19	100
S-20	10Y-24H	0.87	0.70	0.0004	0.31	0.81	100
S-21	10Y-24H	0.85	0.70	0.0018	4.77	5.22	100
S-21-1	10Y-24H	0.80	0.79	0.0022	4.41	0.84	245
S-22	10Y-24H	0.87	0.71	0.0002	0.14	0.43	100
S-23	10Y-24H	0.87	0.71	0.0004	4.00	4.38	100
S-24	10Y-24H	1.05	0.72	0.0002	0.19	0.38	100
S-25	10Y-24H	0.87	0.72	0.0002	3.26	3.63	100
S-26	10Y-24H	0.88	0.73	0.0002	0.17	0.37	100
S-27	10Y-24H	1.05	0.73	0.0002	2.53	2.89	203
S-28	10Y-24H	1.00	0.73	0.0002	0.13	0.36	100
S-29	10Y-24H	1.05	0.73	0.0002	1.81	2.17	309

Node Name	Sim Name	Warning Stage [ft]	Max Stage [ft]	Min/Max Delta Stage [ft]	Max Total Inflow [cfs]	Max Total Outflow [cfs]	Max Surface Area [ft2]
S-30	10Y-24H	0.88	0.74	0.0002	1.15	1.17	171
S-31	10Y-24H	0.88	0.74	0.0002	1.35	1.45	179
S-32	10Y-24H	0.41	0.74	0.0002	0.92	1.06	1034
S-33	10Y-24H	0.42	0.74	0.0002	0.37	0.85	4142
TEE1	10Y-24H	8.00	5.00	0.0121	111.20	102.02	100
TEE10	10Y-24H	8.00	1.64	0.0013	7.14	6.45	100
TEE11	10Y-24H	8.00	1.58	0.0011	4.56	3.91	100
TEE12	10Y-24H	8.00	1.57	0.0011	2.28	1.66	100
TEE2	10Y-24H	8.00	3.84	0.0061	84.95	77.56	100
TEE3	10Y-24H	8.00	3.11	0.0040	64.97	59.24	100
TEE4	10Y-24H	8.00	2.75	0.0035	49.67	44.99	100
TEE5	10Y-24H	8.00	2.56	0.0032	37.31	33.62	100
TEE6	10Y-24H	8.00	2.16	0.0025	27.06	24.75	100
TEE7	10Y-24H	8.00	1.95	0.0020	20.19	18.54	100
TEE8	10Y-24H	8.00	1.85	0.0018	15.04	13.72	100
TEE9	10Y-24H	8.00	1.79	0.0016	10.77	9.71	100
TU	10Y-24H	3.20	-2.43	0.1486	300.99	58.64	100
WW1	10Y-24H	3.20	-8.19	0.0352	71.15	37.60	100
WW1A	10Y-24H	3.20	-8.20	0.0298	37.60	65.07	100
WW2	10Y-24H	3.20	-7.20	0.0250	50.46	36.90	100
WW2A	10Y-24H	3.20	-7.20	0.0297	36.90	65.68	100
GWT	25Y-24H	1.00	0.36	0.0000	34.95	0.00	0
IS	25Y-24H	3.20	-0.08	0.0393	47.11	95.55	100
IS2	25Y-24H	3.20	-0.08	0.1657	58.87	350.92	100
IW1	25Y-24H	8.00	4.62	0.0074	18.18	8.16	100
IW10	25Y-24H	8.00	1.67	0.0009	2.03	1.59	100
IW11	25Y-24H	8.00	1.61	0.0010	1.75	1.45	100
IW12	25Y-24H	8.00	1.59	0.0010	1.71	1.42	100
IW2	25Y-24H	8.00	3.65	0.0048	12.81	6.01	100
IW3	25Y-24H	8.00	3.07	0.0033	9.77	4.70	100
IW4	25Y-24H	8.00	2.73	0.0025	7.86	3.96	100
IW5	25Y-24H	8.00	2.57	0.0022	6.97	3.60	100
IW6	25Y-24H	8.00	2.19	0.0015	4.86	2.75	100
IW7	25Y-24H	8.00	1.98	0.0011	3.69	2.29	100
IW8	25Y-24H	8.00	1.87	0.0009	3.08	2.05	100
IW9	25Y-24H	8.00	1.81	0.0008	2.76	1.91	100
J1	25Y-24H	12.00	7.44	0.0540	130.69	111.41	231
S-01	25Y-24H	3.20	-0.08	0.0105	35.56	47.11	100
S-02	25Y-24H	2.60	-0.08	0.0058	27.63	35.56	100
S-03	25Y-24H	2.60	-0.08	0.0042	21.75	27.63	100
S-04	25Y-24H	2.40	-0.08	0.0032	20.57	21.75	100
S-05	25Y-24H	2.40	-0.08	0.0027	0.20	5.40	100
S-06	25Y-24H	2.20	-0.06	0.0012	18.98	18.98	100
S-07	25Y-24H	2.20	-0.06	0.0012	0.72	2.37	100
S-08	25Y-24H	2.00	0.27	0.0007	9.38	10.45	100
S-09	25Y-24H	2.00	0.27	0.0007	0.55	1.45	100
S-10	25Y-24H	1.40	0.44	0.0006	8.11	8.47	100

Node Name	Sim Name	Warning Stage [ft]	Max Stage [ft]	Min/Max Delta Stage [ft]	Max Total Inflow [cfs]	Max Total Outflow [cfs]	Max Surface Area [ft2]
S-11	25Y-24H	1.20	0.58	0.0005	7.30	7.76	100
S-12	25Y-24H	1.20	0.58	0.0005	0.27	0.91	100
S-13	25Y-24H	0.90	0.73	0.0004	7.02	7.03	100
S-14	25Y-24H	1.10	0.79	0.0004	6.63	6.64	100
S-15	25Y-24H	1.20	0.84	0.0003	6.14	6.15	100
S-16	25Y-24H	1.17	0.91	0.0006	0.68	1.39	100
S-17	25Y-24H	0.80	0.91	0.0006	6.13	6.14	3117
S-18	25Y-24H	0.85	0.97	0.0003	0.43	0.56	1656
S-19	25Y-24H	0.85	0.97	0.0005	5.13	5.19	2069
S-20	25Y-24H	0.87	1.00	0.0004	0.79	0.81	1460
S-21	25Y-24H	0.85	0.99	0.0018	4.77	5.22	2074
S-21-1	25Y-24H	0.80	1.01	0.0022	4.41	1.92	43292
S-22	25Y-24H	0.87	1.02	0.0002	0.17	0.43	844
S-23	25Y-24H	0.87	1.01	0.0005	4.00	4.38	414
S-24	25Y-24H	1.05	1.03	0.0002	0.23	0.38	100
S-25	25Y-24H	0.87	1.02	0.0008	3.26	3.63	954
S-26	25Y-24H	0.88	1.03	0.0002	0.19	0.37	950
S-27	25Y-24H	1.05	1.03	0.0002	2.53	2.89	203
S-28	25Y-24H	1.00	1.04	0.0002	0.16	0.36	204
S-29	25Y-24H	1.05	1.04	0.0002	1.81	2.17	309
S-30	25Y-24H	0.88	1.04	0.0002	1.08	1.10	738
S-31	25Y-24H	0.88	1.04	0.0002	1.29	1.45	1367
S-32	25Y-24H	0.41	1.05	0.0002	0.87	0.98	1978
S-33	25Y-24H	0.42	1.05	0.0002	0.74	0.79	8047
TEE1	25Y-24H	8.00	5.13	0.0123	111.41	102.48	100
TEE10	25Y-24H	8.00	1.67	0.0013	7.19	6.52	100
TEE11	25Y-24H	8.00	1.61	0.0011	4.56	3.97	100
TEE12	25Y-24H	8.00	1.60	0.0011	2.28	1.71	100
TEE2	25Y-24H	8.00	3.94	0.0062	85.27	77.92	100
TEE3	25Y-24H	8.00	3.17	0.0040	65.16	59.55	100
TEE4	25Y-24H	8.00	2.81	0.0035	49.86	45.42	100
TEE5	25Y-24H	8.00	2.61	0.0032	37.62	34.01	100
TEE6	25Y-24H	8.00	2.21	0.0025	27.29	24.95	100
TEE7	25Y-24H	8.00	2.00	0.0020	20.32	18.69	100
TEE8	25Y-24H	8.00	1.88	0.0018	15.13	13.85	100
TEE9	25Y-24H	8.00	1.82	0.0016	10.84	9.81	100
TU	25Y-24H	3.20	-2.43	0.1486	300.99	58.64	100
WW1	25Y-24H	3.20	-8.19	0.0352	71.15	38.09	100
WW1A	25Y-24H	3.20	-8.20	0.0298	38.09	65.07	100
WW2	25Y-24H	3.20	-7.20	0.0250	50.46	37.29	100
WW2A	25Y-24H	3.20	-7.20	0.0297	37.29	65.68	100
GWT	5Y-24H	1.00	0.36	0.0000	31.48	0.00	0
IS	5Y-24H	3.20	-0.08	0.0393	47.11	95.55	100
IS2	5Y-24H	3.20	-0.08	0.1657	58.87	350.92	100
IW1	5Y-24H	8.00	4.47	0.0074	17.96	7.83	100
IW10	5Y-24H	8.00	1.58	0.0009	1.89	1.40	100
IW11	5Y-24H	8.00	1.53	0.0010	1.63	1.28	100

Node Name	Sim Name	Warning Stage [ft]	Max Stage [ft]	Min/Max Delta Stage [ft]	Max Total Inflow [cfs]	Max Total Outflow [cfs]	Max Surface Area [ft2]
IW12	5Y-24H	8.00	1.52	0.0010	1.59	1.26	100
IW2	5Y-24H	8.00	3.50	0.0048	12.65	5.67	100
IW3	5Y-24H	8.00	2.91	0.0033	9.65	4.36	100
IW4	5Y-24H	8.00	2.59	0.0025	7.74	3.63	100
IW5	5Y-24H	8.00	2.43	0.0022	6.84	3.29	100
IW6	5Y-24H	8.00	2.06	0.0015	4.72	2.47	100
IW7	5Y-24H	8.00	1.87	0.0011	3.53	2.04	100
IW8	5Y-24H	8.00	1.78	0.0009	2.92	1.83	100
IW9	5Y-24H	8.00	1.72	0.0008	2.61	1.71	100
J1	5Y-24H	12.00	7.35	0.0542	130.55	110.90	231
S-01	5Y-24H	3.20	-0.08	0.0105	35.56	47.11	100
S-02	5Y-24H	2.60	-0.08	0.0058	27.63	35.56	100
S-03	5Y-24H	2.60	-0.08	0.0042	21.75	27.63	100
S-04	5Y-24H	2.40	-0.08	0.0032	17.36	21.75	100
S-05	5Y-24H	2.40	-0.08	0.0027	0.14	5.40	100
S-06	5Y-24H	2.20	-0.08	0.0012	14.76	14.75	100
S-07	5Y-24H	2.20	-0.08	0.0012	0.76	2.37	100
S-08	5Y-24H	2.00	-0.08	0.0007	9.38	10.45	100
S-09	5Y-24H	2.00	-0.08	0.0007	0.80	1.46	100
S-10	5Y-24H	1.40	-0.08	0.0006	7.76	8.47	100
S-11	5Y-24H	1.20	-0.08	0.0005	7.22	7.76	100
S-12	5Y-24H	1.20	-0.08	0.0006	1.13	0.91	100
S-13	5Y-24H	0.90	-0.08	0.0022	6.48	6.83	100
S-14	5Y-24H	1.10	-0.08	0.0036	7.27	6.48	100
S-15	5Y-24H	1.20	-0.08	0.0012	5.82	6.15	100
S-16	5Y-24H	1.17	-0.08	0.0006	0.47	1.41	100
S-17	5Y-24H	0.80	-0.08	0.0005	5.51	5.82	100
S-18	5Y-24H	0.85	-0.08	0.0005	0.30	1.12	100
S-19	5Y-24H	0.85	-0.08	0.0005	4.88	5.19	100
S-20	5Y-24H	0.87	-0.08	0.0004	0.26	0.87	100
S-21	5Y-24H	0.85	-0.08	0.0018	4.77	5.22	100
S-21-1	5Y-24H	0.80	-0.15	0.0022	4.41	0.72	245
S-22	5Y-24H	0.87	-0.08	0.0002	0.12	0.43	100
S-23	5Y-24H	0.87	-0.08	0.0004	4.00	4.38	100
S-24	5Y-24H	1.05	-0.08	0.0002	0.16	0.38	100
S-25	5Y-24H	0.87	-0.08	0.0005	3.26	3.63	100
S-26	5Y-24H	0.88	-0.08	0.0002	0.14	0.37	100
S-27	5Y-24H	1.05	-0.08	0.0004	2.53	2.89	204
S-28	5Y-24H	1.00	-0.08	0.0003	0.62	0.36	100
S-29	5Y-24H	1.05	-0.08	0.0002	1.81	2.17	309
S-30	5Y-24H	0.88	-0.08	0.0002	0.72	1.08	171
S-31	5Y-24H	0.88	-0.08	0.0002	1.08	1.45	179
S-32	5Y-24H	0.41	-0.08	0.0002	0.42	0.72	161
S-33	5Y-24H	0.42	-0.08	0.0002	0.30	0.39	100
TEE1	5Y-24H	8.00	5.05	0.0122	110.90	102.01	100
TEE10	5Y-24H	8.00	1.59	0.0013	7.06	6.31	100
TEE11	5Y-24H	8.00	1.54	0.0011	4.56	3.81	100

Node Name	Sim Name	Warning Stage [ft]	Max Stage [ft]	Min/Max Delta Stage [ft]	Max Total Inflow [cfs]	Max Total Outflow [cfs]	Max Surface Area [ft2]
TEE12	5Y-24H	8.00	1.53	0.0011	2.28	1.59	100
TEE2	5Y-24H	8.00	3.81	0.0061	85.07	77.71	100
TEE3	5Y-24H	8.00	3.02	0.0040	65.10	59.33	100
TEE4	5Y-24H	8.00	2.65	0.0035	49.73	45.05	100
TEE5	5Y-24H	8.00	2.47	0.0032	37.34	33.52	100
TEE6	5Y-24H	8.00	2.08	0.0025	26.90	24.47	100
TEE7	5Y-24H	8.00	1.88	0.0020	20.00	18.28	100
TEE8	5Y-24H	8.00	1.79	0.0018	14.88	13.50	100
TEE9	5Y-24H	8.00	1.73	0.0016	10.65	9.53	100
TU	5Y-24H	3.20	-2.43	0.1486	300.99	58.64	100
WW1	5Y-24H	3.20	-8.19	0.0352	71.15	36.77	100
WW1A	5Y-24H	3.20	-8.20	0.0298	36.77	65.07	100
WW2	5Y-24H	3.20	-7.20	0.0250	50.46	36.26	100
WW2A	5Y-24H	3.20	-7.20	0.0297	36.26	65.68	100

MASS BALANCE

Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	0	0	0.00
Scenario1	10Y-24H	1	0	0.00
Scenario1	10Y-24H	2	0	0.00
Scenario1	10Y-24H	6	0	0.00
Scenario1	10Y-24H	14	0	0.00
Scenario1	10Y-24H	25	0	0.00
Scenario1	10Y-24H	41	0	0.00
Scenario1	10Y-24H	61	0	0.00
Scenario1	10Y-24H	89	0	0.00
Scenario1	10Y-24H	128	0	0.00
Scenario1	10Y-24H	183	0	0.00
Scenario1	10Y-24H	254	0	0.00
Scenario1	10Y-24H	343	0	0.00
Scenario1	10Y-24H	450	0	0.00
Scenario1	10Y-24H	573	0	0.00
Scenario1	10Y-24H	713	0	0.00
Scenario1	10Y-24H	870	0	0.00
Scenario1	10Y-24H	1041	0	0.00
Scenario1	10Y-24H	1228	0	0.00
Scenario1	10Y-24H	1428	0	0.00
Scenario1	10Y-24H	1643	0	0.00
Scenario1	10Y-24H	1870	0	0.00
Scenario1	10Y-24H	2110	0	0.00
Scenario1	10Y-24H	2361	0	0.00
Scenario1	10Y-24H	2624	0	0.00
Scenario1	10Y-24H	2897	0	0.00
Scenario1	10Y-24H	3181	0	0.00
Scenario1	10Y-24H	3486	14	0.00
Scenario1	10Y-24H	3820	14	0.00
Scenario1	10Y-24H	4185	14	0.00

Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	4579	14	0.00
Scenario1	10Y-24H	5000	14	0.00
Scenario1	10Y-24H	5443	103	0.00
Scenario1	10Y-24H	5907	103	0.00
Scenario1	10Y-24H	6389	103	0.00
Scenario1	10Y-24H	6888	431	0.00
Scenario1	10Y-24H	7403	480	0.00
Scenario1	10Y-24H	7932	1578	0.00
Scenario1	10Y-24H	8474	1678	0.00
Scenario1	10Y-24H	9027	1683	0.01
Scenario1	10Y-24H	9592	1683	0.01
Scenario1	10Y-24H	10167	2551	0.01
Scenario1	10Y-24H	10750	4492	0.01
Scenario1	10Y-24H	11342	4572	0.01
Scenario1	10Y-24H	11942	4575	0.01
Scenario1	10Y-24H	12548	4841	0.00
Scenario1	10Y-24H	13161	5878	0.01
Scenario1	10Y-24H	13780	6948	0.01
Scenario1	10Y-24H	14405	7448	0.01
Scenario1	10Y-24H	15036	7759	0.00
Scenario1	10Y-24H	15671	8777	0.01
Scenario1	10Y-24H	16311	8818	0.00
Scenario1	10Y-24H	16956	8820	0.00
Scenario1	10Y-24H	17606	10956	0.00
Scenario1	10Y-24H	18261	11686	0.00
Scenario1	10Y-24H	18923	11717	0.00
Scenario1	10Y-24H	19594	11718	0.00
Scenario1	10Y-24H	20273	12763	0.00
Scenario1	10Y-24H	20962	14482	0.00
Scenario1	10Y-24H	21660	14611	0.00
Scenario1	10Y-24H	22369	14617	0.00
Scenario1	10Y-24H	23089	15890	0.00
Scenario1	10Y-24H	23819	15966	0.00
Scenario1	10Y-24H	24560	17449	0.00
Scenario1	10Y-24H	25312	18580	0.00
Scenario1	10Y-24H	26075	18862	0.00
Scenario1	10Y-24H	26850	18874	0.00
Scenario1	10Y-24H	27636	20744	0.00
Scenario1	10Y-24H	28433	21736	0.00
Scenario1	10Y-24H	29241	21777	0.00
Scenario1	10Y-24H	30060	22242	0.00
Scenario1	10Y-24H	30890	23782	0.00

Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	31731	24652	0.00
Scenario1	10Y-24H	32582	25202	0.00
Scenario1	10Y-24H	33445	26011	0.00
Scenario1	10Y-24H	34317	26619	0.00
Scenario1	10Y-24H	35200	28355	0.00
Scenario1	10Y-24H	36094	28932	0.00
Scenario1	10Y-24H	36997	28956	0.00
Scenario1	10Y-24H	37911	30978	0.00
Scenario1	10Y-24H	38834	31837	0.00
Scenario1	10Y-24H	39769	31873	0.00
Scenario1	10Y-24H	40725	33123	0.00
Scenario1	10Y-24H	41719	34563	0.00
Scenario1	10Y-24H	42765	35479	0.00
Scenario1	10Y-24H	43860	36126	0.00
Scenario1	10Y-24H	44999	37097	0.00
Scenario1	10Y-24H	46179	38981	0.00
Scenario1	10Y-24H	47394	39079	0.00
Scenario1	10Y-24H	48640	41369	0.00
Scenario1	10Y-24H	49915	41992	0.00
Scenario1	10Y-24H	51217	43265	0.00
Scenario1	10Y-24H	52543	44723	0.00
Scenario1	10Y-24H	53892	46223	0.00
Scenario1	10Y-24H	55263	46354	0.00
Scenario1	10Y-24H	56654	49145	0.00
Scenario1	10Y-24H	58064	49670	0.00
Scenario1	10Y-24H	59492	51858	0.00
Scenario1	10Y-24H	60937	53116	0.00
Scenario1	10Y-24H	62398	53804	0.00
Scenario1	10Y-24H	63874	56298	0.00
Scenario1	10Y-24H	65366	56558	0.00
Scenario1	10Y-24H	66871	59260	0.00
Scenario1	10Y-24H	68391	60126	0.00
Scenario1	10Y-24H	69925	61965	0.00
Scenario1	10Y-24H	71472	63585	0.00
Scenario1	10Y-24H	73032	64260	0.00
Scenario1	10Y-24H	74605	66697	0.00
Scenario1	10Y-24H	76190	67627	0.00
Scenario1	10Y-24H	77787	69668	0.00
Scenario1	10Y-24H	79396	71010	0.00
Scenario1	10Y-24H	81017	72910	0.00
Scenario1	10Y-24H	82648	74090	0.00
Scenario1	10Y-24H	84290	76534	0.00

Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	85944	77095	0.00
Scenario1	10Y-24H	87608	79557	0.00
Scenario1	10Y-24H	89281	81118	0.00
Scenario1	10Y-24H	90965	82396	0.00
Scenario1	10Y-24H	92659	84335	0.00
Scenario1	10Y-24H	94363	86227	0.00
Scenario1	10Y-24H	96076	87354	0.00
Scenario1	10Y-24H	97799	89330	0.00
Scenario1	10Y-24H	99532	91405	0.00
Scenario1	10Y-24H	101275	92261	0.00
Scenario1	10Y-24H	103026	94636	0.00
Scenario1	10Y-24H	104787	96330	0.00
Scenario1	10Y-24H	106557	97993	0.00
Scenario1	10Y-24H	108335	99550	0.00
Scenario1	10Y-24H	110122	101866	0.00
Scenario1	10Y-24H	111918	103355	0.00
Scenario1	10Y-24H	113722	104991	0.00
Scenario1	10Y-24H	115534	107078	0.00
Scenario1	10Y-24H	117354	109014	0.00
Scenario1	10Y-24H	119183	110341	0.00
Scenario1	10Y-24H	121019	112330	0.00
Scenario1	10Y-24H	122863	114646	0.00
Scenario1	10Y-24H	124714	116089	0.00
Scenario1	10Y-24H	126583	117945	0.00
Scenario1	10Y-24H	128515	119667	0.00
Scenario1	10Y-24H	130564	122202	0.00
Scenario1	10Y-24H	132740	123468	0.00
Scenario1	10Y-24H	135028	125689	0.00
Scenario1	10Y-24H	137414	127811	0.00
Scenario1	10Y-24H	139882	130063	0.00
Scenario1	10Y-24H	142420	132884	0.00
Scenario1	10Y-24H	145019	135220	0.00
Scenario1	10Y-24H	147672	137460	0.00
Scenario1	10Y-24H	150372	140396	0.00
Scenario1	10Y-24H	153116	143149	0.00
Scenario1	10Y-24H	155899	145372	0.00
Scenario1	10Y-24H	158717	148037	0.00
Scenario1	10Y-24H	161567	151023	0.00
Scenario1	10Y-24H	164445	153896	0.00
Scenario1	10Y-24H	167348	156572	0.00
Scenario1	10Y-24H	170275	159152	0.00
Scenario1	10Y-24H	173223	162475	0.00

Scenario	Sim	Total Inflow Volume [ft3]	Total Outflow Volume [ft3]	% Error (By Inflow) [%]
Scenario1	10Y-24H	176192	165674	0.00
Scenario1	10Y-24H	179179	168714	0.00
Scenario1	10Y-24H	182185	171560	0.00
Scenario1	10Y-24H	185208	174016	0.00
Scenario1	10Y-24H	188247	176872	0.00
Scenario1	10Y-24H	191302	180106	0.00
Scenario1	10Y-24H	194372	183580	0.00
Scenario1	10Y-24H	197456	186787	0.00
Scenario1	10Y-24H	200555	189770	0.00
Scenario1	10Y-24H	203666	192460	0.00
Scenario1	10Y-24H	206789	195139	0.00
Scenario1	10Y-24H	209925	198507	0.00
Scenario1	10Y-24H	213073	202041	0.00
Scenario1	10Y-24H	216231	205322	0.00
Scenario1	10Y-24H	219401	208424	0.00
Scenario1	10Y-24H	222581	211379	0.00
Scenario1	10Y-24H	225771	214306	0.00
Scenario1	10Y-24H	228971	217418	0.00
Scenario1	10Y-24H	232189	220750	0.00
Scenario1	10Y-24H	235480	223989	0.00
Scenario1	10Y-24H	238907	227135	0.00
Scenario1	10Y-24H	242478	230833	0.00
Scenario1	10Y-24H	246181	234366	0.00
Scenario1	10Y-24H	249995	237691	0.00
Scenario1	10Y-24H	253905	241557	0.00
Scenario1	10Y-24H	257895	245249	0.00
Scenario1	10Y-24H	261954	248930	0.00
Scenario1	10Y-24H	266073	252986	0.00
Scenario1	10Y-24H	270245	256633	0.00
Scenario1	10Y-24H	274466	260855	0.00
Scenario1	10Y-24H	278730	264615	0.00
Scenario1	10Y-24H	283033	268924	0.00
Scenario1	10Y-24H	287370	273305	0.00
Scenario1	10Y-24H	291738	277729	0.00
Scenario1	10Y-24H	296133	282155	0.00
Scenario1	10Y-24H	300553	286136	0.00
Scenario1	10Y-24H	305000	290619	0.00
Scenario1	10Y-24H	309507	294661	0.00
Scenario1	10Y-24H	314133	299272	0.00
Scenario1	10Y-24H	318914	304139	0.00
Scenario1	10Y-24H	323846	308578	0.00
Scenario1	10Y-24H	328910	313080	0.00

Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	334087	317973	0.00
Scenario1	10Y-24H	339359	323259	0.00
Scenario1	10Y-24H	344714	328109	0.00
Scenario1	10Y-24H	350139	332800	0.00
Scenario1	10Y-24H	355627	338402	0.00
Scenario1	10Y-24H	361171	343565	0.00
Scenario1	10Y-24H	366765	349044	0.00
Scenario1	10Y-24H	372403	354586	0.00
Scenario1	10Y-24H	378081	359736	0.00
Scenario1	10Y-24H	383795	365632	0.00
Scenario1	10Y-24H	389540	370945	0.00
Scenario1	10Y-24H	395314	376716	0.00
Scenario1	10Y-24H	401112	382242	0.00
Scenario1	10Y-24H	406918	387843	0.00
Scenario1	10Y-24H	412640	393581	0.00
Scenario1	10Y-24H	418177	398920	0.00
Scenario1	10Y-24H	423511	404810	0.00
Scenario1	10Y-24H	428666	409978	0.00
Scenario1	10Y-24H	433673	415589	0.00
Scenario1	10Y-24H	438557	420791	0.00
Scenario1	10Y-24H	443342	425533	0.00
Scenario1	10Y-24H	448046	431171	0.00
Scenario1	10Y-24H	452682	436260	0.00
Scenario1	10Y-24H	457260	440979	0.00
Scenario1	10Y-24H	461787	445979	0.00
Scenario1	10Y-24H	466272	450742	0.00
Scenario1	10Y-24H	470721	455512	0.00
Scenario1	10Y-24H	475141	459912	0.00
Scenario1	10Y-24H	479537	464329	0.00
Scenario1	10Y-24H	483913	469340	0.00
Scenario1	10Y-24H	488273	473815	0.00
Scenario1	10Y-24H	492619	477994	0.00
Scenario1	10Y-24H	496934	482450	0.00
Scenario1	10Y-24H	501189	486396	0.00
Scenario1	10Y-24H	505364	491212	0.00
Scenario1	10Y-24H	509462	495632	0.00
Scenario1	10Y-24H	513493	499805	0.00
Scenario1	10Y-24H	517470	504059	0.00
Scenario1	10Y-24H	521402	507922	0.00
Scenario1	10Y-24H	525296	512054	0.00
Scenario1	10Y-24H	529159	515836	0.00
Scenario1	10Y-24H	532996	519805	0.00

Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	536810	523622	0.00
Scenario1	10Y-24H	540606	527348	0.00
Scenario1	10Y-24H	544387	531309	0.00
Scenario1	10Y-24H	548154	534773	0.00
Scenario1	10Y-24H	551911	538928	0.00
Scenario1	10Y-24H	555659	542546	0.00
Scenario1	10Y-24H	559402	546468	0.00
Scenario1	10Y-24H	563139	550313	0.00
Scenario1	10Y-24H	566874	553809	0.00
Scenario1	10Y-24H	570605	557957	0.00
Scenario1	10Y-24H	574334	561526	0.00
Scenario1	10Y-24H	578061	565371	0.00
Scenario1	10Y-24H	581785	569195	0.00
Scenario1	10Y-24H	585508	572641	0.00
Scenario1	10Y-24H	589231	576736	0.00
Scenario1	10Y-24H	592953	580305	0.00
Scenario1	10Y-24H	596675	584067	0.00
Scenario1	10Y-24H	600397	587923	0.00
Scenario1	10Y-24H	604119	591349	0.00
Scenario1	10Y-24H	607843	595407	0.00
Scenario1	10Y-24H	611567	599015	0.00
Scenario1	10Y-24H	615293	602720	0.00
Scenario1	10Y-24H	619020	606608	0.00
Scenario1	10Y-24H	622749	610058	0.00
Scenario1	10Y-24H	626479	614063	0.00
Scenario1	10Y-24H	630211	617720	0.00
Scenario1	10Y-24H	633942	621375	0.00
Scenario1	10Y-24H	637655	625299	0.00
Scenario1	10Y-24H	641315	628764	0.00
Scenario1	10Y-24H	644903	632672	0.00
Scenario1	10Y-24H	648421	636294	0.00
Scenario1	10Y-24H	651878	639565	0.00
Scenario1	10Y-24H	655285	643354	0.00
Scenario1	10Y-24H	658650	646715	0.00
Scenario1	10Y-24H	661981	649716	0.00
Scenario1	10Y-24H	665284	653224	0.00
Scenario1	10Y-24H	668564	656821	0.00
Scenario1	10Y-24H	671823	660144	0.00
Scenario1	10Y-24H	675064	663323	0.00
Scenario1	10Y-24H	678290	666968	0.00
Scenario1	10Y-24H	681503	670414	0.00
Scenario1	10Y-24H	684707	673591	0.00

Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	687902	676592	0.00
Scenario1	10Y-24H	691090	679615	0.00
Scenario1	10Y-24H	694273	682741	0.00
Scenario1	10Y-24H	697445	686035	0.00
Scenario1	10Y-24H	700579	689257	0.00
Scenario1	10Y-24H	703637	692372	0.00
Scenario1	10Y-24H	706616	695655	0.00
Scenario1	10Y-24H	709525	698953	0.00
Scenario1	10Y-24H	712374	701775	0.00
Scenario1	10Y-24H	715174	704356	0.00
Scenario1	10Y-24H	717934	707467	0.00
Scenario1	10Y-24H	720660	710458	0.00
Scenario1	10Y-24H	723358	713237	0.00
Scenario1	10Y-24H	726032	715374	0.00
Scenario1	10Y-24H	728684	718245	0.00
Scenario1	10Y-24H	731319	721192	0.00
Scenario1	10Y-24H	733938	723902	0.00
Scenario1	10Y-24H	736545	725881	0.00
Scenario1	10Y-24H	739141	728833	0.00
Scenario1	10Y-24H	741728	731728	0.00
Scenario1	10Y-24H	744309	734265	0.00
Scenario1	10Y-24H	746883	736385	0.00
Scenario1	10Y-24H	749453	739348	0.00
Scenario1	10Y-24H	752018	742135	0.00
Scenario1	10Y-24H	754579	744264	0.00
Scenario1	10Y-24H	757135	746891	0.00
Scenario1	10Y-24H	759689	749792	0.00
Scenario1	10Y-24H	762239	752364	0.00
Scenario1	10Y-24H	764788	754397	0.00
Scenario1	10Y-24H	767334	757356	0.00
Scenario1	10Y-24H	769879	760138	0.00
Scenario1	10Y-24H	772422	762230	0.00
Scenario1	10Y-24H	774964	764876	0.00
Scenario1	10Y-24H	777506	767760	0.00
Scenario1	10Y-24H	780047	770288	0.00
Scenario1	10Y-24H	782588	772367	0.00
Scenario1	10Y-24H	785129	775315	0.00
Scenario1	10Y-24H	787670	778057	0.00
Scenario1	10Y-24H	790210	780023	0.00
Scenario1	10Y-24H	792752	782821	0.00
Scenario1	10Y-24H	795293	785679	0.00
Scenario1	10Y-24H	797836	788131	0.00

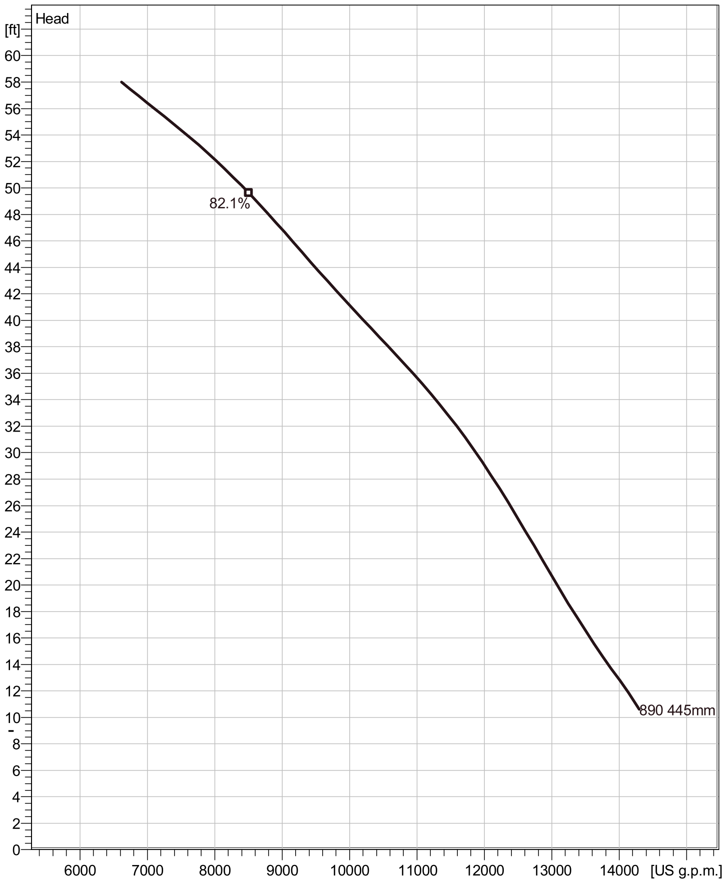
Scenario	Sim	Total Inflow Volume [ft3	Total Outflow Volume [ft3	% Error (By Inflow) [%]
Scenario1	10Y-24H	800378	790299	0.00
Scenario1	10Y-24H	802922	793232	0.00
Scenario1	10Y-24H	805466	795923	0.00
Scenario1	10Y-24H	808011	797816	0.00
Scenario1	10Y-24H	810556	800728	0.00
Scenario1	10Y-24H	813102	803563	0.00
Scenario1	10Y-24H	815649	805940	0.00
Scenario1	10Y-24H	818196	808194	0.00
Scenario1	10Y-24H	820744	811111	0.00
Scenario1	10Y-24H	823292	813758	0.00
Scenario1	10Y-24H	825841	815648	0.00
Scenario1	10Y-24H	828391	818597	0.00
Scenario1	10Y-24H	830941	821415	0.00
Scenario1	10Y-24H	833492	823726	0.00
Scenario1	10Y-24H	836044	826046	0.00
Scenario1	10Y-24H	838596	828951	0.00
Scenario1	10Y-24H	841146	831572	0.00
Scenario1	10Y-24H	843675	833470	0.00
Scenario1	10Y-24H	846152	836403	0.00
Scenario1	10Y-24H	848553	839129	0.00
Scenario1	10Y-24H	850881	840968	0.00
Scenario1	10Y-24H	853146	843331	0.00
Scenario1	10Y-24H	855358	845921	0.00
Scenario1	10Y-24H	857527	847612	0.00
Scenario1	10Y-24H	859660	850474	0.00

APPENDIX C

PUMP
OPERATIONAL
CURVE

LL 3400/706 3~ 890

Technical specification



Water, pure *Curve ISO*

Note: Picture might not correspond to the current configuration.

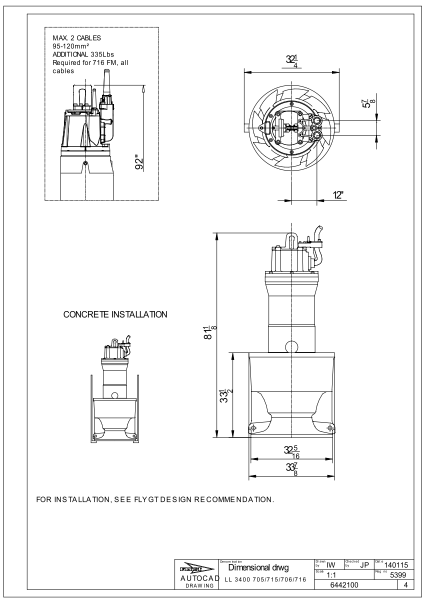
General

Shrouded single or multi-channel mixed flow impellers with bowl type diffuser pump casing for fibre-free liquids.

Impeller

Impeller material	Grey cast iron
ColDia	35 7/16 inch
Suction Flange Diameter	
Impeller diameter	445 mm
Number of blades	3
Throughlet diameter	4 1/8 inch

Installation: L - Column pipe Semi permanent, Wet



Motor

Motor #	L0706.000 43-30-8ID-W 135hp Standard
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	8
Phases	3~
Rated power	135 hp
Rated current	172 A
Starting current	710 A
Rated speed	880 rpm
Power factor	
1/1 Load	0.79
3/4 Load	0.75
1/2 Load	0.66
Motor efficiency	
1/1 Load	92.9 %
3/4 Load	93.6 %
1/2 Load	93.6 %

Configuration

Project	Project ID	Created by	Created on	Last update
			3/18/2019	

LL 3400/706 3~ 890

Performance curve

Pump

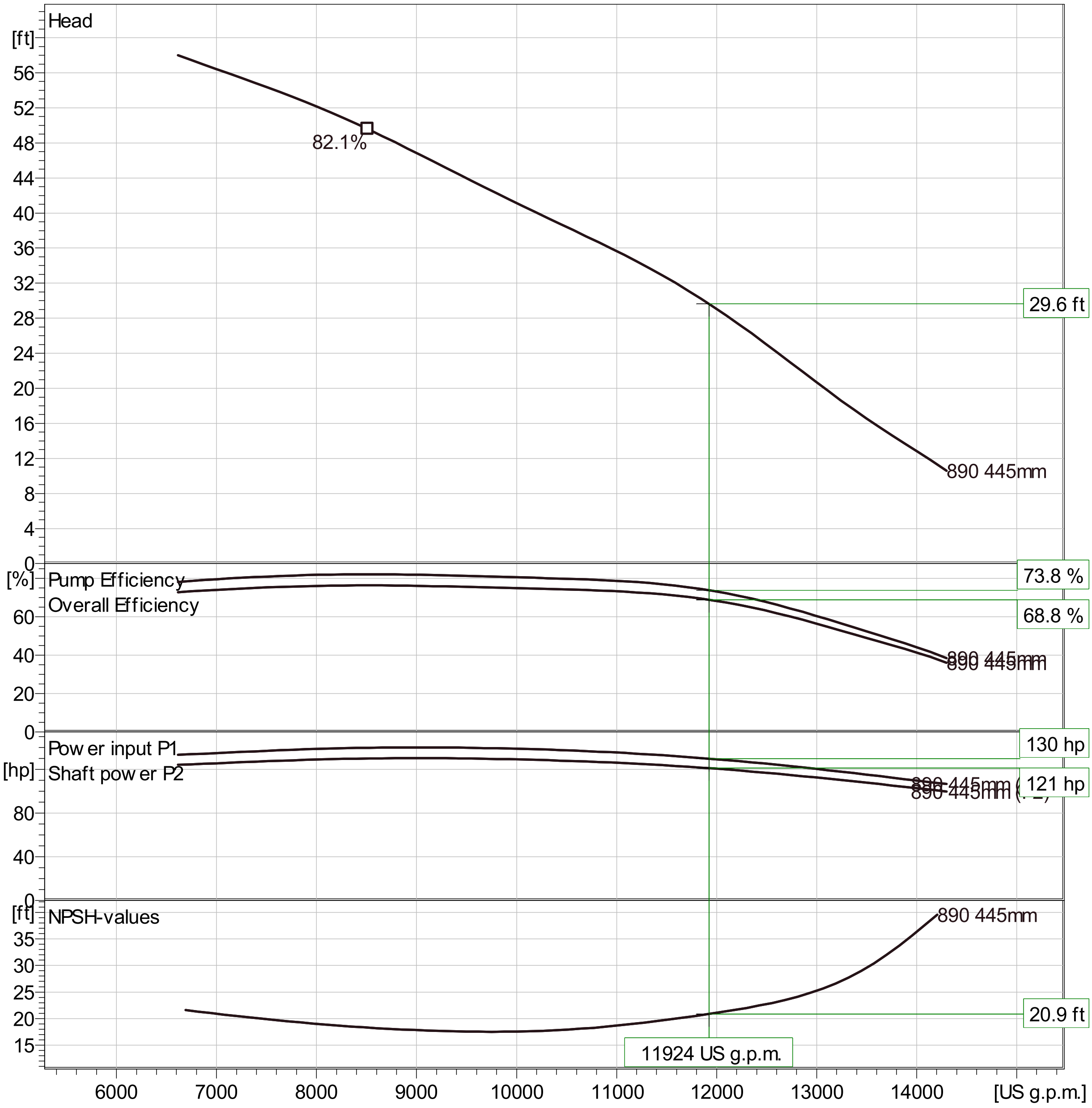
ColDia	35 7/16 inch
Suction Flange Diameter	
Impeller diameter	17 1/2"
Number of blades	3
Throughlet diameter	4 1/8 inch

Motor

Motor #	L0706.000 43-30-8ID-W 135hp
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	8
Phases	3~
Rated power	135 hp
Rated current	172 A
Starting current	710 A
Rated speed	880 rpm

Power factor	
1/1 Load	0.79
3/4 Load	0.75
1/2 Load	0.66

Motor efficiency	
1/1 Load	92.9 %
3/4 Load	93.6 %
1/2 Load	93.6 %



Water, pure

Curve ISO

Duty point | **Guarantee**

Flow	Head	Guarantee
12000 US g.p.m	29.9 ft	No

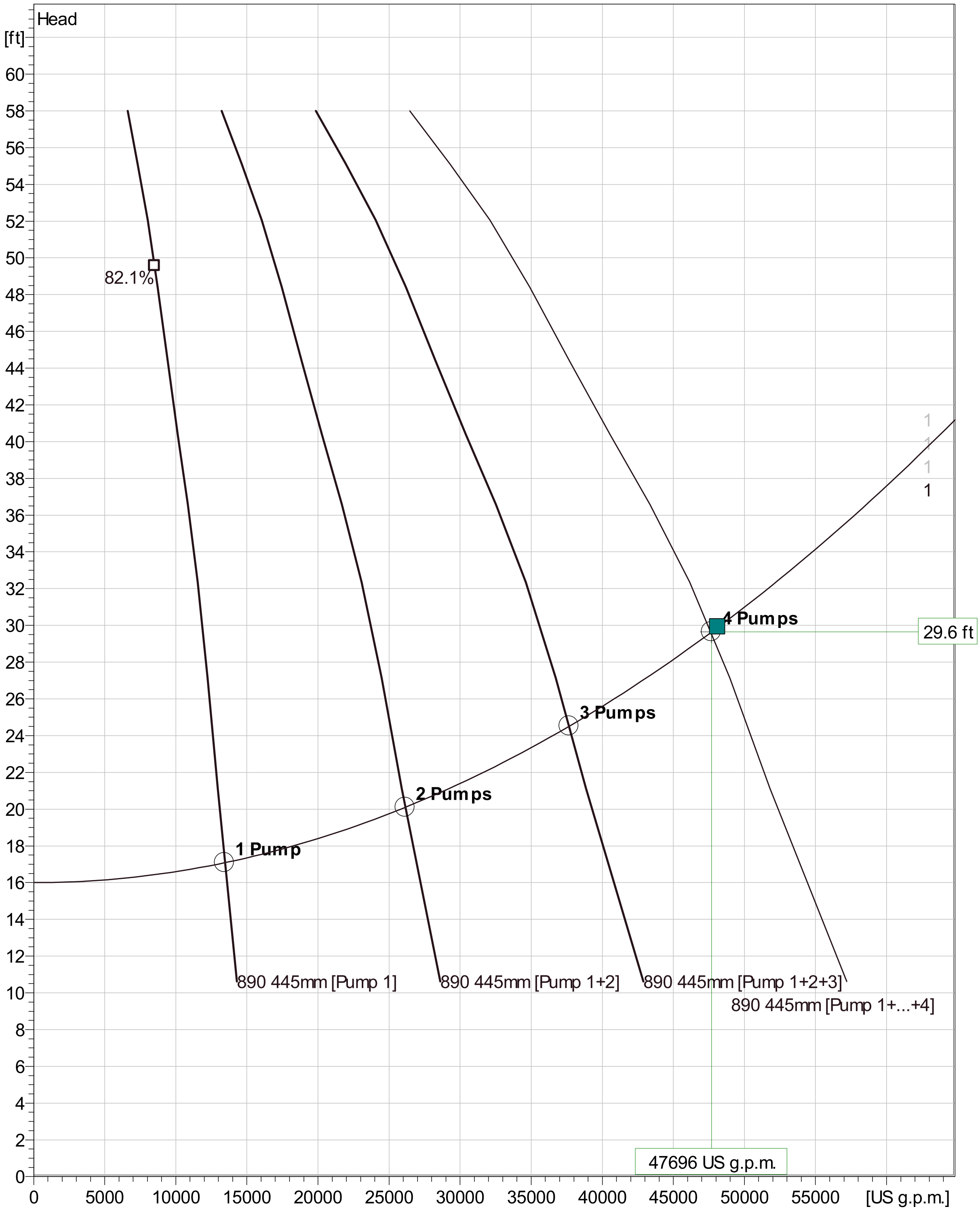
Project	Project ID	Created by	Created on	Last update
			3/18/2019	

xylem

LL 3400/706 3~ 890

Duty Analysis

FLYGT



Water, pure *Curve ISO*

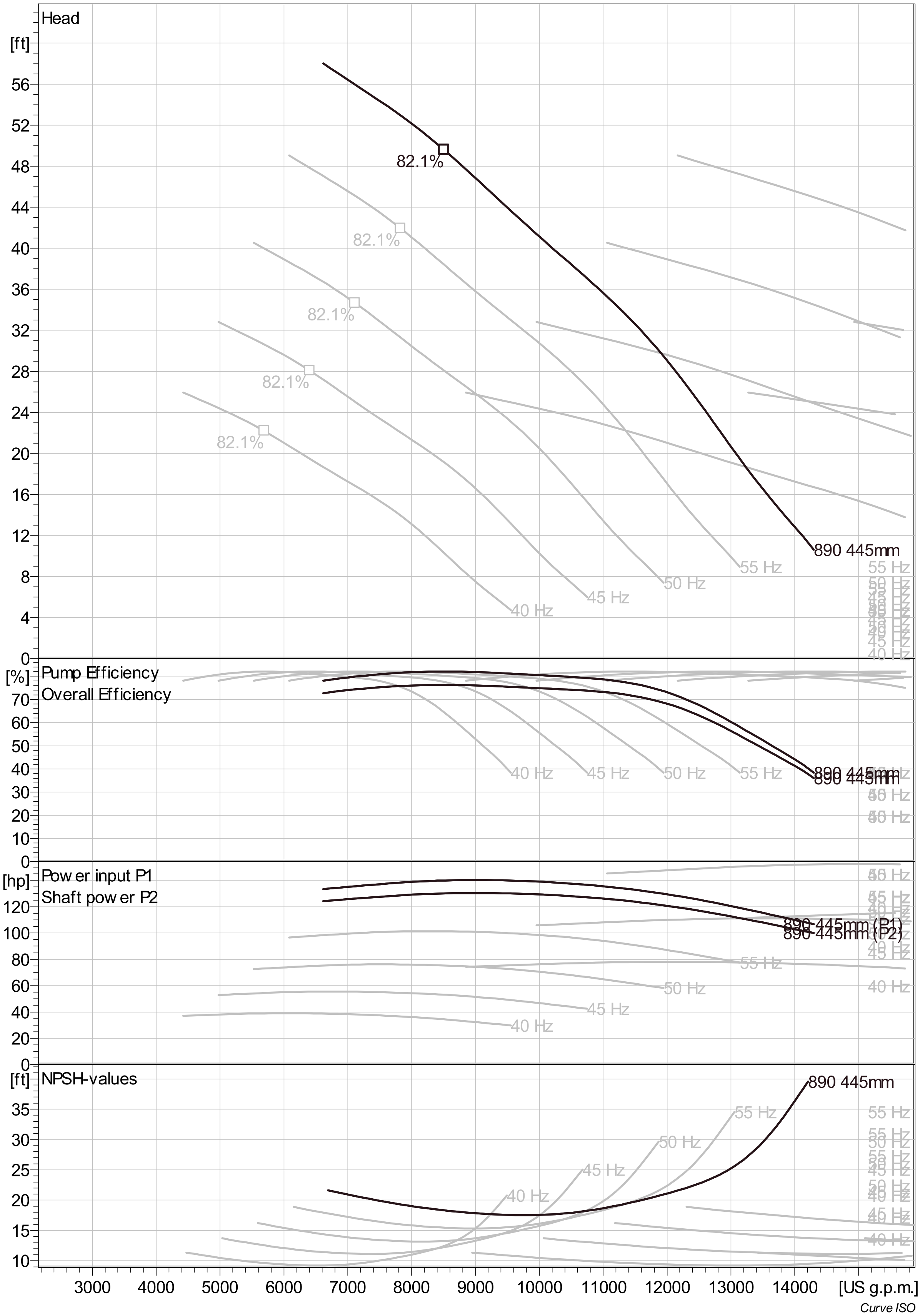
Curve issue *73*

Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
4 / 1	11900 US g.p.m.	29.6 ft	121 hp	47700 US g.p.m.	29.6 ft	485 hp	73.8 %25	135 kWh/US MG	20.9 ft
3 / 1	12600 US g.p.m.	24.5 ft	117 hp	37700 US g.p.m.	24.5 ft	350 hp	66.8 %25	123 kWh/US MG	23 ft
2 / 1	13100 US g.p.m.	20.1 ft	112 hp	26100 US g.p.m.	20.1 ft	224 hp	59.3 %25	114 kWh/US MG	25.7 ft
1 / 1	13400 US g.p.m.	17.1 ft	109 hp	13400 US g.p.m.	17.1 ft	109 hp	53.5 %25	107 kWh/US MG	28.8 ft

Project	Project ID	Created by	Created on	Last update
			3/18/2019	

LL 3400/706 3~ 890

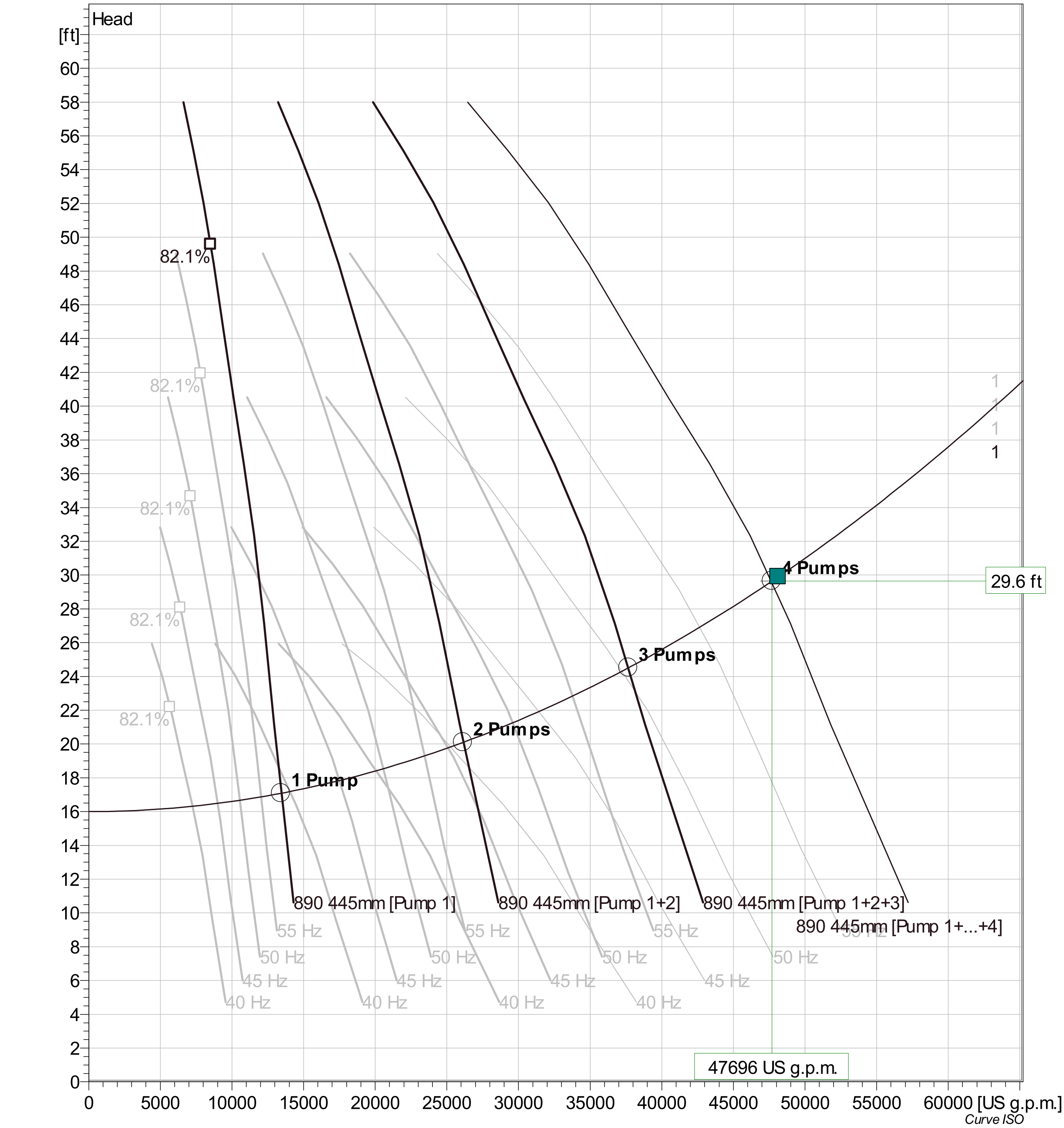
VFD Curve



Project	Project ID	Created by	Created on	Last update
			3/18/2019	

LL 3400/706 3~ 890

VFD Analysis

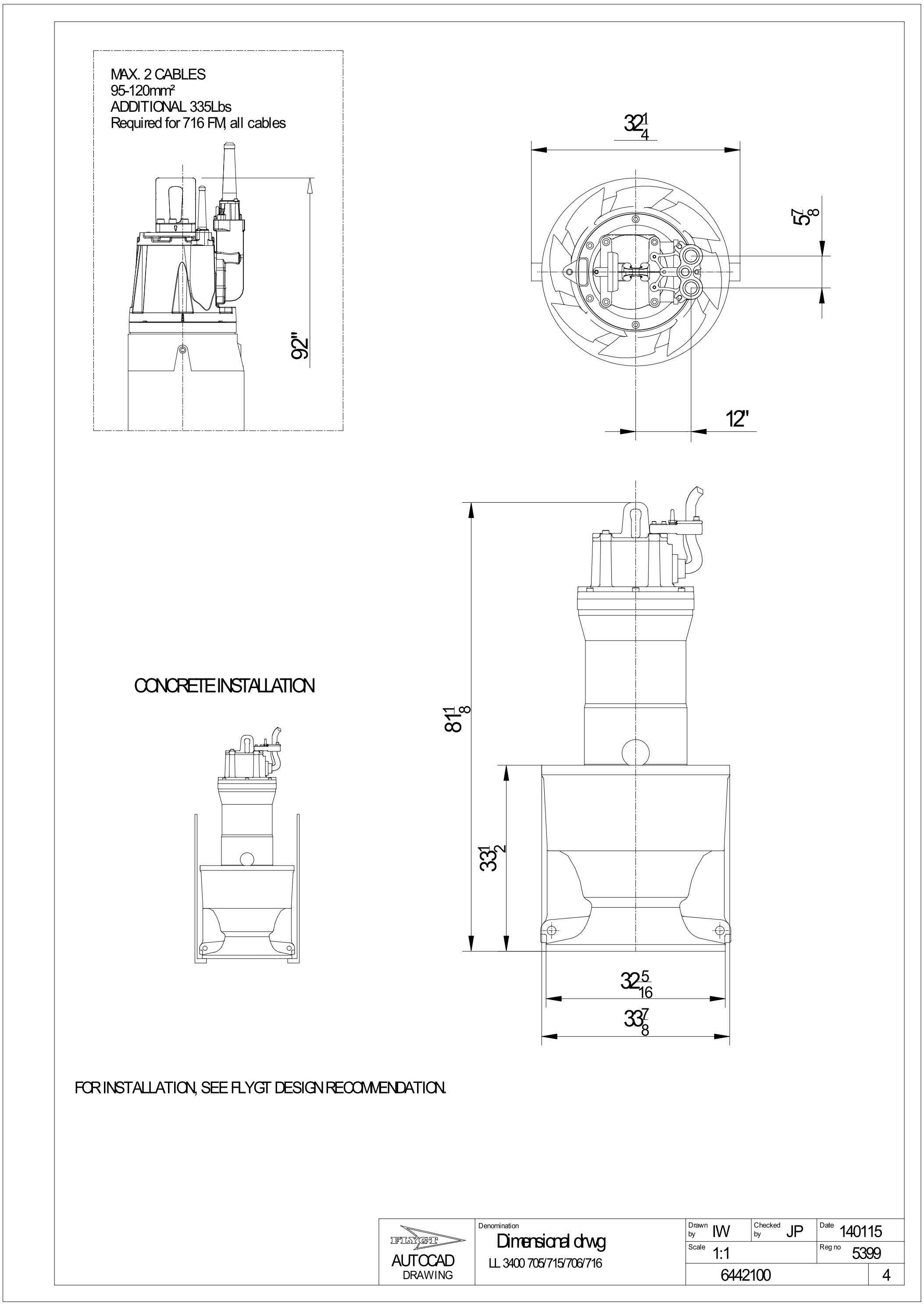


Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
4 / 1	60 Hz	11900 US g.p.m.	29.6 ft	121 hp	47700 US g.p.m.	29.6 ft	485 hp	73.8 %25	135 kWh/US MG	20.9 ft
4 / 1	55 Hz	10700 US g.p.m.	26.9 ft	95.7 hp	42700 US g.p.m.	26.9 ft	383 hp	76 %25	119 kWh/US MG	17.5 ft
4 / 1	50 Hz	9320 US g.p.m.	24.3 ft	73.3 hp	37300 US g.p.m.	24.3 ft	293 hp	78.2 %25	104 kWh/US MG	14.2 ft
4 / 1	45 Hz	7860 US g.p.m.	21.9 ft	54.6 hp	31400 US g.p.m.	21.9 ft	218 hp	79.8 %25	92.8 kWh/US MG	11.3 ft
4 / 1	40 Hz	6310 US g.p.m.	19.8 ft	39 hp	25300 US g.p.m.	19.8 ft	156 hp	81.3 %25	83.6 kWh/US MG	9.24 ft
3 / 1	60 Hz	12600 US g.p.m.	24.5 ft	117 hp	37700 US g.p.m.	24.5 ft	350 hp	66.8 %25	123 kWh/US MG	23 ft
3 / 1	55 Hz	11300 US g.p.m.	22.9 ft	92.4 hp	33800 US g.p.m.	22.9 ft	277 hp	70.5 %25	109 kWh/US MG	19.1 ft
3 / 1	50 Hz	9880 US g.p.m.	21.3 ft	71.2 hp	29600 US g.p.m.	21.3 ft	214 hp	74.6 %25	95.7 kWh/US MG	15.4 ft
3 / 1	45 Hz	8370 US g.p.m.	19.8 ft	53.5 hp	25100 US g.p.m.	19.8 ft	160 hp	78.3 %25	85.4 kWh/US MG	12 ft
3 / 1	40 Hz	6690 US g.p.m.	18.4 ft	38.7 hp	20100 US g.p.m.	18.4 ft	116 hp	80.5 %25	78.4 kWh/US MG	9.23 ft
2 / 1	60 Hz	13100 US g.p.m.	20.1 ft	112 hp	26100 US g.p.m.	20.1 ft	224 hp	59.3 %25	114 kWh/US MG	25.7 ft
2 / 1	55 Hz	11700 US g.p.m.	19.3 ft	89.2 hp	23400 US g.p.m.	19.3 ft	178 hp	64.1 %25	101 kWh/US MG	20.8 ft
2 / 1	50 Hz	10300 US g.p.m.	18.5 ft	69.1 hp	20600 US g.p.m.	18.5 ft	138 hp	69.8 %25	89.2 kWh/US MG	16.6 ft
2 / 1	45 Hz	8770 US g.p.m.	17.8 ft	52.3 hp	17500 US g.p.m.	17.8 ft	105 hp	75.7 %25	79.7 kWh/US MG	12.8 ft
2 / 1	40 Hz	7020 US g.p.m.	17.2 ft	38.3 hp	14000 US g.p.m.	17.2 ft	76.6 hp	79.7 %25	73.9 kWh/US MG	9.41 ft
1 / 1	40 Hz	7260 US g.p.m.	16.3 ft	37.9 hp	7260 US g.p.m.	16.3 ft	37.9 hp	79 %25	70.9 kWh/US MG	9.67 ft

PUMP DIMENSION SHEET

LL 3400/706 3~ 890

Dimensional drawing



Project	Project ID	Created by	Created on	Last update
			3/18/2019	

PUMP
SPECIFICATIONS

xylem
Let's Solve Water

Technical Specification

884322_5.0

L3356, L3400, L3602

LARGE SUBMERSIBLE PUMPS

FLYGT
a xylem brand

Table of Contents

1 Product Description

1.1 Product overview

Submersible pump for pumping water and wastewater containing solids or long-fibred material.

Installation

L-installation

Accessories

Mechanical accessories which are available include the following:

- Cable handling systems
- Lifting equipment

Electrical accessories which are available include the following:

- Pump controller
- Control panels
- Starters
- MAS and other monitoring relays

See your local sales and service representative for further information.

Options

The following options are available:

- Zinc anodes for corrosion protection
- Special coating system (with epoxy base coat) for demanding environments
- Power monitoring
- Monitoring options for temperature, vibration and water in the oil housing

1.2 Materials

Impeller

Table 1: L3356, L3400

Material	Internal material number	Standard	
		Europe	USA
Cast iron	M0314.0125.00	EN 1561 No. JL 1040	ASTM-A 48 – No 35 B
Duplex stainless steel	M0344.2324.12	EN 10283 No. 1.4474	ASTM (CD-4MCuN)

Table 2: L3602

Material	Internal material number	Standard	
		Europe	USA
Cast iron	M0314.0125.00	EN 1561 No. JL 1040	ASTM-A 48 – No 35 B
Duplex stainless steel	M0344.2324.12	EN 10283 No. 1.4474	ASTM (CD-4MCuN)

Pump housing

Table 3: L3356, L3400, L3602

Material	Internal material number	Standard	
		Europe	USA
Cast iron	M0314.0125.00	EN 1561 No. JL 1040	ASTM-A 48 – No 35 B

Mechanical face seals

The inner seal is always corrosion resistant cemented tungsten carbide (WCCR). The outer seal can be either corrosion resistant cemented tungsten carbide (WCCR), or corrosion resistant silicon carbide (RSiC).

Seal	Material, rotating ring	Material, stationary ring
Inner	Corrosion resistant cemented tungsten carbide (WCCR)	WCCR
Outer	WCCR	WCCR
	Corrosion resistant silicon carbide (RSiC)	RSiC

Drive unit shaft

Material	Internal material number	Standard	
		Europe	USA
Martensitic stainless steel	M0344.2321.03	EN 10088-3 No. 1.4057	ASTM/AISI 431
Duplex stainless steel	M0344.2324.02	EN 10088-3 No. 1.4460	ASTM/AISI 329

O-rings

Material	Internal material number	Standard	
		Europe	USA
Nitrile rubber 70º IRH	M0516.2637.04	–	–

Coating system

The following table describes the two variants of paint systems available for the pump, Standard and Special. The choice of coating system depends upon the service environment.

Coating system	Basecoat	Topcoat	Total dry film thickness
Standard	Acrylic (waterborne) or alkyd (solventborne)	Oxirane ester, 2–pack	120–350 µm
Special (option)	Epoxy, 2 layers	Oxirane ester, 2–pack, 1 layer	350–700 µm

Other coating systems are available for special requirements such as drinking water, high temperature, or erosion applications. See the Xylem internal standard M0700.00.0001 (Coating Selection Guidelines).

1.3 Mounting-related data

Depth of immersion

The maximum depth of immersion is 20 m (65 ft).

Weight

See the dimensional drawing for pump weights.

Cables

Table 4: L3356

SUBCAB™	Maximum voltage 600–1000 V, intended for drive units up to 1 kV. Consult Xylem for the cable dimensions.

Table 5: L3400, L3602

SUBCAB™	Maximum voltage 600–1000 V, intended for drive units up to 1 kV. Consult Xylem for the cable dimensions.
NTSCGEWTOEUS	For use with medium voltage (1.2–6.6 kV) drive units. Consult Xylem for the cable dimensions.

Engineering data

Performance curves, motor data, and dimensional drawings are available from the local sales and service representative.

Impeller throughlet

Pump	Throughlet	
	mm	Inch
L3356	102	4.02
L3400	105	4.13
L3602	126	4.96

1.4 Drive units

L3356

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	605	615	15
	665	675	15
Up to 1 kV	705	715	15
	735	745	15
	765	775	15
Up to 1 kV	706	716	10
	736	746	10
	766	776	10

L3400

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	705	715	15
	735	745	15
	765	775	15
Up to 1 kV	706	716	10
	736	746	10
	766	776	10

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	805	815	15
	835	845	15
	865	875	15
Up to 1 kV	806	816	10
	836	846	10
	866	876	10
1.2–6.6 kV	862	872	15
	882	892	10
1.2–6.6 kV	863	873	10
	883	893	10

L3602

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	735	745	15
	765	775	15
Up to 1 kV	736	746	10
	766	776	10
Up to 1 kV	805	815	15
	835	845	15
	865	875	15
Up to 1 kV	806	816	10
	836	846	10
	866	876	10
Up to 1 kV	905	915	10
	935	945	10
Up to 1 kV	906	916	10
	936	946	10
1.2–6.6 kV	862	872	15
	882	892	10
1.2–6.6 kV	863	873	10
	883	893	10

2 Operational Data

2.1 Application limits

Table 6: Process data

Parameter	Value
Liquid temperature	Max. +40°C (+105°F)
Depth of immersion	Max. 20 m (65 ft)
pH of pumped liquid	pH 5.5–14
Liquid density	Max. 1100 kg/m^3 (9.17 lb per gal.)

2.2 Motor data

Motor characteristics

Feature	Description
Frequency	50 Hz or 60 Hz
Stator insulation class	H (180°C [356°F])
Voltage variation	Max. +/- 10%
Voltage imbalance between the phases	2%

Motor encapsulation

Motor encapsulation is in accordance with IP68.

2.3 Monitoring systems

The pump is designed to be used with the following monitoring systems:

- MAS 801
- MAS 711

2.3.1 Comparison of MAS 801 and MAS 711

Drive units up to 1 kV

Description		MAS 801	MAS 711
Signal cable		Built into the motor cable.	Separate signal cable(1), with 12 or 24 leads, is needed.
PEM		Standard	N/A
Pump current, 1 phase		Standard	A current transformer in the control cabinet is needed.
Pump current, 3 phase		A current transformer in the control cabinet is needed.	A current transformer in the control cabinet is needed.
Power monitoring	PAN 312	Optional. Separate electronic instrument with three current transformers.	
Vibration in three directions	Micro electro mechanical sensor (MEMS) built into PEM	Standard	N/A
Vibration in one direction	VIS 10	N/A	Optional (2)

Description		MAS 801	MAS 711
Leakage in the junction box	Float switch leakage sensor, FLS	Standard	Standard
Stator winding temperature in one phase	Pt100 analog temperature sensor in one stator winding	Standard	Standard
Stator winding temperature Thermal contacts or PTC thermistors	Thermal contacts (3)	Standard	Standard
	PTC thermistors (3)	Optional	Optional
Stator winding temperature in phases 2 and 3	Pt100 analog temperature sensors in two more stator windings	Optional	Optional (2)
Main bearing temperature	Pt100 analog temperature sensor	Standard	Standard
Leakage in the stator housing or inspection chamber	Float switch leakage sensor (FLS)	Standard	Standard
Water in oil: Not applicable for EX drive units, or drive units with internal closed-loop cooling.	Capacitive leakage sensor (CLS)	Optional	Optional (2)
Support bearing temperature	Pt100 analog temperature sensor	Optional	Optional (2)
Pump memory		Included in PEM	Standard

(1) Also known as auxiliary, control, or pilot cable.

(2) The signal cable must have 24 leads.

Drive units 1.2–6.6 kV

Description		MAS 801	MAS 711
Signal cable		Built into the motor cable.	Separate signal cable(1), with 24 leads, is needed.
PEM		Standard	N/A
Pump current, 1 phase		Standard	A current transformer in the control cabinet is needed.
Pump current, 3 phase		A current transformer in the control cabinet is needed.	A current transformer in the control cabinet is needed.
Power monitoring	PAN 312	Optional. Separate electronic instrument with three current transformers.	
Vibration in three directions	Built into PEM	Standard	N/A
Vibration in one direction	VIS 10	N/A	Optional
Leakage in the junction box	Float switch leakage sensor (FLS)	Standard	Standard
Stator winding temperature	PTC thermistors: 3+3 (3)	Standard	Standard
Stator winding temperature in phases 1, 2 and 3	Pt100 analog temperature sensors in each stator winding: 3+3 (3)	Standard	Standard
Main bearing temperature	Pt100 analog temperature sensor	Standard	Standard
Leakage in the stator housing	Float switch leakage sensor (FLS)	Standard	Standard

Description		MAS 801	MAS 711
Water in oil: Not applicable for EX drive units, or drive units with internal closed-loop cooling.	Capacitive leakage sensor (CLS)	Optional	Optional
Support bearing temperature	Pt100 analog temperature sensor	Optional	Optional
Pump memory		Included in PEM	Standard
(1) Also known as auxiliary, control, or pilot cable. (3) 6 total: 3 sensors are connected and 3 are built-in spares.			

Stator winding temperature

MAS 801 and MAS 711 offer the same monitoring configurations for stator winding temperature. They are shown in the following table.

Table 7: Stator winding temperature, monitoring configurations

Drive units	Sensors in coil ends of stator windings	Additional sensors, which are incorporated in the stator windings:	
		Always present	Extra option
Up to 1 kV	One of the following choices: • Standard: 3 thermal contacts • Optional: 3 PTC thermistors	Standard: Pt100 analogue temperature sensor in 1 stator winding	Optional: Pt100 analogue temperature sensors in 2 more stator windings
1.2–6.6 kV	PTC thermistors (3+3) 3 sensors are connected in series, and 3 are built-in reserves.	Pt100 analogue temperature sensors in all 3 stator windings (3+3) Each winding has 1 sensor that is connected, and one sensor that is a built-in reserve.	

2.4 Monitoring with MAS 801

Pumps with the standard MAS 801 equipment are mounted with the following items:

- Thermal contacts or PTC thermistors for stator winding temperature monitoring (3 in series)
- Leakage sensor in the stator housing
- Leakage sensor in the junction box
- Pt100 sensor for main bearing temperature monitoring
- Pt100 sensor for stator winding temperature in one phase
- Vibration in three directions
- Current transformer for pump current and frequency measurement

The following options are possible with MAS 801:

- Pt100 sensors for stator winding temperature measurement in phases 2 and 3
- Pt100 sensor for support bearing temperature measurement
- Leakage sensor in the oil housing (CLS)

Optional monitoring channels by using power analyzer PAN 312

- Three-phase power
- Power factor
- System voltage
- Voltage imbalance
- Pump current
- Current imbalance

2.4.1 System overview

The MAS 801 is a monitoring system that protects the pumps, by using measurements from pump sensors and measurement modules. The system offers considerable functionality for the benefit of different user categories:

- A graphical user interface, the configuration and analysis tool, for computer and HMI
- Local and remote presentation of pump status, key data, and alarms
- Analysis and troubleshooting that is based on graph functions, alarm lists, and black boxes
- Service reminders and reporting
- Configuration of the system and monitoring channels
- Protocols for communication with external automation electronics, SCADA, and cloud applications

The system consists of a central unit a base unit, a pump electronic module, and an HMI.

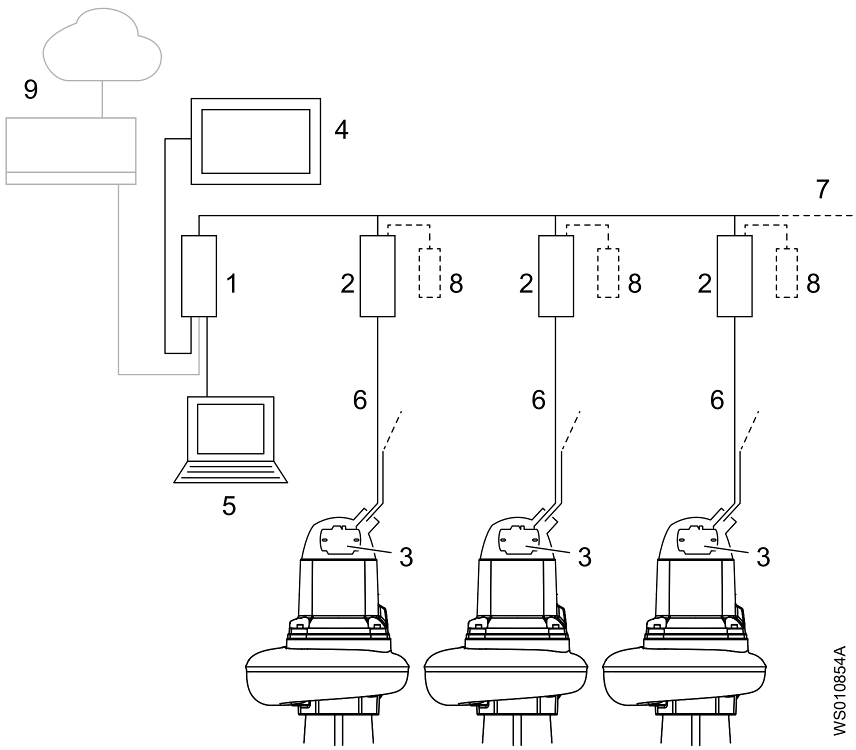


Table 8: Parts

Number	Part	Product name	Description
1	Central unit (CU)	MAS CU 801	The central unit communicates with all base units in the system, up the maximum ten base units. The central unit includes the configuration and analysis tool, embedded webpages, that is used to interact in the system. The central unit is typically installed in an electrical cabinet.
2	Base unit (BU)	MAS BU 811	The base unit communicates data between the pump electronic module and the central unit. If needed, for pump protection, the base unit stops the pump. The base unit is typically installed in an electrical cabinet.
3	Pump electronic module (PEM)	MAS PEM 811	The pump electronic module communicates with the base unit and contains factory settings, specific to the individual pump. It is connected to the pump sensors and stores measured data. The pump electronic module is mounted in the pump junction box.

Number	Part	Product name	Description
4	Human-machine interface (HMI)	FOP 402	The HMI is connected to the central unit and displays the configuration and analysis tool, for user interaction. The HMI is typically front-mounted in an electrical cabinet door.
5	Computer	-	A computer can be connected to the central unit locally or remotely, and displays the configuration and analysis tool, for user interaction.
6	Two-wire communication	-	Bus communication between the pump electronic module and the base unit in a SUBCAB® cable. The bus communication is tolerant to electromagnetic interference.
7	DeviceNet	-	Communication bus connecting the central unit with base units.
8	Power analyzer, optional	PAN 312	Measures power, power factor, current in three phases, voltage in three phases, voltage imbalance, energy
9	Controller SCADA system	-	Not part of the MAS 801 system. MAS 801 uses open protocol for communication with external controller or SCADA systems.

Communication

Measurements and pump information are transmitted over the two wires from each pump electronic module. The data goes through the base unit and further on to the central unit over the DeviceNet bus. This way two equal databases (CU and PEM) of pump information are continually updated securing redundancy and providing different access possibilities.

2.5 Monitoring with MAS 711

With the Flygt MAS 711 monitoring system, the parameters that are tracked can include the following:

- Temperature: main and support bearings, stator windings
- Vibration
- Leakage: in stator housing, junction box, and water into oil chamber
- Power monitoring

Table 9: Parameters monitored

Description	Sensor	Standard or optional
Pump memory	Printed circuit board for pump memory includes a temperature sensor.	Standard
Leakage in the junction box	Float switch leakage sensor, FLS	Standard
Main bearing temperature	Pt100 analogue temperature sensor	Standard
Leakage in the stator housing	Float switch leakage sensor, FLS	Standard
Stator winding temperature	See the following table.	Standard
Support bearing temperature	Pt100 analogue temperature sensor	Optional
Water in oil	Capacitive leakage sensor (CLS)	Optional
Vibration	VIS 10	Optional
Power monitoring	Separate electronic instrument which uses three current transformers.	Optional
Pump current	A current transformer in the control cabinet is required.	

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

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Visit our Web site for the latest version of this document and more information

The original instruction is in English. All non-English instructions are translations of the original instruction.

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PUMP O&M

xylem
Let's Solve Water

Installation, Operation, and Maintenance Manual

887390_5.0

L3356, L3400, L3602

FLYGT
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Table of Contents

1 Introduction and Safety

1.1 Introduction

Purpose of the manual

The purpose of this manual is to provide necessary information for working with the unit. Read this manual carefully before starting work.

Read and keep the manual

Save this manual for future reference, and keep it readily available at the location of the unit.

Intended use

WARNING:

Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment and the surroundings. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.

Other manuals

See also the safety requirements and information in the original manufacturer's manuals for any other equipment furnished separately for use in this system.

1.2 Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

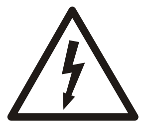
- Personal accidents and health problems
- Damage to the product and its surroundings
- Product malfunction

Hazard levels

Hazard level	Indication
DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	Notices are used when there is a risk of equipment damage or decreased performance, but not personal injury.

Special symbols

Some hazard categories have specific symbols, as shown in the following table.

Electrical hazard	Magnetic fields hazard
 **Electrical Hazard:**	 **CAUTION:**

1.3 User safety

All regulations, codes, and health and safety directives must be observed.

The site

- Observe lockout/tagout procedures before starting work on the product, such as transportation, installation, maintenance, or service.
- Pay attention to the risks presented by gas and vapors in the work area.
- Always be aware of the area surrounding the equipment, and any hazards posed by the site or nearby equipment.

Qualified personnel

This product must be installed, operated, and maintained by qualified personnel only.

Protective equipment and safety devices

- Use personal protective equipment as needed. Examples of personal protective equipment include, but are not limited to, hard hats, safety goggles, protective gloves and shoes, and breathing equipment.
- Make sure that all safety features on the product are functioning and in use at all times when the unit is being operated.

1.4 Ex-approved products

Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and Xylem-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, IEC/EN 60079-17).

Xylem disclaims all responsibility for work done by untrained and unauthorized personnel.

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during operation. The volute must be filled with liquid during operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.

- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an Ex-approved Xylem representative.
- Only use original Xylem spare parts that are provided by an Ex-approved Xylem representative.
- The thermal detectors that are fitted to the stator windings must be connected correctly to a separate motor control circuit and in use. The detectors disconnect the power supply to the motor timely. This action prevents the rise of temperatures above the temperature value for the approval classification.
- The width of flameproof joints is more than the values specified in the tables of the IEC 60079–1 standard.
- The gap of flameproof joints is less than the values specified in Table 1 of the IEC 60079–1 standard.
- The flameproof joints are NOT intended to be repaired.

Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an Ex-approved Xylem representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079–14).

Minimum permitted liquid level

See the dimensional drawings of the product for the minimum permitted liquid level according to the approval for explosion proof products. If the information is missing on the dimensional drawing, the product must be fully submerged. Level-sensing equipment must be installed if the product can be operated at less than the minimum submersion depth.

Monitoring equipment

For additional safety, use condition-monitoring devices. Examples of condition-monitoring devices include, but are not limited to, the following:

- Level indicators
- Temperature detectors in addition to the stator thermal detectors

Any thermal detectors or thermal protection devices delivered with the pump must be installed and in use at all times.

1.5 Special hazards

1.5.1 Biological hazards

The product is designed for use in liquids that can be hazardous to your health. Observe these rules when you work with the product:

- Make sure that all personnel who may come into contact with biological hazards are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.

WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

1.5.2 Wash the skin and eyes

Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Chemicals or hazardous fluids on skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.6 Protecting the environment

Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities
- Sorting, recycling and disposal of solid or liquid waste
- Clean-up of spills

Exceptional sites

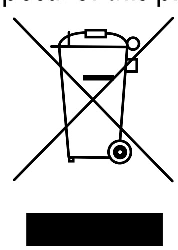
CAUTION: Radiation Hazard

Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

1.7 End of life product disposal

Handle and dispose of all waste in compliance with local laws and regulations.

EU only: Correct disposal of this product — WEEE Directive on waste electrical and electronic equipment



WS009973A

This marking on the product, accessories or literature indicates that the product should not be disposed of with other waste at the end of its working life.

To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

Waste from electrical and electronic equipment can be returned to the producer or distributor.

1.8 Spare parts

CAUTION:

Only use the manufacturer’s original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the warranty.

1.9 Warranty

For information about warranty, see the sales contract.

2 Transportation and Storage

2.1 Examine the delivery

2.1.1 Examine the package

1. Examine the package for damaged or missing items upon delivery.
2. Record any damaged or missing items on the receipt and freight bill.
3. If anything is out of order, then file a claim with the shipping company.

   If the product has been picked up at a distributor, make a claim directly to the distributor.

2.1.2 Examine the unit

1. Remove packing materials from the product.

   Dispose of all packing materials in accordance with local regulations.
2. To determine whether any parts have been damaged or are missing, examine the product.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.

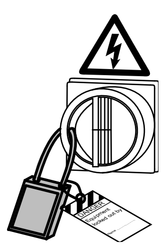
   Use care around nails and straps.
4. If there is any issue, then contact a sales representative.

2.2 Transportation guidelines

2.2.1 Precautions

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



Position and fastening

The unit can be transported either horizontally or vertically. Make sure that the unit is correctly fastened during transportation, and cannot roll or fall over.

Horizontal position

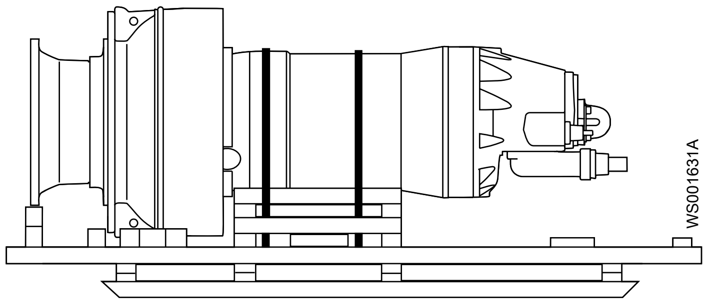


Figure 1: Horizontal position for transport

If the unit is transported in the horizontal position, then the propeller must be locked during transportation.

Vertical position

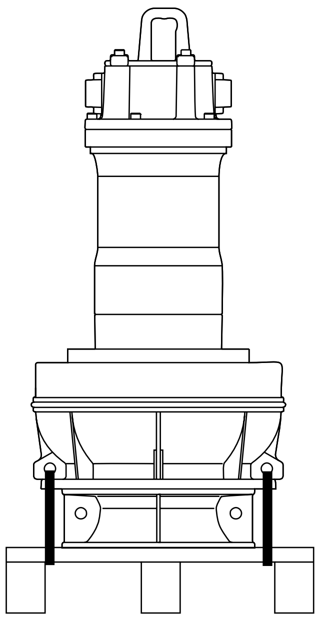


Figure 2: Vertical position for transport

The impeller or propeller must also be locked during transportation. Units with drive units 605, 615, 665 or 675 are not equipped with the locking device.

2.2.2 Lifting

Always inspect the lifting equipment and tackle before starting any work.

WARNING: Crush Hazard

1) Always lift the unit by its designated lifting points. 2) Use suitable lifting equipment and ensure that the product is properly harnessed. 3) Wear personal protective equipment. 4) Stay clear of cables and suspended loads.

NOTICE:

Never lift the unit by its cables or hose.

Lifting equipment

Lifting equipment is always required to handle the unit. The lifting equipment must fulfill the following requirements:

- The minimum height between the lifting hook and the floor must be sufficient to lift the unit. Contact a Xylem representative for more information.
- The lifting equipment must be able to hoist the unit straight up and down, preferably without the need for resetting the lifting hook.
- The lifting equipment must be correctly anchored and in good condition.
- The lifting equipment must support the weight of the entire assembly. Only authorized personnel may use the lifting equipment.
- Two sets of lifting equipment must be used to lift the unit for repair work.
- The lifting equipment must be dimensioned to lift the unit with any remaining pumped media in it.
- The lifting equipment must not be oversized.

CAUTION: Crush Hazard

Over-dimensioned lifting equipment can lead to injury. A site-specific risk analysis must be done.

2.2.3 Lifting link placement for vertical lifting

Use the following lifting link configurations to lift the pump in the vertical position.

The arrow indicates placement of the lifting link when lifting the drive unit only, or the complete unit, with 605–675 drive units.

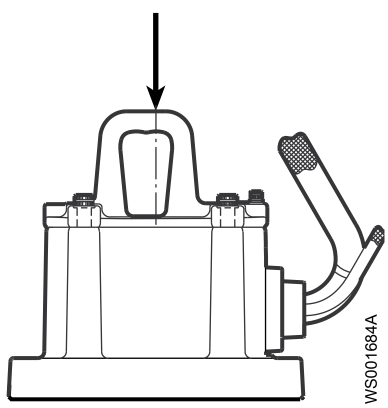


Figure 3: Drive units 605–675

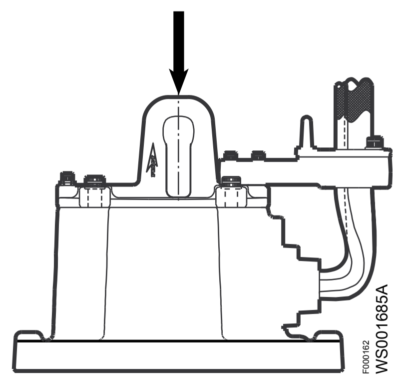
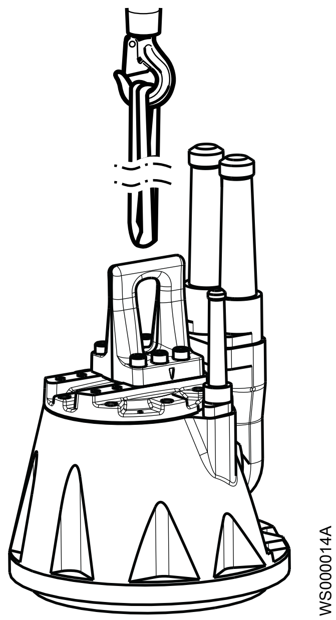
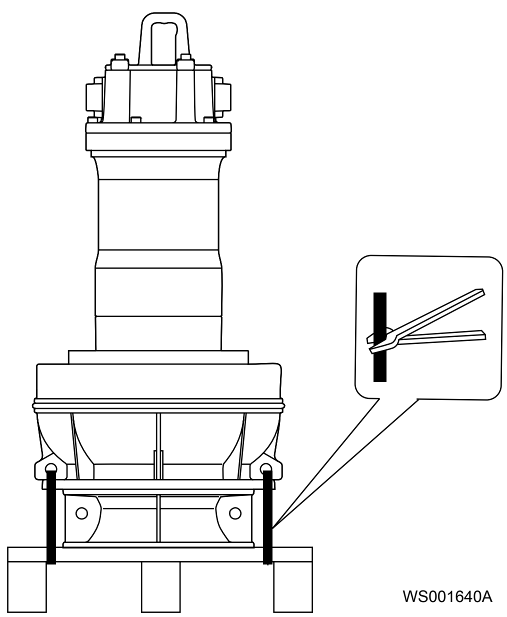


Figure 4: Drive units 705–776

Figure 5: Drive units 805–998 For 805–998 drive units, the lifting link must be put so that the complete unit hangs forward with an incline of 0–2° in relation to the vertical axis.	

2.2.4 Lift pump from vertical position and remove transport pallet

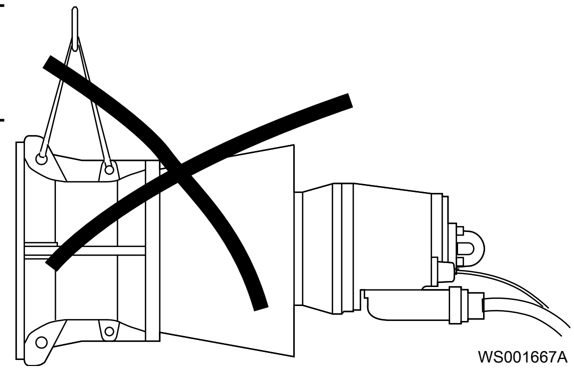
1. Fit a lifting strap or sling to the lifting eye on the top of the drive unit.
2. Cut the transportation strap.



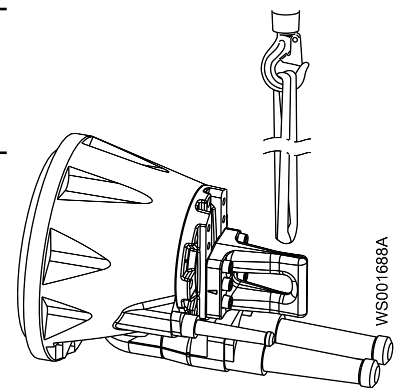
3. Lift the pump with correct lifting equipment.
4. Put the pump upright on a rigid horizontal surface so that it cannot fall over.

2.2.5 Lift pump from horizontal position and remove transport pallet

NOTICE:
An assembled pump must never be lifted by the holes in the hydraulic unit.



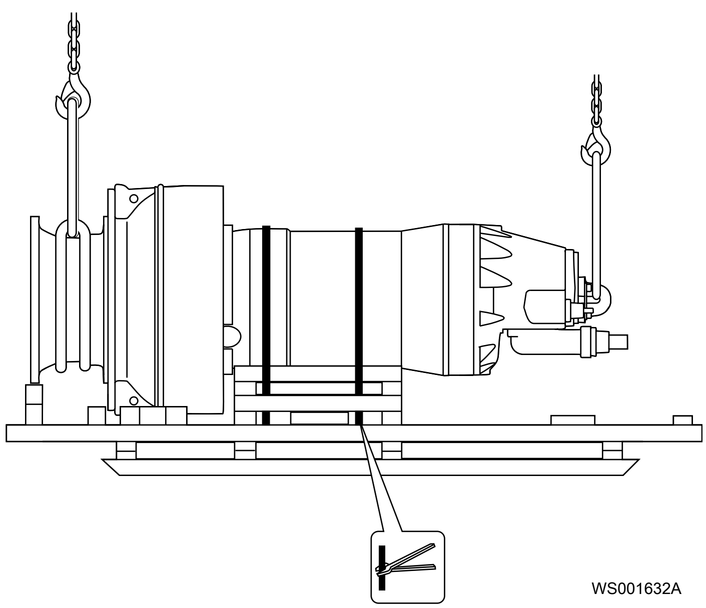
NOTICE:
When handling the unit to and from horizontal position, the unit should always be lifted by the lifting link. Use a suitable lifting sling/strap.



Lift with two lifting devices (recommended)

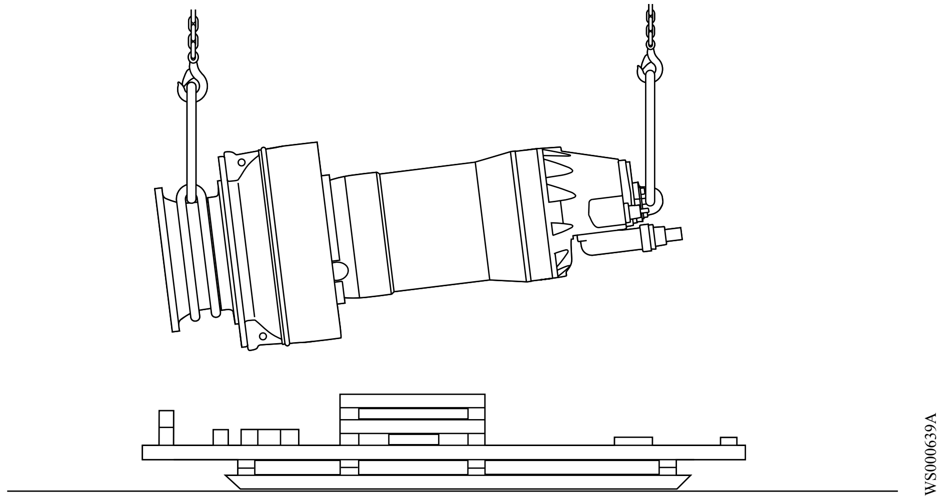
1. Attach a lifting sling or strap to the lifting eye on the top of the drive unit. Attach the sling to the first lifting device.

   See *Lifting* on page 9.
2. Attach a sling around the hydraulic unit. Attach the sling to the second lifting device.



3. Remove the straps securing the unit to the transport pallet.

   The transport pallet is custom-made for the pump and can be stored for future use.
4. Lift the unit.



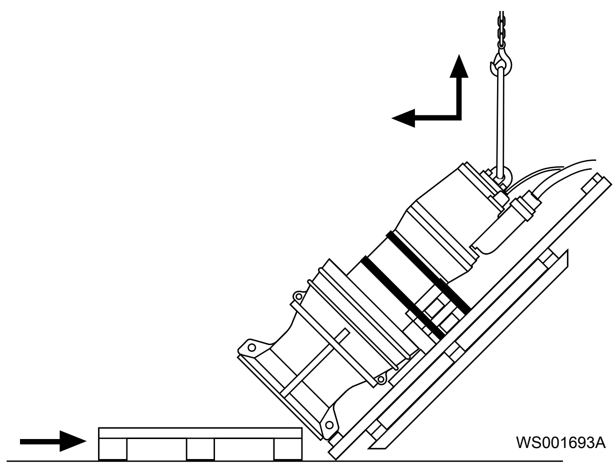
5. Put the unit upright on a rigid horizontal surface so that it cannot fall over.

Lift with one lifting device

1. Attach a lifting sling or strap to the lifting eye on the top of the drive unit.
2. Lift the unit until it is halfway upright.

   The unit is attached to the transport pallet at this point.
3. Slide a pallet or similar object under the inlet section.

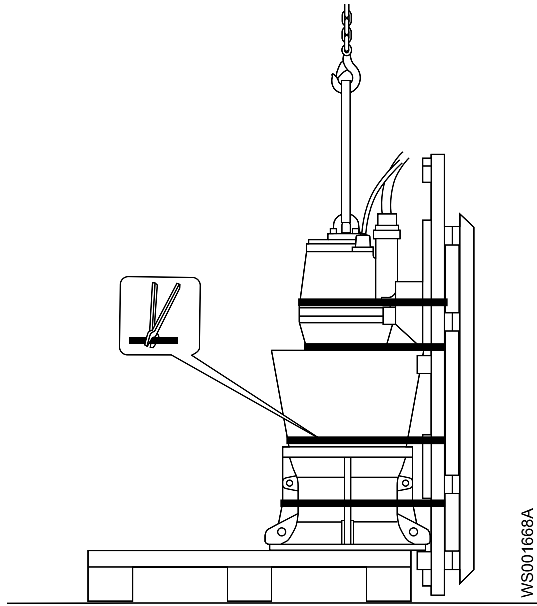
   The pallet minimizes the jolt which can occur later in the lifting, when the unit is almost fully upright.



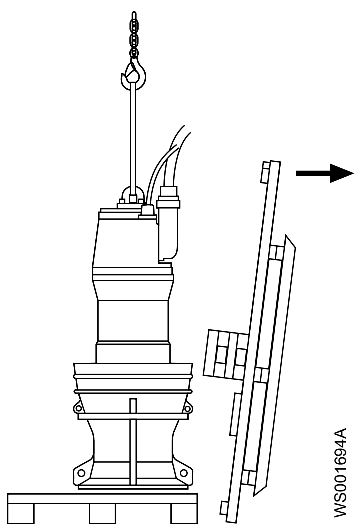
4. Continue raising the unit until it is upright.

   The unit can jolt or sway near the end of the lifting operation.
5. Remove the straps holding the unit to the transport pallet.

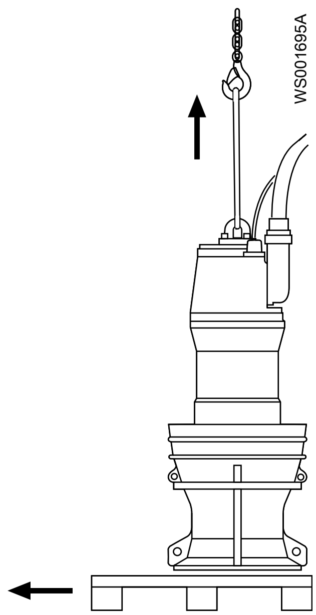
Location of straps can vary. Figure shows a generic impeller or propeller unit.



6. Remove the transport pallet.
   The transport pallet is custom-made for the pump and can be stored for future use.



7. Lift the unit and remove the support pallet.



8. Put the unit upright on a rigid horizontal surface so that it cannot fall over.

2.3 Temperature ranges for transportation, handling and storage

Handling at freezing temperature

At temperatures below freezing, the product and all installation equipment, including the lifting gear, must be handled with extreme care.

Make sure that the product is warmed up to a temperature above the freezing point before starting up. Avoid rotating the impeller/propeller by hand at temperatures below the freezing point. The recommended method to warm the unit up is to submerge it in the liquid which will be pumped or mixed.

NOTICE:

Never use a naked flame to thaw the unit.

Unit in as-delivered condition

If the unit is still in the condition in which it left the factory - all packing materials are undisturbed - then the acceptable temperature range during transportation, handling and storage is: –50°C (–58°F) to +60°C (+140°F).

If the unit has been exposed to freezing temperatures, then allow it to reach the ambient temperature of the sump before operating.

Lifting the unit out of liquid

The unit is normally protected from freezing while operating or immersed in liquid, but the impeller/propeller and the shaft seal may freeze if the unit is lifted out of the liquid into a surrounding temperature below freezing.

Follow these guidelines to avoid freezing damage:

1. Empty all pumped liquid, if applicable.
2. Check all liquids used for lubrication or cooling, both oil and water-glycol mixtures, for the presence of unacceptable amounts of water. Change if needed.

Water-glycol mixtures: Units equipped with an internal closed-loop cooling system are filled with a mixture of water and 30% glycol. This mixture remains a flowing liquid at temperatures down to –13°C (9°F). Below –13°C (9°F), the viscosity increases such that the glycol mixture will lose its flow properties. However, the glycol-water mixture will not solidify completely and thus cannot harm the product.

2.4 Storage guidelines

Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

NOTICE:

Protect the product against humidity, heat sources, and mechanical damage.

NOTICE:

Do not place heavy weights on the packed product.

Freezing precautions

The unit is frost-proof while operating or immersed in liquid, but the impeller/propeller and the shaft seal may freeze if the unit is lifted out of the liquid into a surrounding temperature below freezing.

Follow these guidelines to avoid freezing damage:

When	Guideline
Before storage	• The unit must be allowed to run for a short time after raising it to discharge remaining pumped liquid. This does not apply to impeller/propeller units. • The discharge opening must be covered in a suitable way, or placed facing down so that any still remaining pumped liquid runs out. • If present, the cooling jacket must be drained manually by opening the air vent screws at the top of the cooling jacket.
After storage	If the impeller/propeller is frozen, it must be thawed by immersing the unit in liquid before operating the unit. NOTICE: Never use a naked flame to thaw the unit.

Long-term storage

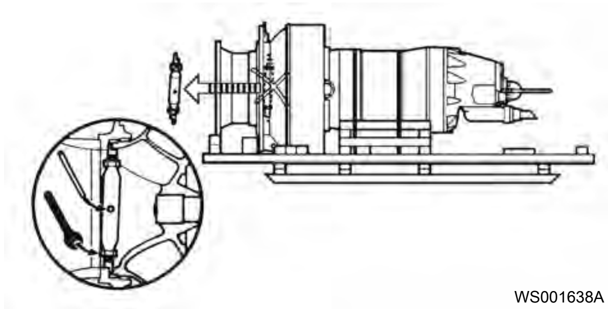
If the unit is stored more than six months, then the following apply:

- Before operating the unit after storage, it must be inspected with special attention to the seals and the cable entry.
- The impeller/propeller must be rotated every other month to prevent the seals from sticking together.

2.4.1 Reinstall the locking device

If the unit is transported in the horizontal position, then the impeller or propeller must be locked with the locking device during the transport.

1. Reinstall the locking device.



2. Clamp the locking device in place by turning and locking it by hand as tightly as possible.
3. For pumps with 700–, 800– and 900–series drive units: Tighten a further 1/6 to 1/3 of a turn according to the torque specified in the cross-sectional drawing in the Part List.

3 Product Description

3.1 Pump design

Intended Use

The product is intended for moving wastewater, sludge, raw and clean water. Always follow the limits that are given in *Application limits* on page 98. If there is a question regarding the intended use of the equipment, then contact a Xylem representative before proceeding.

DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is EN/ATEX-, MSHA- or FM-approved, then see the specific EX information in the Safety chapter before taking any further actions.

NOTICE:

Do NOT use the unit in highly corrosive liquids.

3.1.1 Spare part requirements

The following applies when the unit is serviced or repaired:

- Modifications to the unit or installation must only be carried out after consulting with Xylem.
- Original spare parts and accessories that are authorized by Xylem are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation. For more information, contact a Xylem representative.

3.2 Drive units

L3356

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	605	615	15
	665	675	15
Up to 1 kV	705	715	15
	735	745	15
	765	775	15
Up to 1 kV	706	716	10
	736	746	10
	766	776	10

L3400

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	705	715	15
	735	745	15
	765	775	15

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	706	716	10
	736	746	10
	766	776	10
Up to 1 kV	805	815	15
	835	845	15
	865	875	15
Up to 1 kV	806	816	10
	836	846	10
	866	876	10
1.2–6.6 kV	862	872	15
	882	892	10
1.2–6.6 kV	863	873	10
	883	893	10

L3602

Voltage range	Standard drive units	Ex-proof drive units	Maximum number of starts per hour
Up to 1 kV	735	745	15
	765	775	15
Up to 1 kV	736	746	10
	766	776	10
Up to 1 kV	805	815	15
	835	845	15
	865	875	15
Up to 1 kV	806	816	10
	836	846	10
	866	876	10
Up to 1 kV	905	915	10
	935	945	10
Up to 1 kV	906	916	10
	936	946	10
1.2–6.6 kV	862	872	15
	882	892	10
1.2–6.6 kV	863	873	10
	883	893	10

3.3 The MAS 801 monitoring equipment

3.3.1 FLS: float switch sensor

The float switches are leakage sensors.

The float switches are located in the lower part of the stator housing and in the junction box.

3.3.2 Vibration in three directions

A vibration sensor that is located in the PEM measures vibration speed in three directions.

Two adjustable alarm limits can be applied for each measurement direction:

- Early warning: “B”-alarm
- Pump stop: “A”-alarm

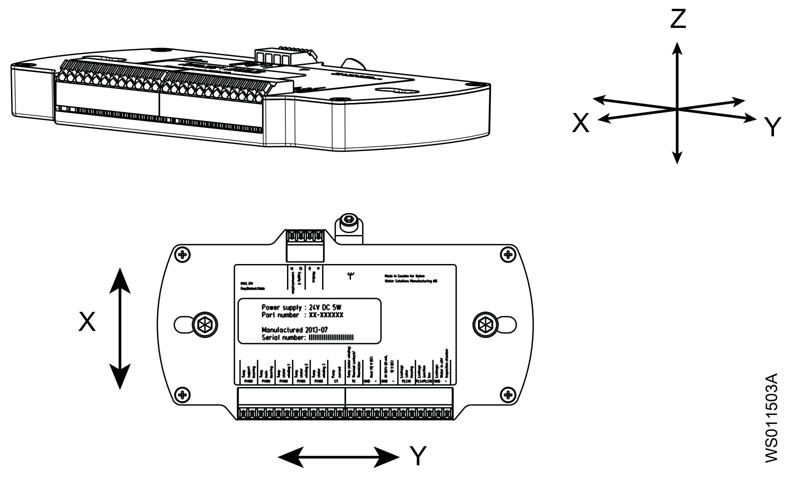


Figure 6: Vibration directions with reference to the PEM

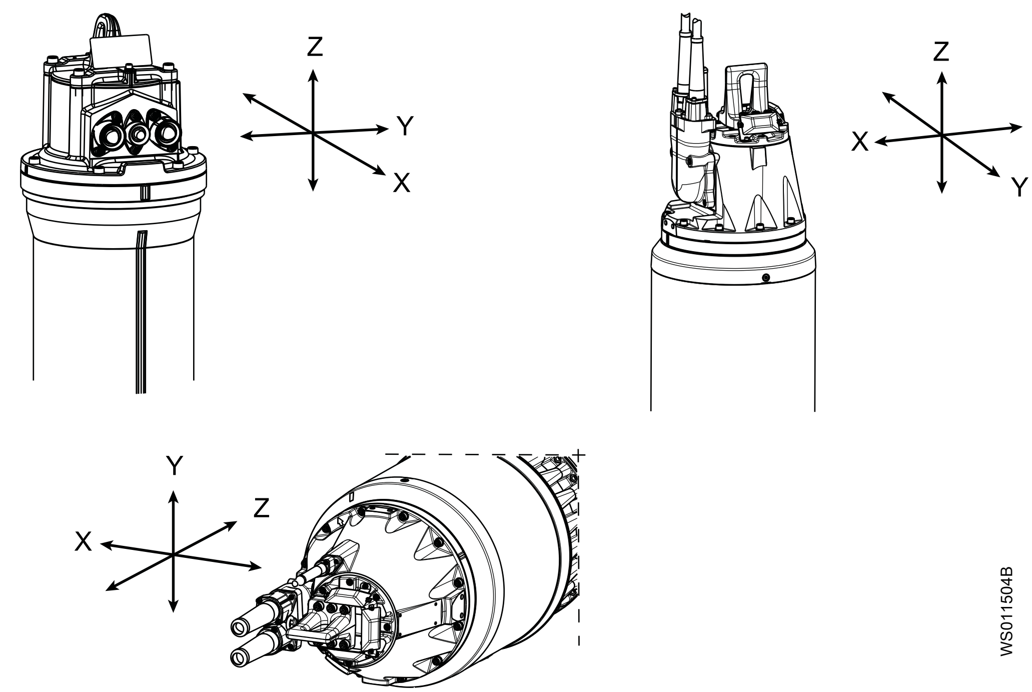


Figure 7: Vibration directions with reference to the pump

3.3.3 Bearing temperature measurement

Pt100 sensors monitor the bearing temperatures to protect the pump from the consequences of a bearing failure.

Main bearing

Main bearing temperature monitoring is standard in the MAS 711 and MAS 801. The Pt100 sensor is pressed by a spring against the outer ring of the ball bearing.

Support bearing

Support bearing temperature monitoring is an option in the MAS 711 and MAS 801. The Pt100 sensor is pressed by a spring against the outer ring of the roller bearing.

Alarms

Two adjustable alarm limits can be used:

- Early warning: "B"-alarm
- Pump stop: "A"-alarm

3.3.4 Stator temperature monitoring methods

The purpose of stator winding temperature monitoring is to make the motor shut off at high temperature. There are several monitoring methods, depending on the voltage of the motor, and types of thermal sensors chosen.

By using an analogue sensor, two adjustable alarm limits can be used, one for warning ("B"-alarm) and one for pump stop ("A"-alarm). The configurations which can be used for monitoring the stator winding temperature depend upon the voltage range of the drive unit. See *Drive units* on page 18 for the voltage range for each drive unit.

Up to 1 kV drive units

Table 1: Stator temperature monitoring configuration, up to 1 kV

Standard / Optional	Monitoring configuration description
Standard	• Three thermal contacts, connected in series, are incorporated in the coil ends of the stator winding. The contacts are normally closed, and open at 140°C (285°F). • One Pt100 sensor is incorporated in one of the windings.
	Or:
	• Three thermistors, PTC, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=140°C (285°F). • One Pt100 sensor is incorporated in one of the windings.
Optional	• Three thermal contacts, connected in series, are incorporated in the coil ends of the stator winding. The contacts are normally closed, and open at 140°C (285°F). • Three Pt100 sensors, one for each phase, are incorporated in the windings.
	Or:
	• Three thermistors, PTC, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=140°C (285°F). • Three Pt100 sensors, one for each phase, are incorporated in the windings.

1.2–6.6 kV drive units

Table 2: Stator temperature monitoring configuration, 1.2–6.6 kV

Standard / Optional	Monitoring configuration description
Standard	This configuration uses the following: • Three thermistors, PTC, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=155°C (310°F) for medium-voltage drive units • Three Pt100 sensors, one for each phase, are incorporated in the windings. There are three extra thermistors, and three extra Pt100 sensors, already in position in the stator windings as reserves.

Stators used in the 1.2–6.6 kV drive units are equipped with three Pt100 sensors marked 19:20, 21:22, and 23:24. These sensors are connected at the plinth on the terminal plate. The stator is also equipped with a duplicate set of three Pt100 sensors, marked 19s:20s, 21s:22s, and 23s:24s. The duplicate set is not connected to the terminal plate as long as the first set of three Pt100 sensors function; it is kept in reserve as a back-up set. The ends of the reserve sensor leads are isolated, and leads bundled among the other cables, until the back-up Pt100 sensors are needed.

For pumps with drive units in voltage range 1.2–6.6 kV, the medium-voltage stator settings are shown in the following table.

Table 3: Stator alarm settings for 1.2-6.6 kV drive units

Stator Alarm	Setting
A	155°C
B	145°C

3.3.4.1 Temperature sensors

Table 4: Thermal contact

Description	Measured value	Fault values
The thermal contact is a normally closed contact.	0–3 ohm, unless the wires are long.	An infinite value (open circuit) indicates either high temperature or a fault. Examples of faults include a broken wire, or a bad contact in a connector.

Table 5: PTC thermistor

Description	Measured value	Fault values
The PTC thermistor is a semiconductor device.	Resistance at normal temperature: • 50–100 ohm (150–300 ohm for three in series).	• Above the tripping point, T_{Ref}, the resistance increases dramatically to several kilohm. • An infinite value (open circuit) indicates a fault. Examples of faults include a broken wire, or a bad contact in a connector. • A value close to zero indicates a short circuit in the wiring.

Table 6: Pt100 sensor

Description	Measured value	Fault values
The Pt100 sensor is a resistor changing value almost linearly with temperature.	Resistance: • 100 ohm at 0°C (32°F) • 107.79 ohm at room temperature (20°C, 68°F) • 138.5 ohm at 100°C (212°F) For resistance data between 0–160°C (32–320°F), see *Pt100 resistance* on page 99.	> 200 ohm (approximate) can indicate the following situations: • Broken sensor • Bad contact • Broken lead < 70 ohm (approximate) indicates: • Short circuit

NOTICE:

Never connect the Pt100 transducer to a voltage higher than 2.5 V.

For information on the various configurations of contacts, thermistors and sensors that are used to monitor stator winding temperature, see *Stator temperature monitoring methods* on page 26.

3.3.5 Pump current and power monitoring

Pump current

Pump current is an important parameter in itself, which the MAS 801 can also use to record running time, number of starts and other operating diagnostics. This information is fundamental for monitoring operation, maintenance planning, and fault diagnosis.

Pump current in one phase is standard with the MAS 801.

Pump current in three phases

Pump current in three phases is also possible with the MAS 801. To track pump current in three phases with the MAS 801, the following are needed:

- Three current transformers in the control cabinet
- The PAN 312 power analyzer

The current transformers are connected to the PAN 312. The PAN 312 transmits the data to the CU and the PEM in the MAS 801 system.

Power monitoring: PAN 312

The optional Flygt power analyzer PAN 312 allows the following parameters to be monitored:

- Three-phase power
- Power factor
- System voltage
- Voltage imbalance
- Pump current in three phases
- Current imbalance

3.3.6 CLS

This section applies to the following drive units:

- 605, 665
- 705, 735, 765
- 805, 835, 865, 885
- 862, 882
- 905, 935, 965
- 950, 985, 988

Table 7: Water-in-oil sensor (CLS)

Description	Measured value	Fault values
Capacitive leakage sensor located in the oil housing. This sensor issues an alarm if the water content reaches a concentration of approximately 30% or more.	Standard drive unit only. CLS must be connected to 12 V DC with correct polarity (+/–).	See table below.

CLS alarm is not a cause for stopping the pump. It is merely an indicator to check the oil and outer seal at the next planned service.

Table 8: CLS current measurements

Measuring result	Explanation
0 mA	Can indicate one of the following conditions: • The sensor has the wrong polarity. Check by changing plus and minus. • The cable/lead is broken.
4.0 to 8.0 mA	OK
27 to 33 mA	Alarm current
> 33 mA	Short circuit

3.4 The MAS 711 monitoring equipment

The MAS 711 system

MAS 711 (Monitoring and Status) is a monitoring system for Flygt pumps. It monitors and stores measurements from a number of sensors (temperature, leakage, and vibration). These are used to:

- Protect the pump by raising an alarm when undesirable events occur.
- Track operational data.

Alarm levels can be set so that the operator is notified when an alarm event has occurred. Depending on the alarm/event configuration, the MAS 711 system may stop the pump.

The base unit stores all measurement data on its embedded server.

The system also includes a pump memory module, storing identity data of the pump.

The parameters that are tracked are chosen by the customer, and may include the following:

- Temperature:
  - Main bearing
  - Support bearing
  - Stator winding
- Vibration
- Leakage:
  - In the stator housing or inspection chamber
  - In the junction box
  - Water in the oil chamber (if applicable)
- Power monitoring

For more information, see the MAS 711 Installation and User Manual.

Pump current

Pump current is an important parameter in itself, which the MAS 711 can also use to record running time, number of starts and other operating diagnostics.

Pump current is not measured using the 12/24 lead monitoring cable. To measure it, the control cabinet must be equipped with a current transformer. Alternatively the Flygt power analyzer PAN 312 is used, requiring three transformers. The measurement results are transmitted to MAS 711 over a serial link (Modbus).

This information is fundamental for monitoring operation, maintenance planning, and fault diagnosis.

Signal cables

The pump is delivered with the signal cable (also known as “auxiliary,” “control” or “pilot” cable) mounted. The following SUBCAB signal cables are available:

- 12x1.5 mm^2 (unscreened, also known as unshielded). Conductors 1-12.
- 24x1.5 mm^2 (unscreened, also known as unshielded). Conductors 1-24.
- S12x1.5 mm^2 (screened, also known as shielded). Conductors 1-12.
- S24x1.5 mm^2 (screened, also known as shielded). Conductors 1-24.

The number of conductors that are required to connect the sensors to the monitoring system depends on the number and type of sensors being used. Medium-voltage (1.2–6.6 kV) drive units always have 24 signal cable leads.

Sensors, drive units up to 1 kV

The drive units in this voltage range are shown in *Drive units* on page 18.

Table 9: Sensors for pumps using drive units up to 1 kV

Parameter Monitored	Sensor	Signal Cable, Number of Leads Required	Standard or Optional
Vibration	VIS 10	24	Optional
Leakage in the junction box	Float switch leakage sensor (FLS)	12	Standard
Stator winding temperature in one phase	Pt100 analog temperature sensor in one stator winding	12	Standard
Stator winding temperature	Thermal contacts (3), or	12	Standard
	PTC-thermistors (3)	24	Optional

Parameter Monitored	Sensor	Signal Cable, Number of Leads Required	Standard or Optional
Stator winding temperature in phases 2 and 3	Pt100 analog temperature sensors in two additional stator windings	24	Optional
Main bearing temperature	Pt100 analog temperature sensor	12	Standard
Leakage in the stator housing or inspection chamber	Float switch leakage sensor (FLS)	12	Standard
Water in oil: standard drive units only. (Not applicable for drive units with internal closed-loop cooling.)	Capacitive leakage sensor (CLS)	24	Optional
Support bearing temperature	Pt100 analog temperature sensor	24	Optional
Pump memory	Printed circuit board for pump memory includes a temperature sensor.	12	Standard
Pump current	A current transformer in the control cabinet is required.		
Power monitoring	Separate electronic instrument using three current transformers.		Optional

For more information on the stator temperature monitoring, see *Stator temperature monitoring methods* on page 26.

Sensors, drive units 1.2 – 6.6 kV

The drive units in this voltage range are shown in *Drive units* on page 18.

Table 10: Sensors for pumps using 1.2 – 6.6 kV drive units

Description	Sensor	Signal Cable, Number of Leads Required	Standard or Optional
Vibration	VIS 10	24	Optional
Leakage in the junction box	Float switch leakage sensor (FLS)	24	Standard
Stator winding temperature	PTC-thermistors (3+3)	24	Standard
Stator winding temperature in phases 1, 2 and 3	Pt100 analog temperature sensors in each stator winding (3+3)	24	Standard
Main bearing temperature	Pt100 analog temperature sensor	24	Standard
Leakage in the stator housing	Float switch leakage sensor (FLS)	24	Standard
Water in oil: standard drive units only. (Not applicable for drive units with internal closed-loop cooling.)	Capacitive leakage sensor (CLS)	24	Optional
Support bearing temperature	Pt100 analog temperature sensor	24	Optional
Pump memory	Printed circuit board for pump memory includes a temperature sensor.	24	Standard
Pump current	A current transformer in the control cabinet is required.		
Power monitoring	Separate electronic instrument using three current transformers.		Optional

For more information on the stator temperature monitoring, see *Stator temperature monitoring methods* on page 26.

1 6 total: 3 sensors are connected and 3 are built-in spares.
2 6 total: 3 sensors are connected and 3 are built-in spares.

3.4.1 FLS: float switch sensor

The float switches are leakage sensors.

The float switches are located in the lower part of the stator housing and in the junction box.

3.4.2 Vibration sensor (VIS10)

Description	Measured value	Fault values
The vibration sensor located in the junction box measures vibrations in one direction. The output is a 4-20 mA signal proportional to the vibration level.	Current, 4-20 mA	• >> 20 mA indicates a short circuit. • << 4 mA indicates a fault. • A zero value indicates a broken wire or bad contact in a connector.

3.4.3 Bearing temperature measurement

Pt100 sensors monitor the bearing temperatures to protect the pump from the consequences of a bearing failure.

Main bearing

Main bearing temperature monitoring is standard in the MAS 711 and MAS 801. The Pt100 sensor is pressed by a spring against the outer ring of the ball bearing.

Support bearing

Support bearing temperature monitoring is an option in the MAS 711 and MAS 801. The Pt100 sensor is pressed by a spring against the outer ring of the roller bearing.

Alarms

Two adjustable alarm limits can be used:

- Early warning: “B”-alarm
- Pump stop: “A”-alarm

3.4.4 Stator temperature monitoring methods

The purpose of stator winding temperature monitoring is to make the motor shut off at high temperature. There are several monitoring methods, depending on the voltage of the motor, and types of thermal sensors chosen.

By using an analogue sensor, two adjustable alarm limits can be used, one for warning (“B”-alarm) and one for pump stop (“A”-alarm). The configurations which can be used for monitoring the stator winding temperature depend upon the voltage range of the drive unit. See *Drive units* on page 18 for the voltage range for each drive unit.

Up to 1 kV drive units

Table 11: Stator temperature monitoring configuration, up to 1 kV

Standard / Optional	Monitoring configuration description
Standard	• Three thermal contacts, which are connected in series, are incorporated in the coil ends of the stator winding. The contacts are normally closed, and open at 140°C (285°F). • One Pt100 sensor is incorporated in one of the windings.
	Or:
	• Three thermistors, PTC, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=140°C (285°F). • One Pt100 sensor is incorporated in one of the windings.

Standard / Optional	Monitoring configuration description
Optional	• Three thermal contacts, which are connected in series, are incorporated in the coil ends of the stator winding. The contacts are normally closed, and open at 140°C (285°F). • Three Pt100 sensors, one for each phase, are incorporated in the windings.
	Or:
	• Three thermistors, PTC, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=140°C (285°F) • Three Pt100 sensors, one for each phase, are incorporated in the windings.

1.2–6.6 kV drive units

Table 12: Stator temperature monitoring configuration, 1.2–6.6 kV

Standard / Optional	Monitoring configuration description
Standard	This configuration uses the following: • Three thermistors, PTC, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=155°C (310°F) for medium-voltage drive units • Three Pt100 sensors, one for each phase, are incorporated in the windings. There are three extra thermistors, and three extra Pt100 sensors, already in position in the stator windings as reserves.

Stators that are used in the 1.2–6.6 kV drive units are equipped with three Pt100 sensors marked 19:20, 21:22, and 23:24. The sensors are connected at the plinth on the terminal plate. The stator is also equipped with a duplicate set of three Pt100 sensors, marked 19s:20s, 21s:22s, and 23s:24s. This duplicate set is not connected to the terminal plate as long as the first set of three Pt100 sensors function. The duplicate set is kept in reserve as a back-up set. The ends of the reserve sensor leads are isolated, and leads bundled among the other cables, until the back-up Pt100 sensors are needed.

The MAS 711 has preset stator alarm settings. For pumps with drive units in voltage range 1.2–6.6 kV, the settings must be changed upon installation. The medium-voltage stator settings are shown in the following table.

Table 13: Stator alarm settings for 1.2–6.6 kV drive units

Stator Alarm	Setting
A	155°C
B	145°C

3.4.4.1 Temperature sensors

Table 14: Thermal contact

Description	Measured value	Fault values
The thermal contact is a normally closed contact.	0–3 ohm, unless the wires are long.	An infinite value (open circuit) indicates either high temperature or a fault. Examples of faults include a broken wire, or a bad contact in a connector.

Table 15: PTC thermistor

Description	Measured value	Fault values
The PTC thermistor is a semiconductor device.	Resistance at normal temperature: • 50–100 ohm (150–300 ohm for three in series).	• Above the tripping point, T_{Ref}, the resistance increases dramatically to several kilohm. • An infinite value (open circuit) indicates a fault. Examples of faults include a broken wire, or a bad contact in a connector. • A value close to zero indicates a short circuit in the wiring.

Table 16: Pt100 sensor

Description	Measured value	Fault values
The Pt100 sensor is a resistor changing value almost linearly with temperature.	Resistance: • 100 ohm at 0°C (32°F) • 107.79 ohm at room temperature (20°C, 68°F) • 138.5 ohm at 100°C (212°F) For resistance data between 0–160°C (32–320°F), see *Pt100 resistance* on page 99.	> 200 ohm (approximate) can indicate the following situations: • Broken sensor • Bad contact • Broken lead < 70 ohm (approximate) indicates: • Short circuit

NOTICE:

Never connect the Pt100 transducer to a voltage higher than 2.5 V.

For information on the various configurations of contacts, thermistors and sensors that are used to monitor stator winding temperature, see *Stator temperature monitoring methods* on page 26.

3.4.5 CLS

This section applies to the following drive units:

- 605, 665
- 705, 735, 765
- 805, 835, 865, 885
- 862, 882
- 905, 935, 965
- 950, 985, 988

Table 17: Water-in-oil sensor (CLS)

Description	Measured value	Fault values
Capacitive leakage sensor located in the oil housing. This sensor issues an alarm if the water content reaches a concentration of approximately 30% or more.	Standard drive unit only. CLS must be connected to 12 V DC with correct polarity (+/–).	See table below.

CLS alarm is not a cause for stopping the pump. It is merely an indicator to check the oil and outer seal at the next planned service.

Table 18: CLS current measurements

Measuring result	Explanation
0 mA	Can indicate one of the following conditions: • The sensor has the wrong polarity. Check by changing plus and minus. • The cable/lead is broken.
4.0 to 8.0 mA	OK

Measuring result	Explanation
27 to 33 mA	Alarm current
> 33 mA	Short circuit

3.4.6 Pump memory

The pump memory is located inside the junction box of the pump. The memory is loaded with data from the factory, which is then uploaded to the MAS system at first start-up.

The data that is uploaded contains the following features:

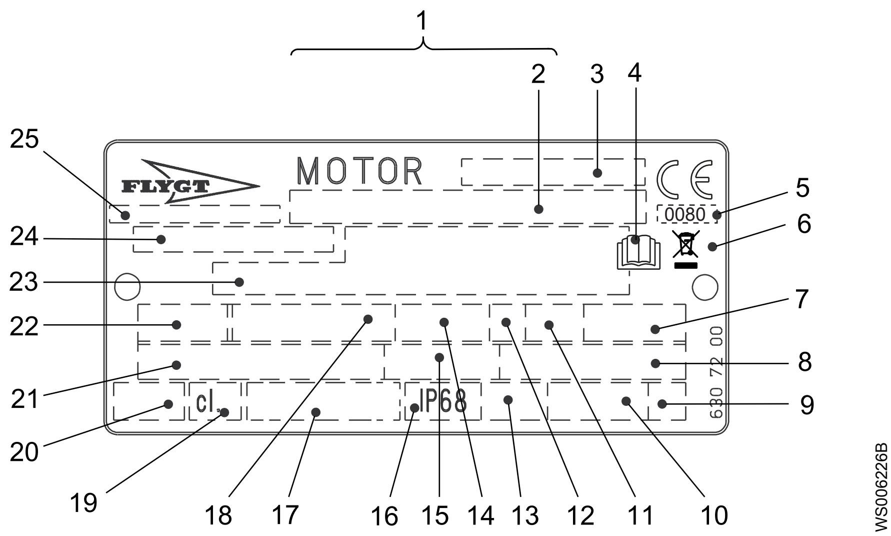
- Data plate information
- Sensor types and alarm settings recommended by the manufacturer
- Operational data and data to support service:
  - Histograms of temperatures, vibrations, and cycle length
  - Start and stop registration
  - Service log with a maximum of 200 lines of text
  - Conditions to prompt for service based on for example, running time, number of starts and stops or specific dates

For more information, see the MAS 711 Installation and User Manual.

3.5 The data plates

The data plates include key product specifications.

Drive unit

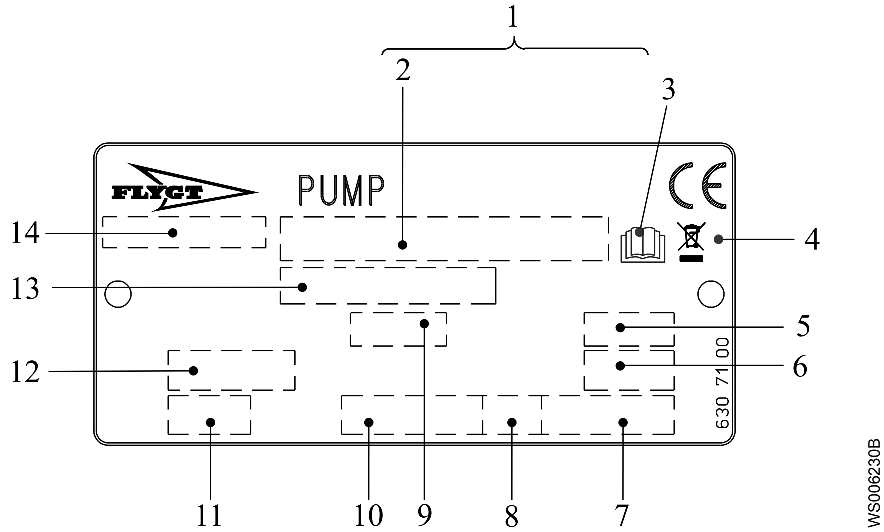


1. Serial number
2. Product code and number
3. Motor denomination
4. Read installation manual
5. Notified body, only for EN-approved Ex products
6. WEEE-Directive symbol
7. Maximum ambient temperature
8. Power factor
9. Locked rotor code letter
10. Product weight
11. Duty factor
12. Duty class
13. Maximum submergence
14. Rated speed
15. Rated current
16. Degree of protection
17. International standard
18. Rated shaft power
19. Thermal class
20. Thermal protection
21. Rated voltage
22. Phase; Type of current; Frequency
23. Additional information

24. Product number
25. Country of origin

Figure 8: The drive unit plate valid from 990101

Hydraulic unit



1. Serial number
2. Product code and number
3. Read installation manual
4. WEEE-Directive symbol
5. Impeller diameter
6. Propeller blade angle
7. Product weight
8. Direction of rotation: L=left, R=right
9. Impeller or Propeller code
10. Rated speed
11. Pressure class
12. Column diameter or Inlet and outlet diameter
13. Product number
14. Country of origin

Figure 9: The hydraulic unit plate

3.6 Approvals

Product approvals for hazardous locations

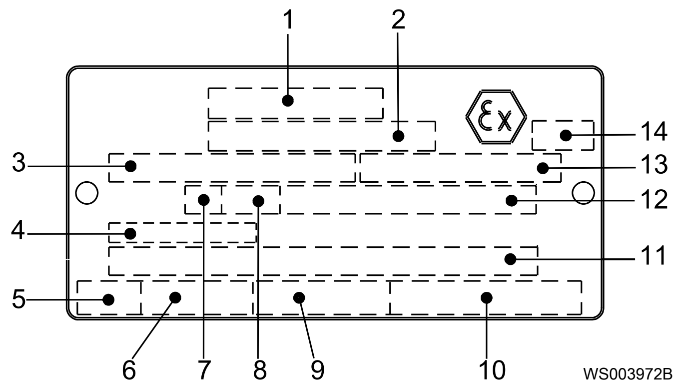
Table 19: Product approvals

Drive Unit	European Norm (EN)	IEC	FM (FM Approvals)	CSA Ex
615 675	• ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN 13463-1:2009, EN 13463-5:2011 • Ex II 2 G c Ex db IIB T3 Gb • Ex II 2 G c Ex db IIB T4 Gb	• IECEx scheme • IEC 60079-0, IEC 60079-1 • Ex d IIB T3 Gb • Ex d IIB T4 Gb	• Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations	• Explosion proof for use in Class I, Div. 1, Group C and D
715 745 775	• ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN 13463-1:2009, EN 13463-5:2011 • Ex II 2 G c Ex db IIB T3 Gb • Ex II 2 G c Ex db IIB T4 Gb	• IECEx scheme • IEC 60079-0, IEC 60079-1 • Ex d IIB T3 Gb • Ex d IIB T4 Gb	• Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations	• Explosion proof for use in Class I, Div. 1, Group C and D

Drive Unit	European Norm (EN)	IEC	FM (FM Approvals)	CSA Ex
716 746 776	• ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN 13463-1:2009, EN 13463-5:2011 • Ex II 2 G c Ex db IIB T3 Gb	• IECEx scheme • IEC 60079-0, IEC 60079-1 • Ex d IIB T3 Gb	• Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations	• Explosion proof for use in Class I, Div. 1, Group C and D
815 845 872 875 892 895	• ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN 13463-1:2009, EN 13463-5:2011 • Ex II 2 G c Ex db IIB T3 Gb	• IECEx scheme • IEC 60079-0, IEC 60079-1 • Ex d IIB T3 Gb	• Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations	• Explosion proof for use in Class I, Div. 1, Group C and D
816 846 873 876 893 896	• ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN 13463-1:2009, EN 13463-5:2011 • Ex II 2 G c Ex db IIB T3 Gb	• IECEx scheme • IEC 60079-0, IEC 60079-1 • Ex d IIB T3 Gb	• Explosion proof for use in Class I, Div. 1, Group C and D	• Explosion proof for use in Class I, Div. 1, Group C and D
915 945 960 975 995 998	• ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN 13463-1:2009, EN 13463-5:2011 • Ex II 2 G c Ex db IIB T3 Gb • Ex II 2 G c Ex db IIB T4 Gb (For T4, T_{amb} = 25°C.)	• IECEx scheme • IEC 60079-0, IEC 60079-1 • Ex d IIB T3 Gb • Ex d IIB T4 Gb (For T4, T_{amb} = 25°C.)	• Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations	• Explosion proof for use in Class I, Div. 1, Group C and D
916 946 961 976 996 997	• ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN 13463-1:2009, EN 13463-5:2011 • Ex II 2 G c Ex db IIB T3 Gb • Ex II 2 G c Ex db IIB T4 Gb (For T4, T_{amb} = 25°C.)	• IECEx scheme • IEC 60079-0, IEC 60079-1 • Ex d IIB T3 Gb • Ex d IIB T4 Gb (For T4, T_{amb} = 25°C.)	• Explosion proof for use in Class I, Div. 1, Group C and D	• Explosion proof for use in Class I, Div. 1, Group C and D

EN approval plate

This illustration describes the EN approval plate and the information that is contained in its fields.

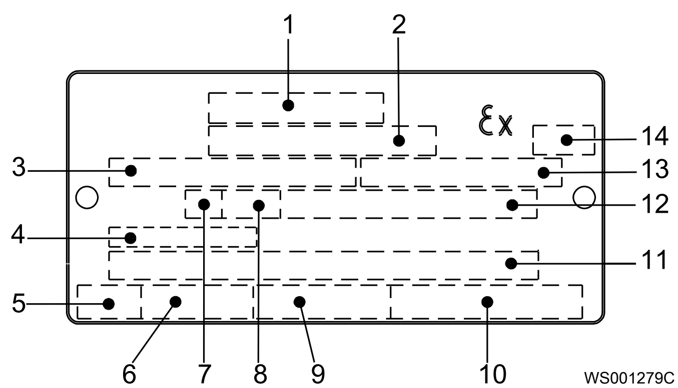


1. Approval
2. Approval authority and Approval number
3. Approved for drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking

IEC approval plate

This illustration describes the IEC approval plate and the information that is contained in its fields.

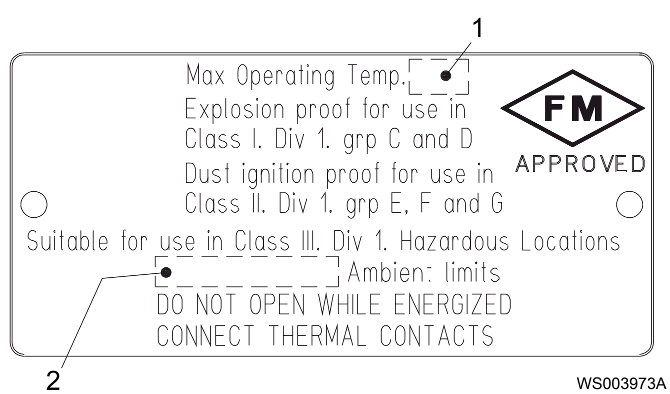
International Norm; not for EU member countries.



1. Approval
2. Approval authority and Approval number
3. Approved for drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking

FM approval plate

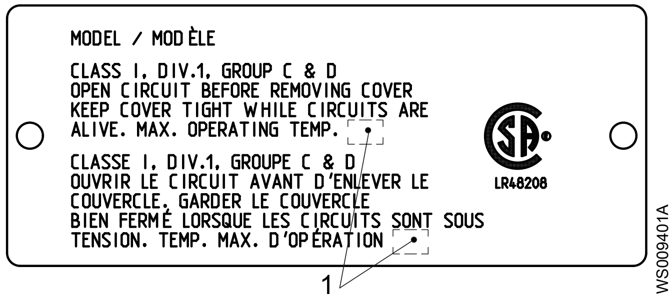
This illustration describes the FM approval plate and the information that is contained in its fields.



1. Temperature class
2. Maximum ambient temperature

CSA approval plate

This illustration describes the CSA approval plate and the information that is contained in its fields.



1. Temperature class

3.7 Product denomination

Reading instruction

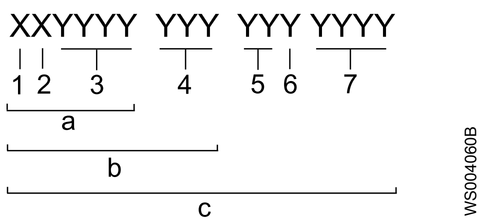
In this section, code characters are illustrated accordingly:

X = letter

Y = digit

The different types of codes are marked up with a, b, and c. Code parameters are marked up with numbers.

Codes and parameters



Type of Callout	Number	Indication
Type of code	a	Sales denomination
	b	Product code
	c	Serial number
Parameter	1	Hydraulic end
	2	Type of installation
	3	Sales code
	4	Drive unit
	5	Production year
	6	Production cycle
	7	Running number

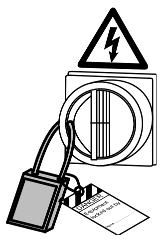
4 Installation

4.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 4 have been read and understood.

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.



DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is EN/ATEX-, MSHA- or FM-approved, then see the specific EX information in the Safety chapter before taking any further actions.

DANGER: Inhalation Hazard

Before entering the work area, make sure that the atmosphere contains sufficient oxygen and no toxic gases.

Before installing the pump, do the following:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that equipment is in place so that the unit cannot roll or fall over during the installation process.
- Check the explosion risk before you weld or use electric hand tools.
- Check that the cable and cable entry have not been damaged during transport.
- Always remove all debris and waste material from the sump before you install the pump.

Authority regulation

Vent the tank of a sewage station in accordance with local plumbing codes.

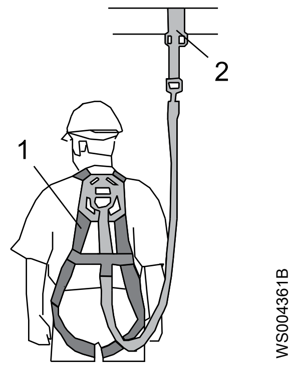
4.1.1 Falling

CAUTION: Fall Hazard

Slips and falls can cause severe injuries. Watch your step.

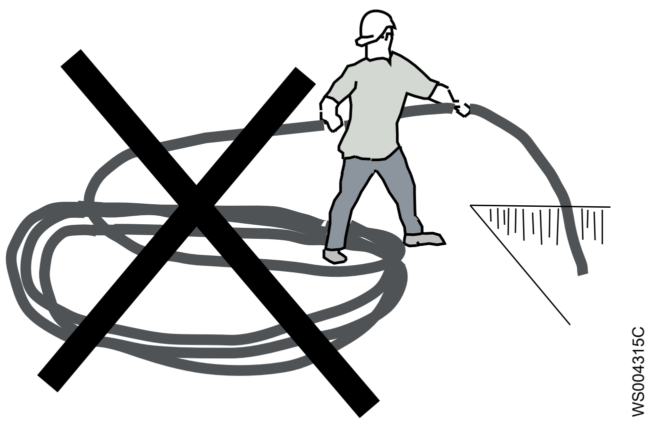
To minimize the risk of falling, observe the following:

- Use appropriate personal protection equipment when working in or near open basins, shafts, or trenches.



1. Fall protection harness
2. Anchoring point

- Make sure that all safety guards are in place and secure, and that there is a suitable barrier around the work area.
- Wear clean slip-resistant shoes.
- Make sure that any ladders or climbing equipment that is used is correctly sized and in good working condition.
- Never stand in coiled cables, ropes or wires, or between them and the open shaft or basin.



4.1.2 Hazardous atmospheres

DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is EN/ATEX-, MSHA- or FM-approved, then see the specific EX information in the Safety chapter before taking any further actions.

WARNING: Explosion/Fire Hazard

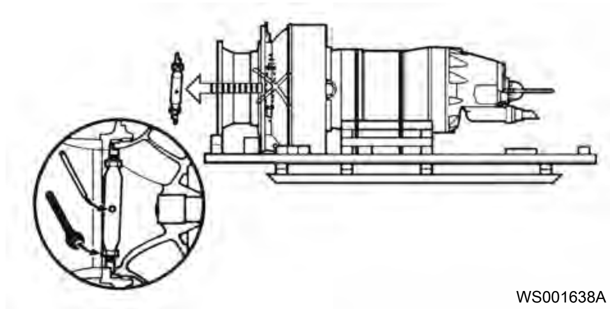
Do not install CSA-approved products in locations that are classified as hazardous in the National Electric Code(TM), ANSI/NFPA 70-2005.

Fasteners

- Only use fasteners of the correct size and material.
- Replace all corroded or damaged fasteners.
- Make sure that all the fasteners are correctly tightened and that there are no missing fasteners.

The locking device

Pumps delivered in the horizontal position have a locking device for the impeller/propeller. Before you install the pump, you must remove this locking device.



4.2 Cables

General requirements

- The voltage drop in a long cable must be taken into account. Always follow the local regulations for voltage drop.
- If a Variable Frequency Drive (VFD) is used, then the screened cable must be used according to the European CE and EMC requirements. For more information, contact a sales or authorized service representative (VFD-supplier).
- All unused conductors must be insulated.
- The cable entry seal sleeve and washers must conform to the outside diameter of the cable.

Cable condition

- The cable must not have any sharp bends, and not be pinched.

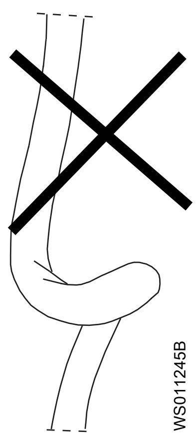


Figure 10: Kinked cable

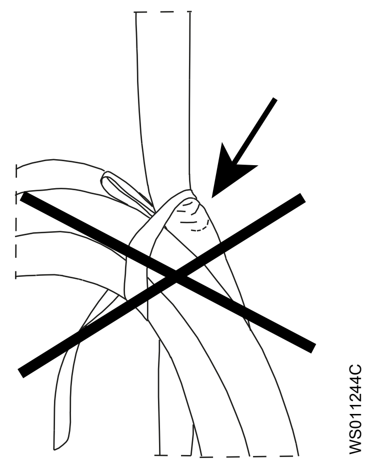


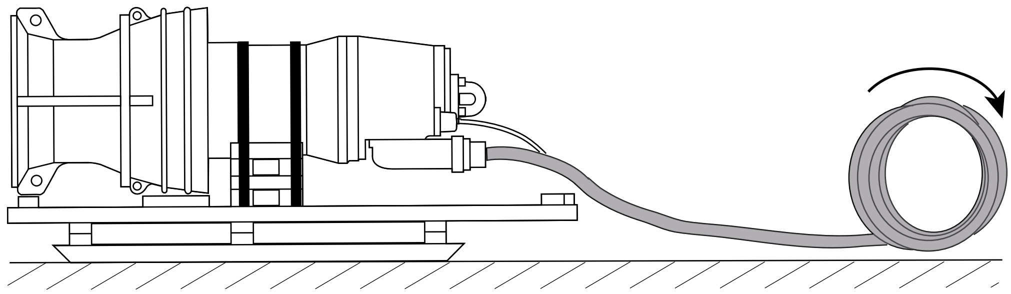
Figure 11: Pinched cable

- If the outer sheath of the cable is damaged, then replace the cable.
- The cable must not be damaged and must not have indentations or be embossed at the cable entry.
- If the cable has been used before, then a short piece must be peeled off when refitting it. This prevents the cable entry seal sleeve from closing around the cable at the same point.
- The cable must not be exposed for long periods to direct UV light. The cable ends must be protected from water during storage.

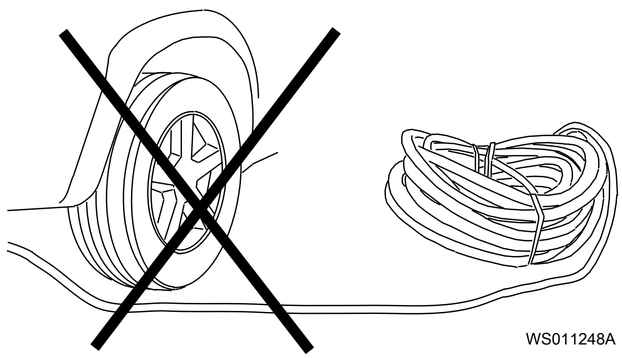
Cable handling

To install cables, follow these requirements:

- Start at the pump and carefully roll out the cable.



- When pulling the cable, do not exceed the maximum permissible tensile force.
- Do not bend the cable to a radius smaller than the recommended minimum bending radius.The recommended minimum bending radius is 10 times the diameter of the cable.
- Make sure that vehicles cannot run over the cable.



- All cables lose flexibility at lower temperatures. Use extra care when the cable is cold.Do not work with a cable whose temperature is below –30°C (–22°F).

4.3 Cable handling system

Cable system overview

When the pump is installed in a discharge tube, it is critically important that a correct cable support and protection system is used. This is especially important when using long power cables and closed discharge tubes. Characteristics of the cable handling system include:

- Cables must be supported in such a way, so that they do not come in contact with any hard surface which could abrade the cable sheathing. Examples of surfaces include pump and tube components, lifting cables or wires and any other hardware.
- Power cables should be bundled together, by using components that do not cut or abrade the cables.
- Correct strain relief and support at prescribed intervals must be provided.
- Spring-controlled tensioning and an integrated guide wire system are recommended for long cables.

Example of the Flygt cable handling system

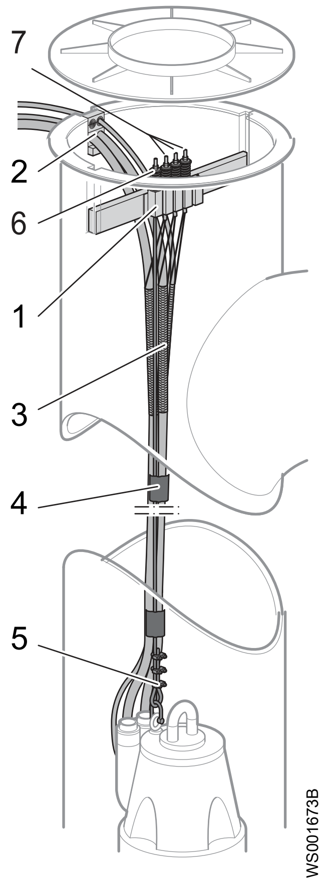


Figure 12: Example of the Flygt cable handling system

Number	Description
1	Support beam and cable holder
2	Cable entry unit
3	Cable support grips
4	Bundling kits
5	Wire unit
6	Lifting eye unit: wire
7	Lifting eye unit: cable

Instructions for installing the cable handling system

Instructions for installing the Flygt cable handling system are given in the document "Installation, Operation and Maintenance, Flygt Cable Handling System". For more information, contact the sales and service representative.

4.4 Install the pump

Consult the nearest local sales and service representative regarding the following:

- Sizing of the pump, piping station, and access frame
- Choice of auxiliary equipment
- Other aspects of installation

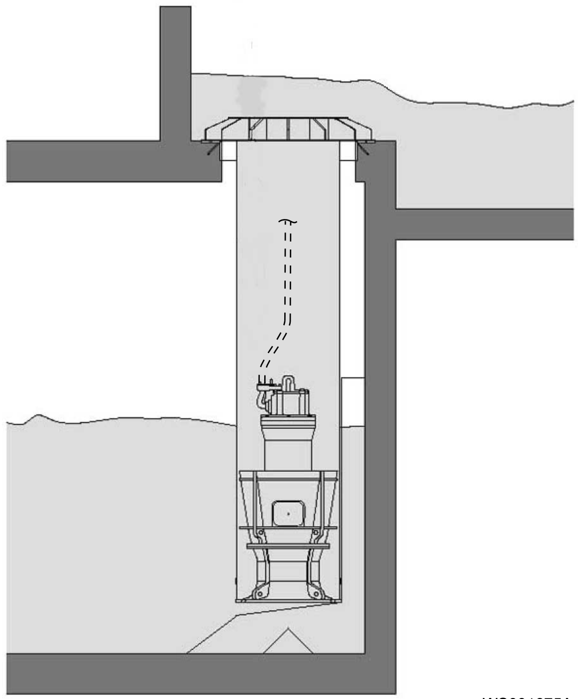
NOTICE:

Do not run the pump dry.

NOTICE:

Never force piping to make a connection with a pump.

The pump is usually installed in a vertical discharge tube on a pump seat, which is incorporated in the lower end of the tube. No anchoring is required because the weight of the pump is sufficient to keep it in position. The pumps are equipped with anti-rotation devices.



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When the pump is installed in a discharge tube, the following must be considered:

- An appropriate cable support and protection system must be used.

Before installation, check the following:

- The propeller must rotate in the correct direction.

  If the rotation is not in the correct direction, then the pump can lift and start rotating inside the tube. This movement can seriously damage the equipment.
- The rubber seal ring underneath the pump is in position.
- There is no damage to, or debris on, the pump seat.
- There is no large construction debris under the pump tube, or at the pump intake. If debris is present, then there is a risk that it can get sucked into the pump and cause propeller damage.
- The pump control is set to turn off the pump at or above the minimum operating water level for this pump installation.

1. Secure the cables so that they can be fed into the column in a controlled manner.

   When the pump is lowered into the column, the cables must be fed into the column at the same speed as the pump is lowered.

   See also the Installation, Operation, and Maintenance manual for the Flygt Cable Handling System.

WS006791A

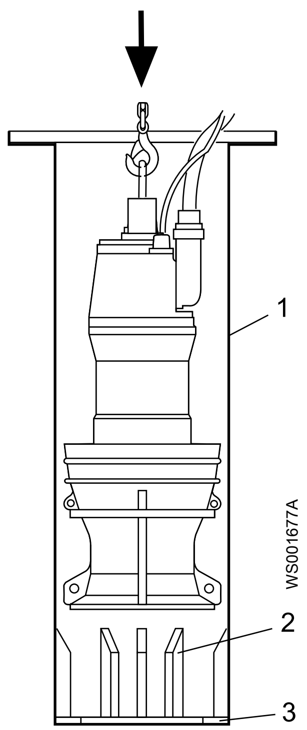
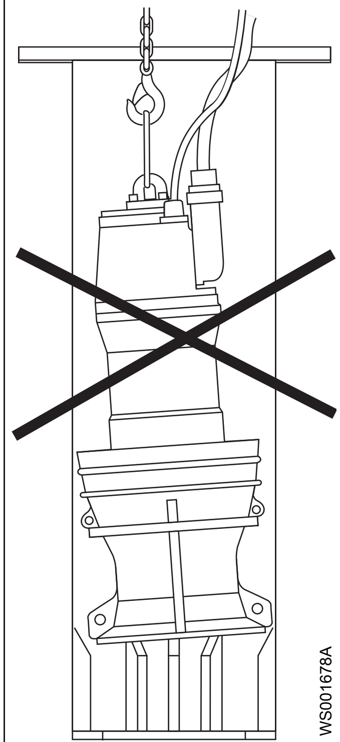
2. Make sure that the lifting strap or chain for lowering the pump, is shorter than the length of the cables.

   Never lift the pump by its cables.

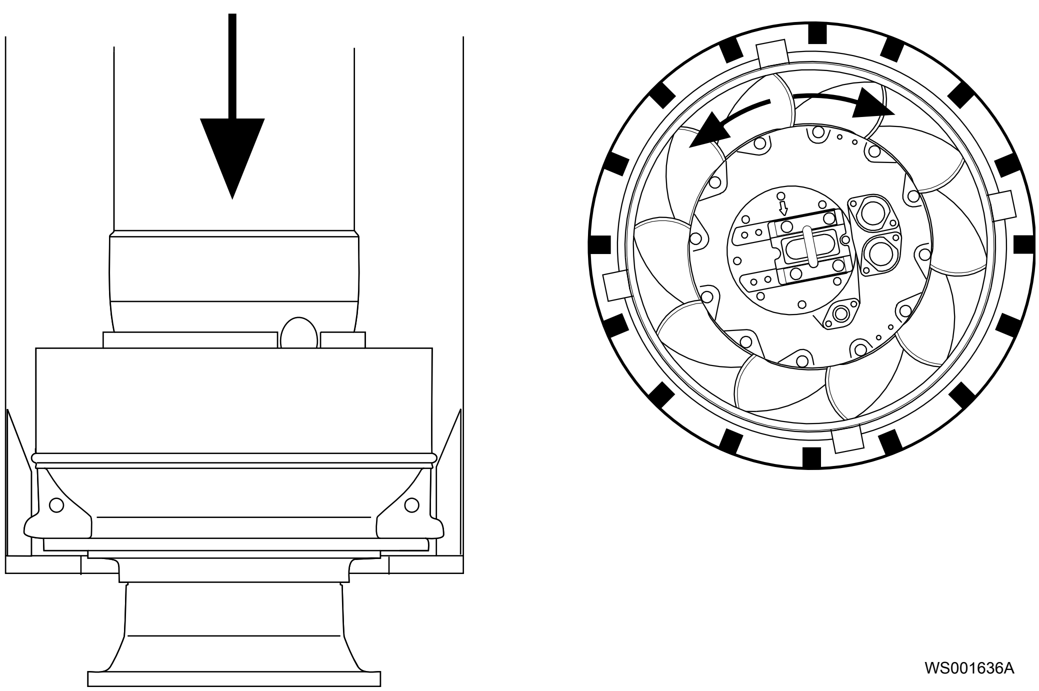
WS006792A

3. After cable preparation, lower the pump into the pump column.

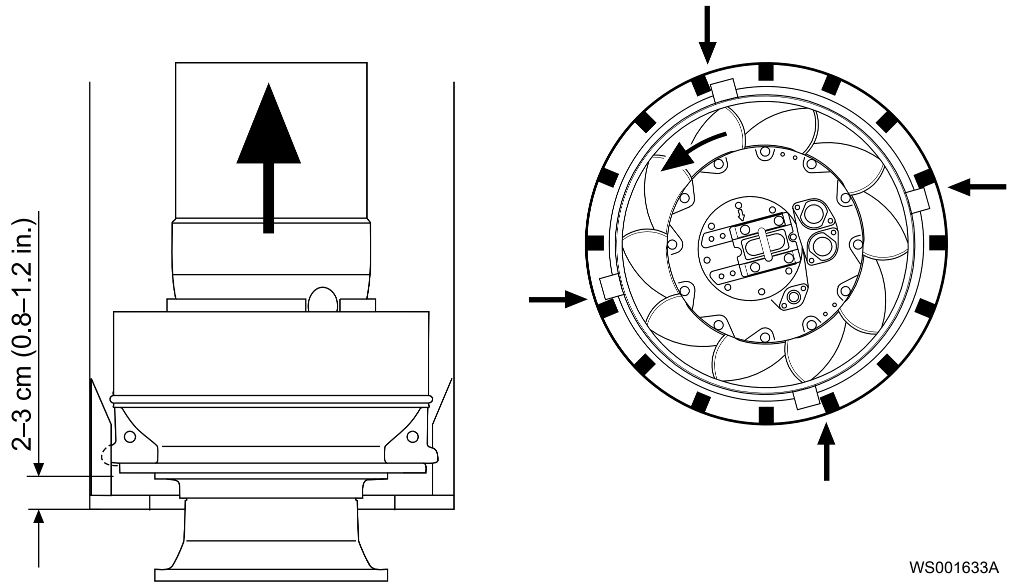
   Make sure that the pump does not tilt on the stop vanes, which are at the bottom of the column.

Correct	Incorrect
 1 Discharge column 2 Antirotation gusset (stop vanes) 3 Pump seat	

4. Lower the pump to its bottom position, at the same time carefully moving it back and forth between the nearest anti-rotation gusset.

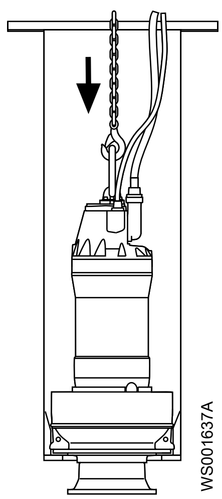


5. Lift the pump slightly again, approximately 2–3 cm (1 in.), and turn it counterclockwise until the anti-rotation device on the hydraulic end lands against the nearest adjacent vanes.



6. Lower the pump to its final bottom position.

   No additional anchoring of the pump is required. Maximum permissible submersion depth is 20 m (65 ft).



7. If the recommended cable handling system is used, then follow the instructions for finishing the cable connection. See the document "Mounting Instructions, Flygt Cable Handling System".
8. If the recommended cable handling system is not used, then attach the power cables on the cable holder, and run them to the electric junction box.

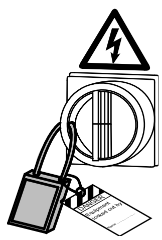
   Make sure that the cables have no sharp bends, are not pinched, and do not disturb the water flow.

4.5 Make the electrical connections

4.5.1 General precautions

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.



WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

WARNING: Crush Hazard

Risk of automatic restart.

CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the cable ends dry at all times.

Requirements

These general requirements apply for electrical installation:

- The supply authority must be notified before installing the pump if it will be connected to the public mains. When the pump is connected to the public power supply, it may cause flickering of incandescent lamps when started.
- The mains voltage and frequency must agree with the specifications on the data plate. If the pump can be connected to different voltages, then the connected voltage is specified by a yellow sticker close to the cable entry.
- The fuses and circuit breakers must have the proper rating, and the pump overload protection (motor protection breaker) must be connected and set to the rated current according to the data plate and if applicable the cable chart. The starting current in direct-on-line start can be up to six times higher than the rated current.

- The fuse rating and the cables must be in accordance with the local rules and regulations.
- If intermittent operation is prescribed, then the pump must be provided with monitoring equipment supporting such operation.
- The thermal contacts must be connected to a protection circuit in accordance with the product approvals.
- The thermal contacts/thermistors must be in use.
- The environment must be appropriate for medium-voltage (1.2–10 kV) cables and electrical work.
- For FM-approved pumps, a leakage sensor must be connected and in use in order to meet approval requirements.
- Specially-approved pumps must be earthed (grounded) at the external earthing (grounding) site on the outside of the drive unit, in order to meet approval requirements.

4.5.2 Grounding (earthing)

Grounding (earthing) must be done in compliance with all local codes and regulations.

DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.

WARNING: Electrical Hazard

If the power cable is jerked loose, then the ground (earth) conductor must be the last conductor to come loose from its terminal. Make sure that the ground (earth) conductor is longer than the phase conductors at both ends of the cable.

WARNING: Electrical Hazard

Risk of electrical shock or burn. You must connect an additional ground- (earth-) fault protection device to the grounded (earthed) connectors if persons are likely to come into contact with liquids that are also in contact with the pump or pumped liquid.

4.5.3 Connect the ground at the outside of the drive unit

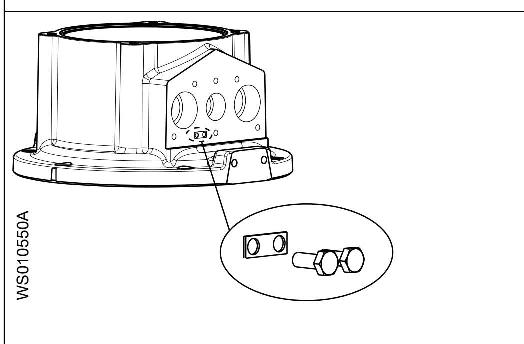
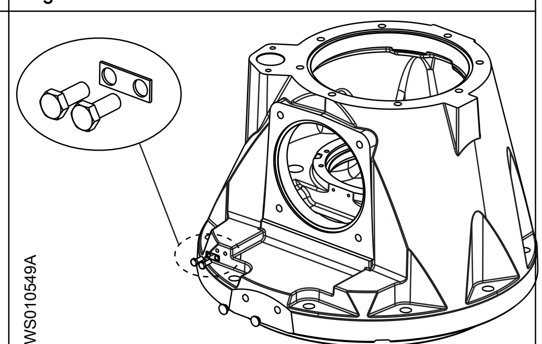
This section gives instructions for connecting the external earthing to the outside of the drive unit.

This procedure must be followed for:

- Pumps that are installed in an EX environment
- Medium voltage pumps.

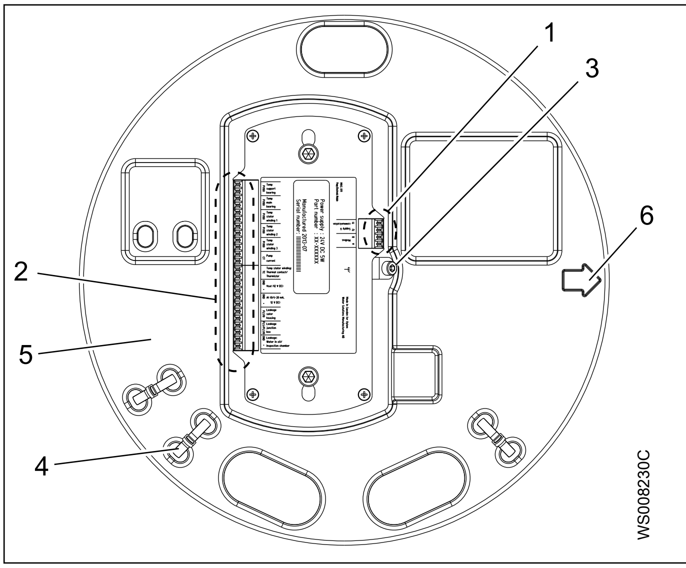
Other circumstances can also make this procedure applicable.

Connect the ground (earth) at the external grounding (earthing) site on the outside of the drive unit. See the following figures.

Small connection house	Large connection house
	

4.5.4 Connect the cables: Standard pumps with MAS 801

This procedure must not be used for Ex-proof applications. If the pump is Ex-proof, then use the procedure that is described in *Connect the cables: Ex-proof pumps with MAS 801* on page 48.

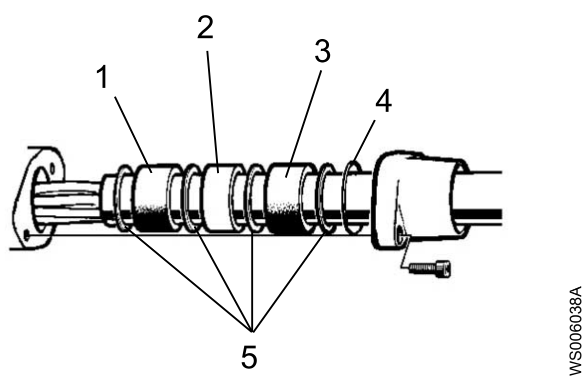


1. PEM communication terminals
2. PEM control terminals
3. Functional ground
4. Cable tie
5. Terminal plate
6. Index arrow. The index arrow on the terminal plate is aligned with the cable inlet.

1. Install the monitoring equipment. See the System Installation and Operation (SIO) Manual for the MAS 801 monitoring equipment.
2. Connect the two signal leads that are integrated in the SUBCAB® cable, T1 and T2, to the MAS BU.

   See the chapter “Installation” in the SIO Manual for the MAS 801 monitoring equipment.
3. If they are not already connected, then connect the T1 and T2 leads integrated in the SUBCAB cable to the PEM. See the illustration and table in *Terminals used in standard applications* on page 48.
4. If they are not already connected, then connect the power leads:
   a) Check the data plate to determine which connection is valid for the voltage supply.
   b) Connect the power leads to the terminal board connection U1, U2, V1, V2, W1, W2, and ground (earth) according to the cable chart.

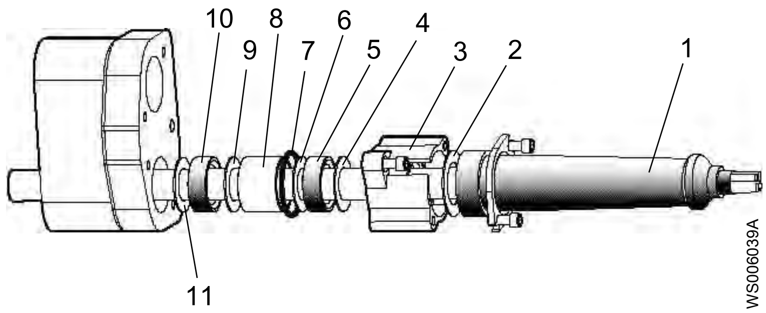
      See *Cable charts* on page 63.
5. Install the entrance flange:
   a) Fit the entrance flange parts according to the illustration for the correct drive unit.



1. Seal sleeve
2. Spacer ring
3. Seal sleeve

4. O-ring
5. Washer

Figure 13: Drive units 605–776



1. Protective sleeve
2. Washer
3. Connection flange
4. Washer
5. Seal sleeve
6. Washer
7. O-ring
8. Spacer ring
9. Washer
10. Seal sleeve
11. Washer

Figure 14: Drive unit 805–998

Pumps with drive units 605–776 are also equipped with a cable holder illustrated here.

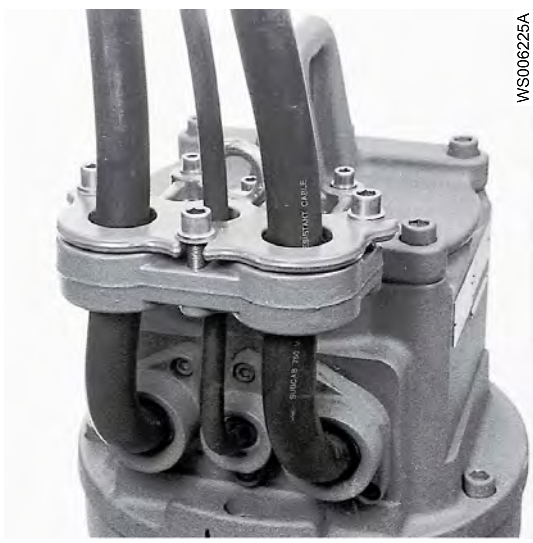


Figure 15: Cable holder. Pumps equipped with MAS 801 do not have the auxiliary cable.

b) Fit the protective rubber sleeve onto the cable where it leaves the connection housing.

   The rubber sleeve must have the correct size to give the correct compression around the cable.

c) Attach the connection flange to the entrance flange.

   Make sure that the seal sleeve is not misaligned with the rubber sleeve. Check that the entrance flange supports the cable so that it cannot be excessively bent.

6. Connect the SUBCAB cable phase leads to the starter equipment according to the diagram in *Power cable phase sequence* on page 58.

7. Perform the system setup by using the Setup wizard and other commissioning procedures in the chapter “System Setup” in the SIO Manual for the MAS 801.
8. For pumps with drive units in voltage range 1.2–6.6 kV: Check that the stator alarm settings have been changed to the values in the following table.

Table 20: Stator alarm settings for 1.2–6.6 kV drive units

Stator Alarm	Setting
A	155°C
B	145°C

For more information, see the SIO Manual for the MAS 801. For drive unit voltage ranges, see *Drive units* on page 18.

4.5.4.1 Wiring for standard pumps

In standard pumps, thermal contacts or thermistors are connected to the PEM. All sensor signals are digitally transmitted through T1 and T2 in the SUBCAB™ power cable.

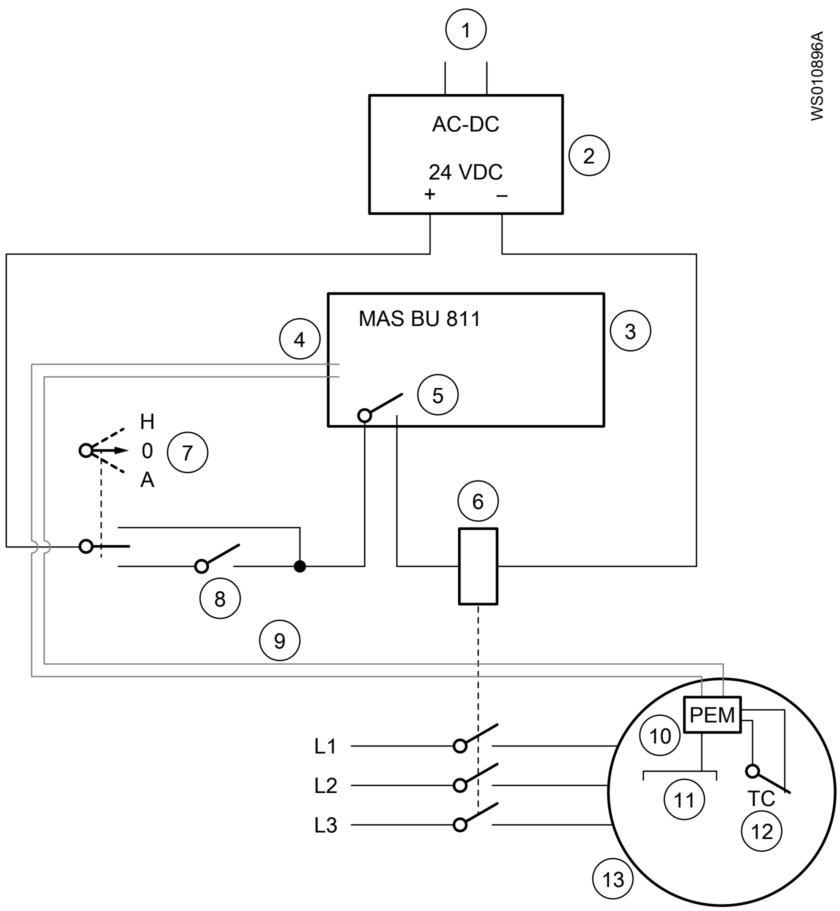
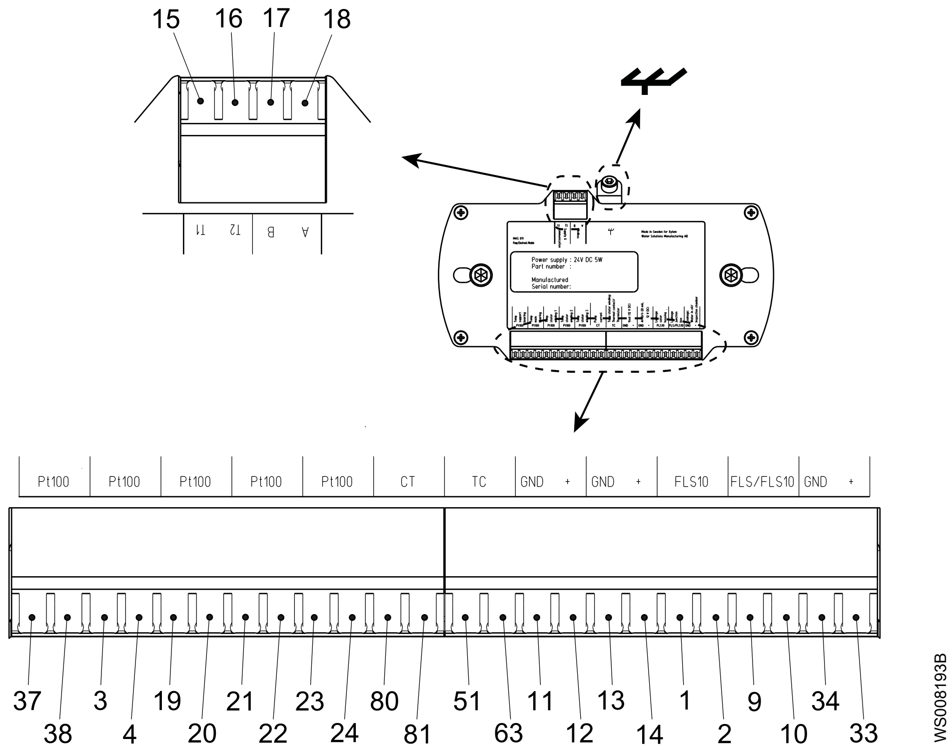


Figure 16: Thermal contacts or thermistors connections to the PEM

1. Power outlet, 100 VAC – 240 VAC	8. Pump control, on or off
2. AC/DC converter	9. T1 and T2 signal leads in SUBCAB™ power cable
3. Base unit	10. PEM
4. Pump electronic module communication	11. Pump sensors
5. GO contact	12. Thermal contact or thermistor
6. Contactor	13. Pump
7. Hand-Off-Auto (HOA) controller	

4.5.4.2 Terminals used in standard applications

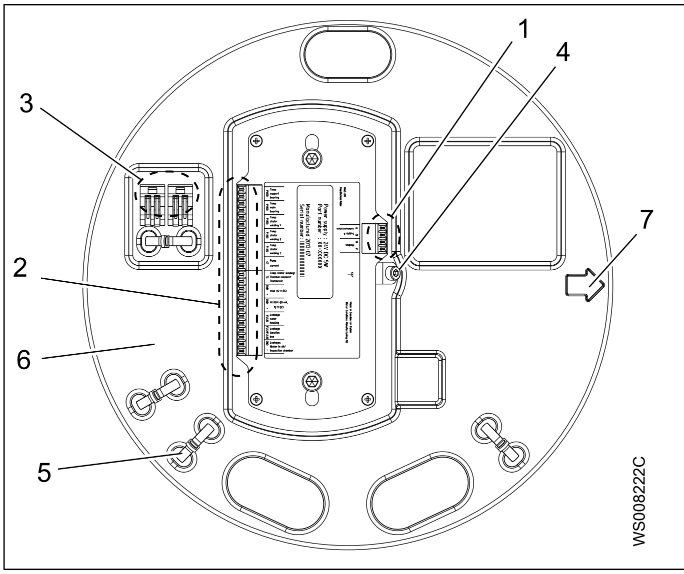


Terminal	Description	Terminal	Description
37, 38	Temperature support bearing, Pt100	13, 14	Analog input 0/4 -20 mA, +12 VDC, GND
3, 4	Temperature main bearing, Pt100	1, 2	Leakage: Inspection chamber or stator housing, FLS/FLS10
19, 20	Temperature stator winding 1, Pt100	9, 10	Leakage, junction box: FLS/FLS10
21, 22	Temperature stator winding 2, Pt100	34, 33	Leakage, inspection chamber: FLS10. Water in oil: CLS
23, 24	Temperature stator winding 3, Pt100	15	T1 power supply and communication
80, 81	Pump current, CT	16	T2 power supply and communication
51, 63	Temperature stator winding: Thermal contact or thermistor, TC	17	Not used
11, 12	V_{out} +12 VDC, GND	18	Not used

4.5.5 Connect the cables: Ex-proof pumps with MAS 801

For Ex-proof applications, the stator winding temperature sensors are not connected to terminals 51 and 63 on the PEM. They are connected to the T3 and T4 terminals on the separate plinth.

- Thermal contacts must be wired separately to break contactor circuit directly.
- Thermistors must be wired to a Safety Integrity Level (SIL)-approved thermistor relay.



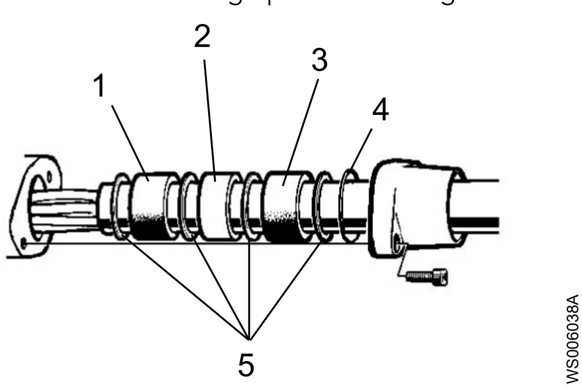
1. PEM communication terminals
2. PEM control terminals
3. Separate plinth with T3, T4 terminals
4. Functional ground
5. Cable tie
6. Terminal plate
7. Index arrow. The index arrow on the terminal plate is aligned with the cable inlet.

1. Install the monitoring equipment. See the System Installation and Operation (SIO) Manual for the MAS 801 monitoring equipment.
2. Connect the two signal leads that are integrated in the SUBCAB® cable, T1 and T2, to the MAS base unit.

   See the chapter "Installation" in the SIO Manual for the MAS 801 monitoring equipment.
3. Connect the T3 and T4 terminals to the auxiliary relay (thermal contacts) or the SIL-approved thermistor relay (thermistors). See *Wiring for Ex-proof application* on page 51.

   Do not connect the stator winding temperature sensor leads to PEM terminals 51 and 63.
4. If they are not already connected, then connect the T1 and T2 leads integrated in the SUBCAB cable to the PEM. See the illustration and table in *Terminals used in Ex applications* on page 53.
5. If they are not already connected, then connect the power leads:
   a) Check the data plate to determine which connection is valid for the voltage supply.
   b) Connect the power leads to the terminal board connection U1, U2, V1, V2, W1, W2, and ground (earth) according to the cable chart.

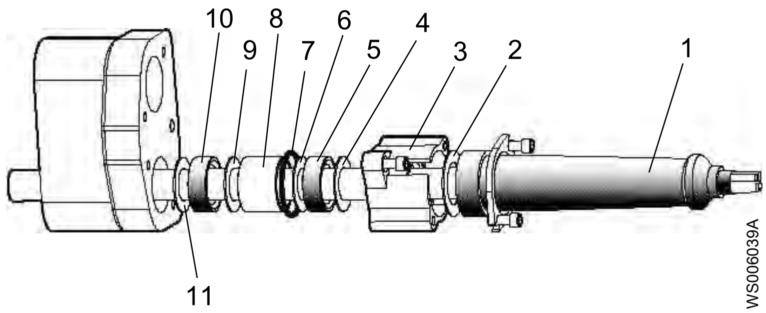
      See *Cable charts* on page 63.
6. Install the entrance flange:
   a) Fit the entrance flange parts according to the illustration for the correct drive unit.



1. Seal sleeve
2. Spacer ring
3. Seal sleeve

4. O-ring
5. Washer

Figure 17: Drive units 605–776



1. Protective sleeve
2. Washer
3. Connection flange
4. Washer
5. Seal sleeve
6. Washer
7. O-ring
8. Spacer ring
9. Washer
10. Seal sleeve
11. Washer

Figure 18: Drive unit 805–998

Pumps with drive units 605–776 are also equipped with a cable holder illustrated here.

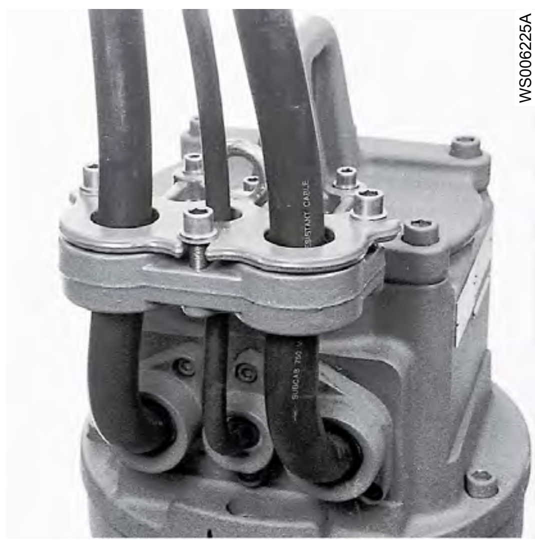


Figure 19: Cable holder. Pumps equipped with MAS 801 do not have the auxiliary cable.

b) Fit the protective rubber sleeve onto the cable where it leaves the connection housing.

   The rubber sleeve must have the correct size to give the correct compression around the cable.

c) Attach the connection flange to the entrance flange.

   Make sure that the seal sleeve is not misaligned with the rubber sleeve. Check that the entrance flange supports the cable so that it cannot be excessively bent.

7. Connect the SUBCAB cable phase leads to the starter equipment according to the diagram in *Power cable phase sequence* on page 58.

8. Perform the system setup by using the Setup wizard and other commissioning procedures in the chapter "System Setup" in the SIO Manual for the MAS 801.
9. For pumps with drive units in voltage range 1.2–6.6 kV: Check that the stator alarm settings have been changed to the values in the following table.

Table 21: Stator alarm settings for 1.2–6.6 kV drive units

Stator Alarm	Setting
A	155°C
B	145°C

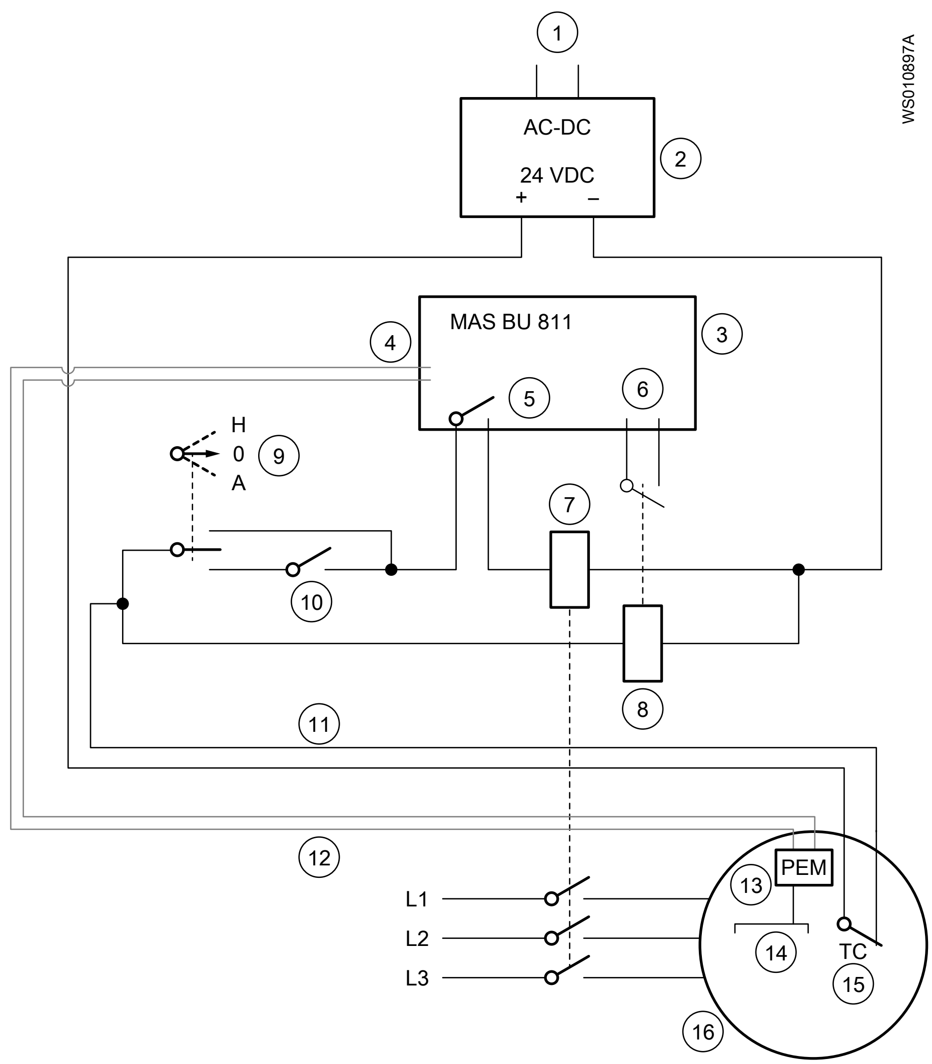
For more information, see the SIO Manual for the MAS 801. For drive unit voltage ranges, see *Drive units* on page 18.

4.5.5.1 Wiring for Ex-proof application

For Ex-proof applications, the stator winding temperature sensors are not connected to terminals 51 and 63 on the PEM. They are connected to the T3 and T4 terminals on the separate plinth.

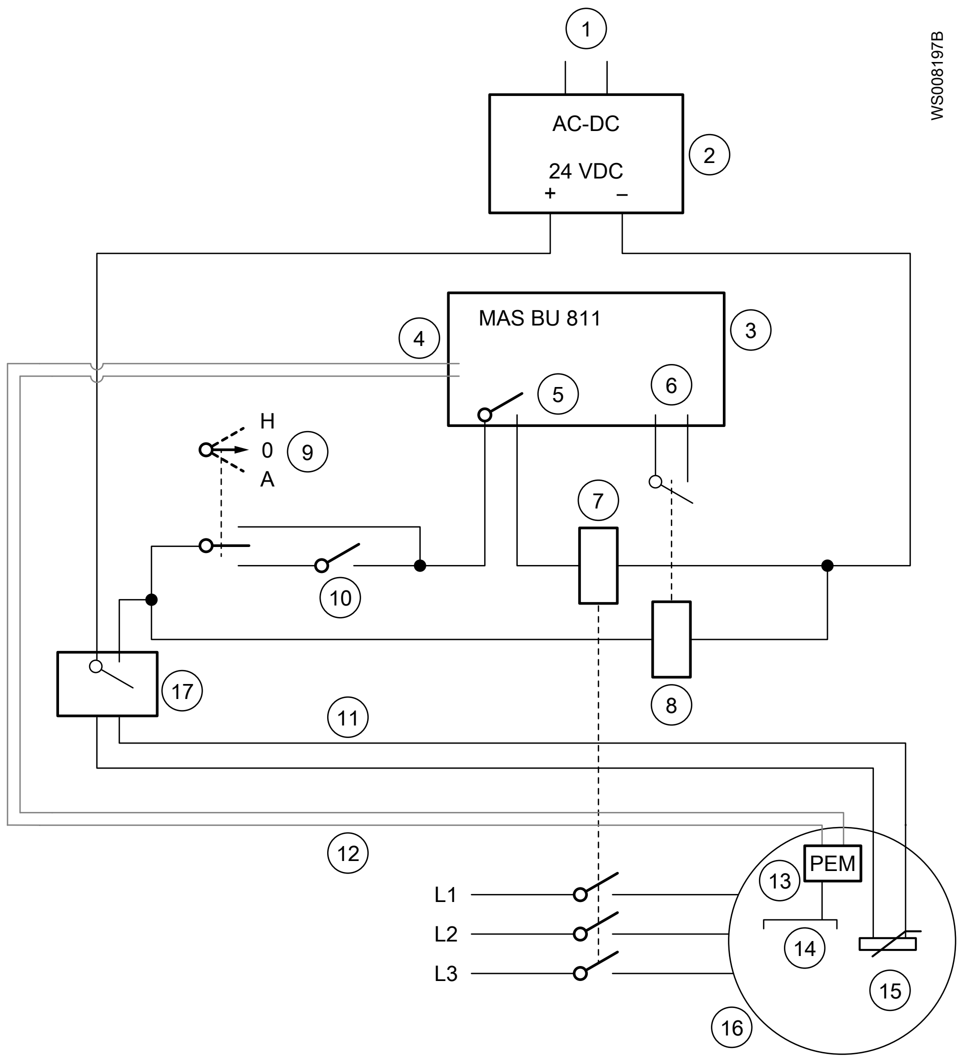
- Thermal contacts must be wired separately to break contactor circuit directly.
- Thermistors must be wired to a Safety Integrity Level (SIL)-approved thermistor relay.

Thermal contacts



1. Power outlet, 100–240 VAC	9. Controller • H – Hands • 0 – Off • A – Automatic
2. AC DC converter	10. Pump control: on or off
3. Base unit	11. T3 and T4 signal leads in SUBCAB® power cable
4. Pump electronic module communication	12. T1 and T2 signal leads in SUBCAB® power cable
5. GO -contact	13. Pump electronic module
6. Digital input	14. Pump sensors
7. Contactor	15. Thermal contact
8. R1 auxiliary relay	16. Pump

Thermistors



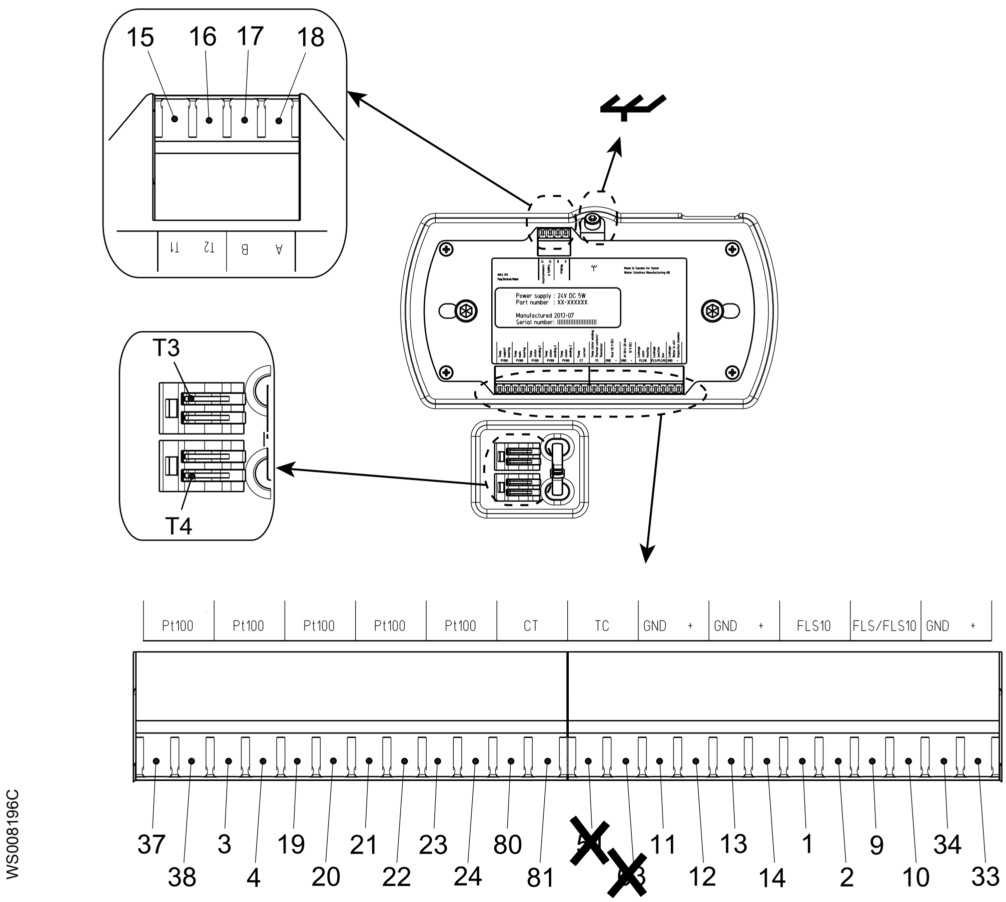
1. Power outlet, 100–240 VAC	9. Controller • H – Hands • 0 – Off • A – Automatic
2. AC DC converter	10. Pump control: on or off
3. Base unit	11. T3 and T4 signal leads in SUBCAB® power cable
4. Pump electronic module communication	12. T1 and T2 signal leads in SUBCAB® power cable

5. GO -contact	13. Pump electronic module
6. Digital input	14. Pump sensors
7. Contactor	15. Thermistors
8. R1 auxiliary relay	16. Pump
	17. Thermistor relay

4.5.5.2 Terminals used in Ex applications

For Ex applications, the stator winding temperature sensors are not connected to terminals 51 and 63 on the PEM. They are connected to the T3 and T4 terminals on the separate plinth.

- Thermal contacts must be wired separately to break contactor circuit directly.
- Thermistors must be wired to a Safety Integrity Level (SIL)-approved thermistor relay.



Terminal	Description	Terminal	Description
37, 38	Temperature support bearing, Pt100	1, 2	Leakage: Inspection chamber or stator housing, FLS/FLS10
3, 4	Temperature main bearing, Pt100	9, 10	Leakage junction box, FLS/FLS10
19, 20	Temperature stator winding 1, Pt100	34, 33	Leakage, inspection chamber: FLS10
21, 22	Temperature stator winding 2, Pt100	15	T1 power supply and communication
23, 24	Temperature stator winding 3, Pt100	16	T2 power supply and communication
80, 81	Pump current, CT	17	Not used
11, 12	V_{out} +12 VDC, GND	18	Not used
13, 14	Analog input 0/4 -20 mA, +12 VDC, GND	T3, T4	Temperature stator winding: Thermal contact or thermistor, TC

4.5.6 Connect the cables: Pumps with MAS 711

1. Connect the monitoring equipment.
2. Connect the cable to the terminal board:
   - If the MAS 711 system is used, then connect the cable to its terminal board according to the illustration and table in *MAS 711 sensor connections* on page 56.

   NOTICE:

   As the cable ends are sealed to eliminate moisture entrainment during transport and storage, no wire markings for the sensors at the outlet end of the cable are made at the factory. Markings must therefore be carried out during installation of the unit.
3. Synchronize the MAS 711 base unit and the pump memory at the first installation:
   a) Check that the communication between the pump and the MAS base unit is activated.
   b) Upload the factory settings of sensors and related parameters by choosing the command "copy all from pump memory to MAS". For more information about the MAS installation, see the Installation and User Manual for the MAS 711 monitoring equipment.
4. For pumps with drive units in voltage range 1.2–6.6 kV: Change the preset to stator alarms to the values in the following table.

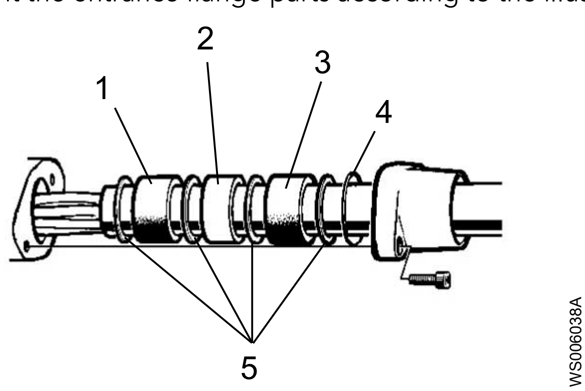
   Table 22: Stator alarm settings for 1.2–6.6 kV drive units

Stator Alarm	Setting
A	155°C
B	145°C

   For more information, see the Installation and User Manual for the MAS 711 monitoring equipment. For drive unit voltage ranges, see *Drive units* on page 18.
5. Connect the power cable:
   a) Check the data plate to determine which connection is valid for the voltage supply.
   b) Arrange the connection on the terminal board.
   c) Connect the power cable leads to the terminal board connection U1, U2, V1, V2, W1, W2, and ground (earth) according to the cable chart.

   See *Cable charts* on page 63.

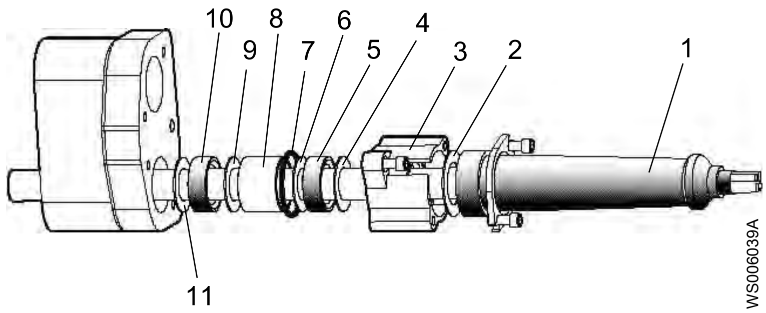
   d) If control elements are present and not used, then cut and cap them.
6. Install the entrance flange:
   a) Fit the entrance flange parts according to the illustration for the correct drive unit.



1. Seal sleeve
2. Spacer ring
3. Seal sleeve

4. O-ring
5. Washer

Figure 20: Drive units 605-776



1. Protective sleeve
2. Washer
3. Connection flange
4. Washer
5. Seal sleeve
6. Washer
7. O-ring
8. Spacer ring
9. Washer
10. Seal sleeve
11. Washer

Figure 21: Drive unit 805-998

Pumps with drive units 605-776 are also equipped with a cable holder illustrated here.

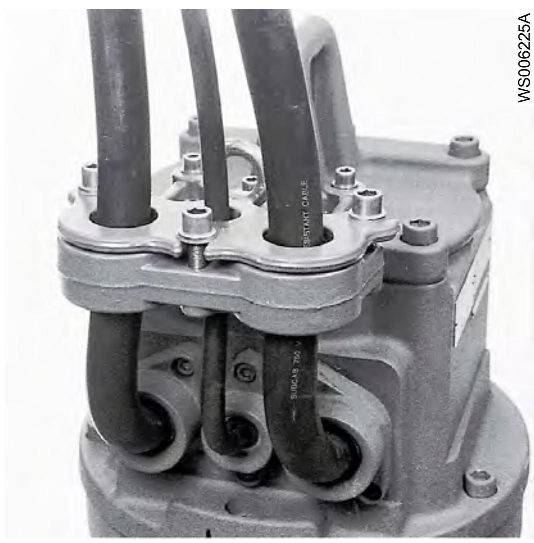


Figure 22: Cable holder

b) Fit the protective rubber sleeve onto the cable where it leaves the connection housing.

   The rubber sleeve must have the correct size to give the correct compression around the cable.

c) Attach the connection flange to the entrance flange.

   Make sure that the seal sleeve is not misaligned with the rubber sleeve. Check that the entrance flange supports the cable so that it cannot be excessively bent.

7. Connect the starter equipment:

   a) Connect the power cable to the starter equipment according to the diagram in *Power cable phase sequence* on page 58.

   b) Connect the auxiliary cable to the starter equipment.

4.5.6.1 MAS 711 sensor connections

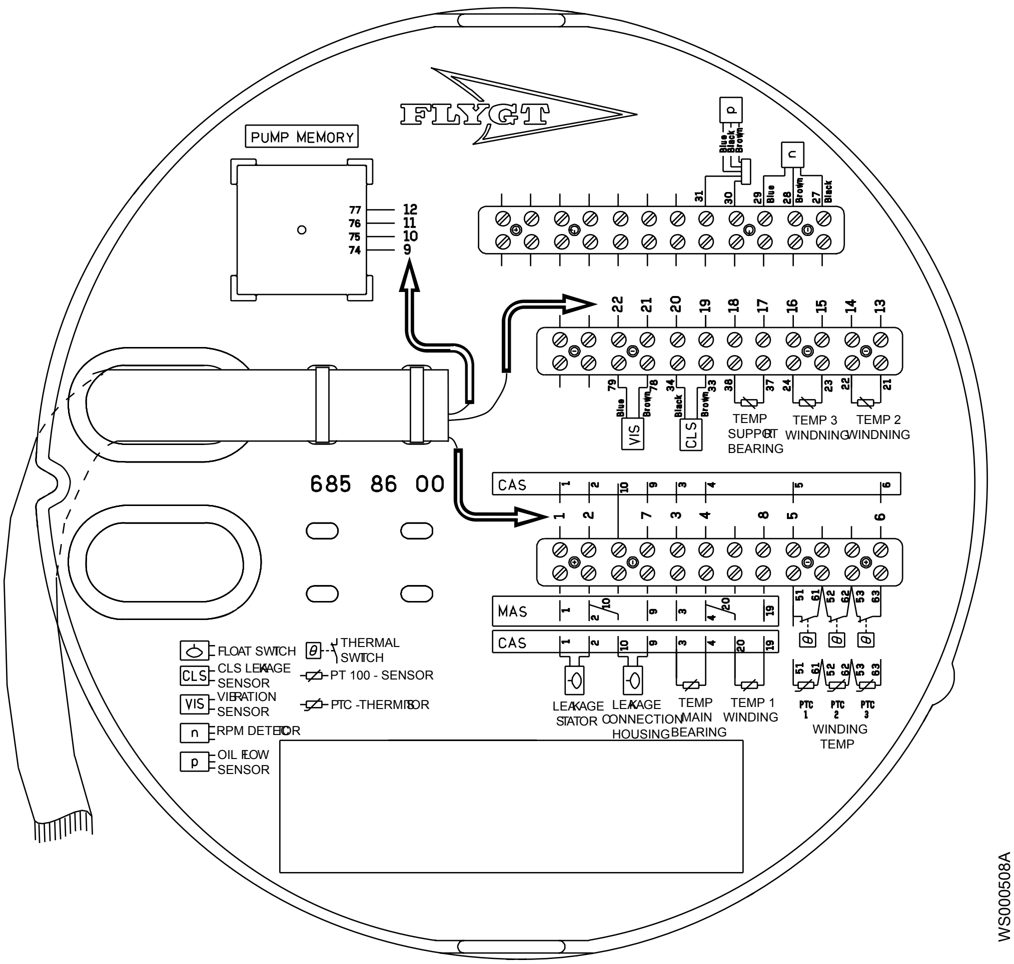


Figure 23: Connections at the product. Arrows indicate SUBCAB cable lead numbers.

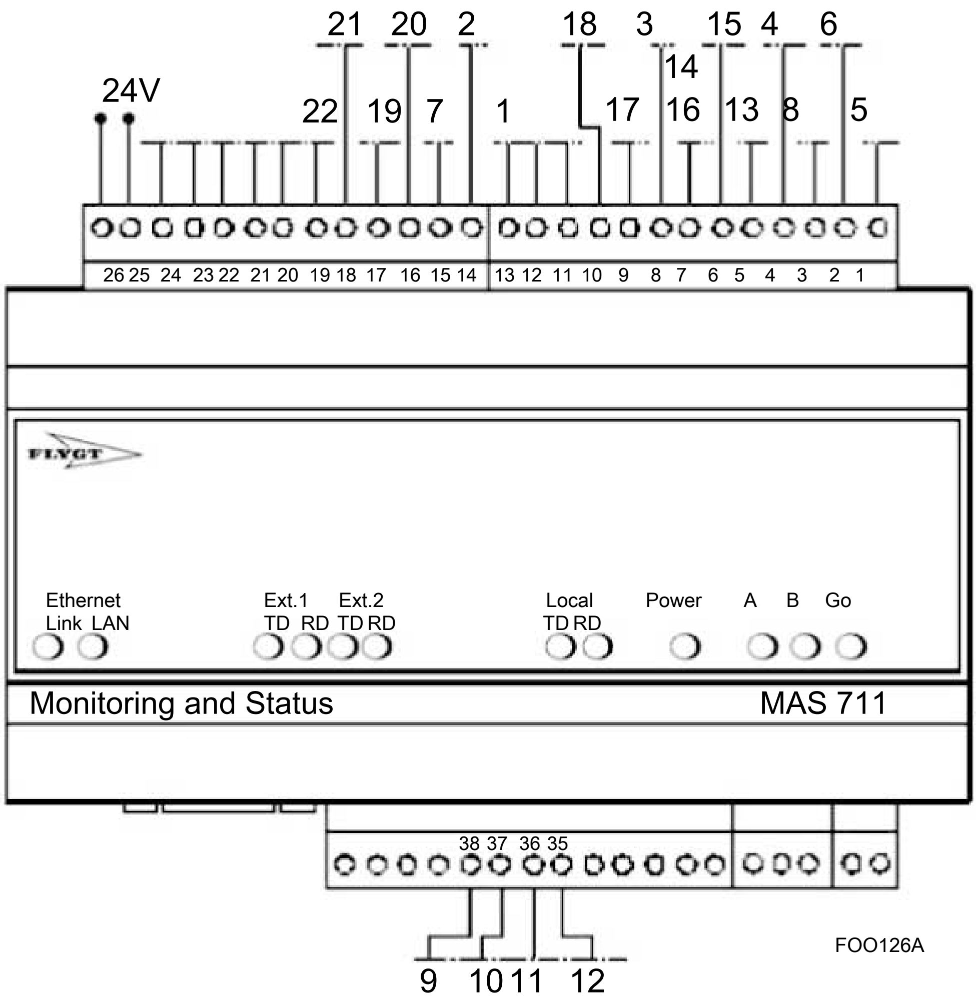


Figure 24: Connections at the MAS 711 base unit

This table shows how the conductors are connected to the different sensors.

Sensor		Terminal block	Conductor number for 12-lead cable	Conductor for 24-lead cable
Float switch in the stator house[3]		1	1	1
		2	2	2
Float switch in the junction box		9	7	7
		2	–	–
Pt100 in the main bearing[4]		3	3	3
		4	4	4
Pt100 in the support bearing		37	–	17
		38	–	18
Thermal switches or thermistors in the stator		5	5	5
		6	6	6
CLS sensor in the oil housing	+	33	–	19
	-	34	–	20

3 The leakage sensor in the stator housing and the leakage sensor in the junction box use the same terminal (terminal 2) on the terminal block.
4 The Pt100 sensors in the main bearing and the support bearing use the same terminal (terminal 4) on the terminal block.

Sensor		Terminal block	Conductor number for 12-lead cable	Conductor for 24-lead cable
Pt100 in the stator winding 1		19	8	8
		4	–	–
Pt100 in the stator winding 2		21	–	13
		22	–	14
Pt100 in the stator winding 3		23	–	15
		24	–	16
Memory module RS-485 B		74	9	9
Memory module RS-485 A		75	10	10
Memory module supply, ground (earth)		76	11	11
Memory module supply, 12 VDC+		77	12	12
Vibration sensor VIS 10	+	78	–	21
	-	79	–	22

4.5.7 Power cable phase sequence

In the following figure, the triangle marked “L1,” “L2” and “L3” shows the phase sequence.

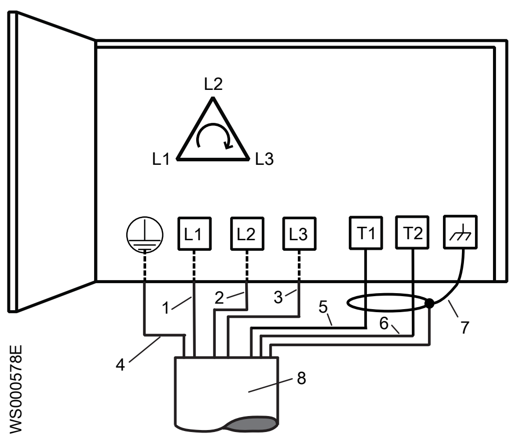
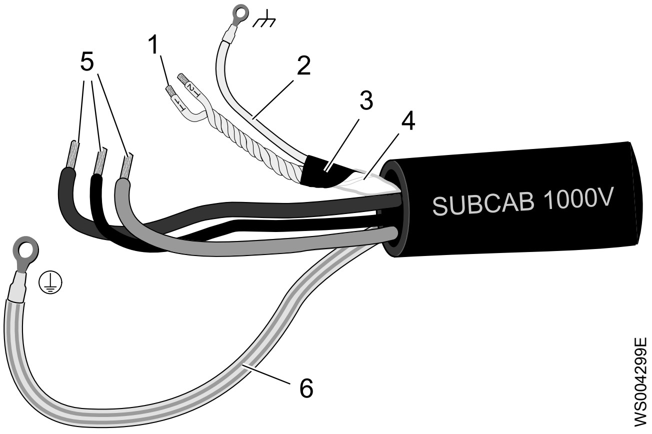


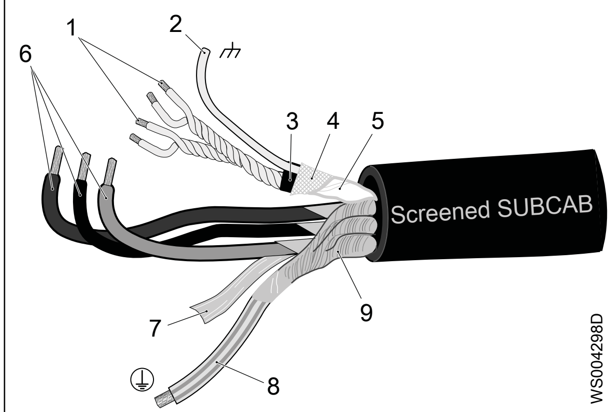
Figure 25: Correct phase sequence

Item	Description	
1	L1 cable lead	Brown
2	L2 cable lead	Black
3	L3 cable lead	Gray
4	Earth PE or ground lead cable	
5	T1 cable lead (control element)	In cables with both power cores and control element. MAS 801: See the SIO manual for T1, T2, and drain wire connections.
6	T2 cable lead (control element)	
7	Screen (drain wire)	
8	Power cable to unit	

4.5.8 Prepare the SUBCAB® cables

This section applies to SUBCAB® cables with twisted-pair control cores.

<table>
<tr><th>The prepared SUBCAB® cable</th><th>The prepared screened SUBCAB® cable</th></tr>
<tr><td>


1. T1+T2 twisted pairs in control element
2. Drain wire in control element (bare aluminum wire)
3. Screened aluminum pt-foil
4. Insulation sheath (jacket) or PT-foil for control element
5. Power cores
6. Ground (earth) core
</td><td>


1. T1+T2 and T3+T4 twisted pairs in control element
2. Drain wire in control element (bare aluminum wire)
3. Screened aluminum pt-foil
4. Insulation sheath (jacket) for control element
5. Power cores
6. Aluminum foil
7. Ground (earth) core with green/yellow shrink hose
8. Uncovered screen/braided wire
</td></tr>
</table>

1. Peel off the outer sheath at the end of the cable.
2. Prepare the control element:
   a) Peel the sheath (if applicable) and the aluminum foil.

   The aluminum foil is a screen and is conductive. Do not peel more than necessary, and remove the peeled foil.

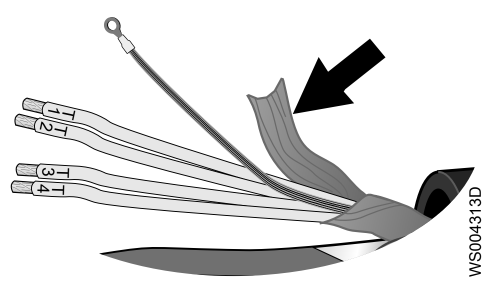


Figure 26: Aluminum foil on control element.

   b) Put a white shrink hose over the drain wire and the cable terminal.
   c) Fit a cable lug on the drain wire.
   d) Twist T1+T2 and T3+T4.
   e) Put a shrink hose over the control element.

   Make sure that the conductive aluminum foil and drain wire is covered.
3. Prepare the ground (earth) core for SUBCAB™ cable:
   a) Peel the yellow-green insulation from the ground (earth) core.
   b) Check that the ground (earth) core is at least 10% longer than the phase cores in the cabinet.
   c) If applicable, put a cable lug on the ground core.
4. Prepare the ground (earth) core for screened SUBCAB™ cable:
   a) Untwist the screens around the power cores.
   b) Put a yellow-green shrink hose over the ground (earth) core.

   Leave a short piece uncovered.
   c) If applicable, put a cable lug on the screened ground core.

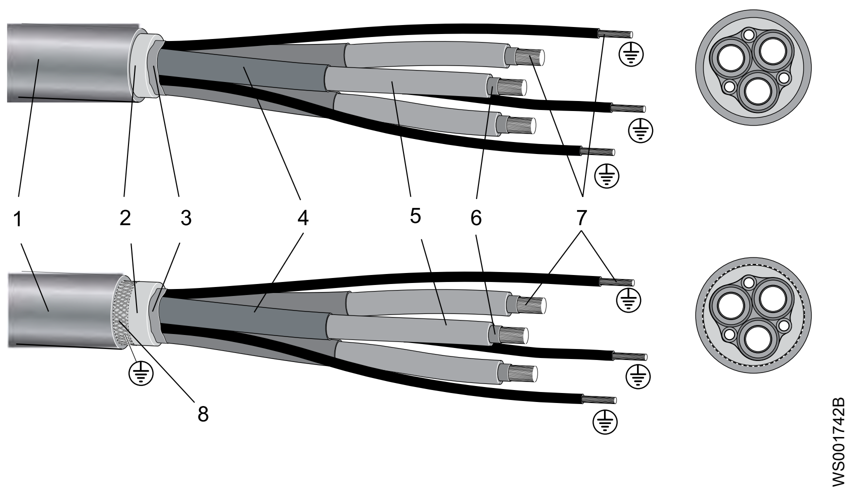
d) Twist all power core screens together to create a ground (earth) core and fit a cable terminal to the end.
e) Check that the ground (earth) core is at least 10% longer than the phase cores in the cabinet.

5. Connect to ground (earth):
   - Screw: Fit cable terminals to the ground (earth) core and the power cores.
   - Terminal block: Leave the core ends as they are.
6. Prepare the main leads:
   a) Remove the aluminum foil around each power core.
   b) Peel the insulation from each power core.

4.5.9 Prepare the medium-voltage cable

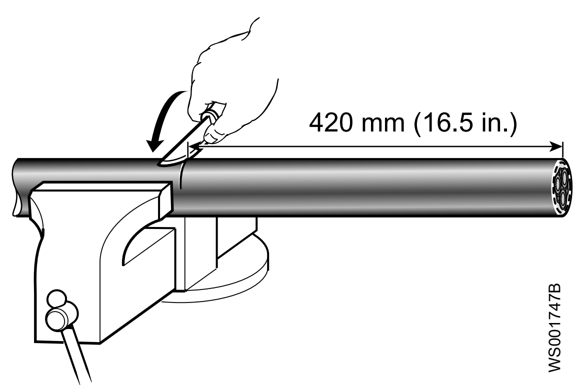
This instruction is for preparing medium voltage (1.2-15 kV) power cables prior to connecting them at the pump.

The upper illustration shows a cable without screen. The lower illustration shows a screened cable.

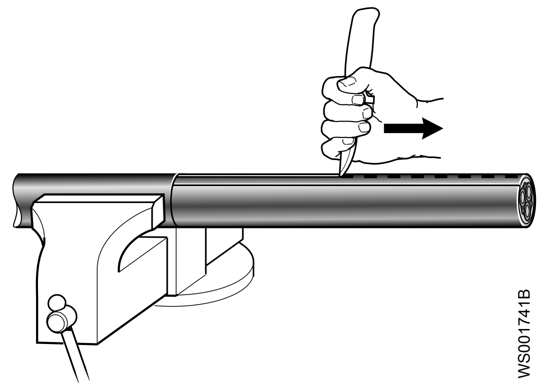


1. Outer cable sheath
2. Inner sheath
3. Conductive foil
4. Conductive layer
5. Conductor insulation
6. Conductive foil
7. Copper conductor
8. Shield wires

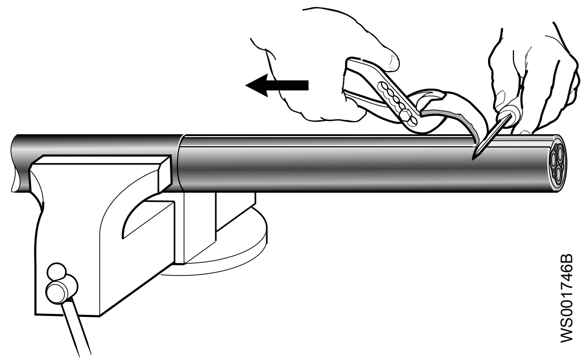
1. Peel off 420 mm of the cable casing at the connection end of the cable.
   a) Make the vertical cut.



   b) Make the horizontal cut.

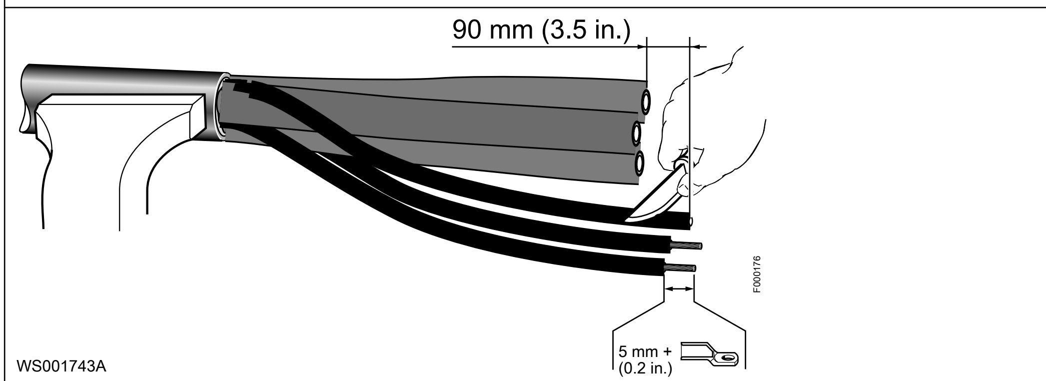


c) Remove the cable casing.

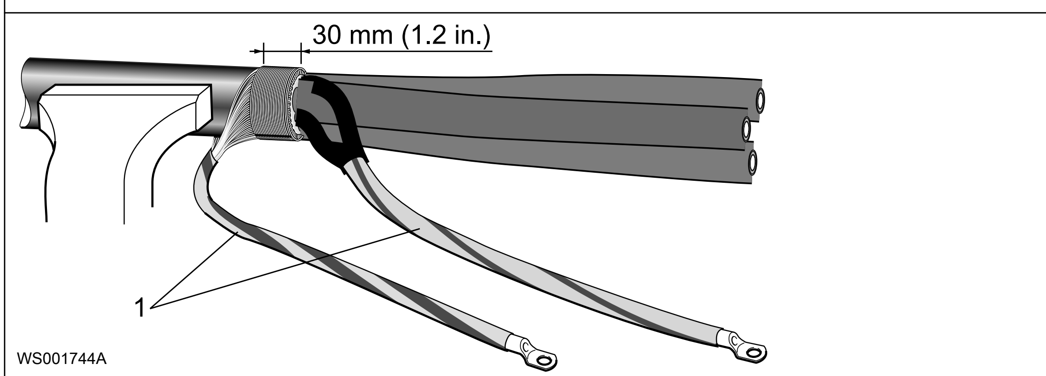


2. Peel off the casing from the leads.

Cable without screen:

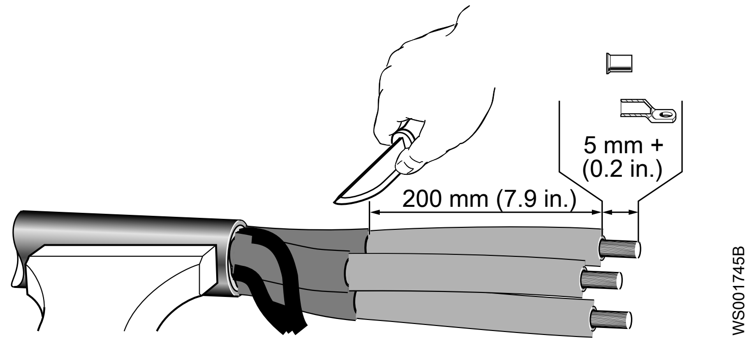


Screened cable:

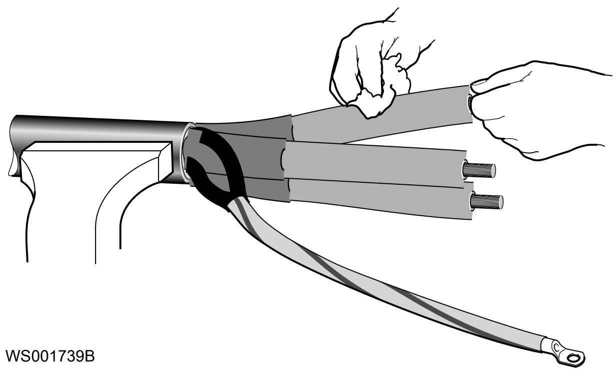


1. Yellow/green insulating hose

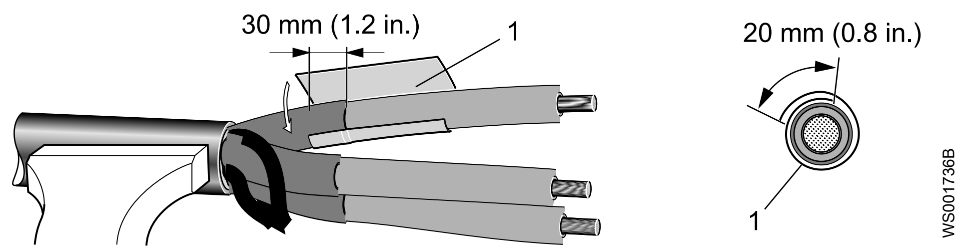
3. Peel off the conductive layer.



4. Clean the power leads with chemically pure petrol.

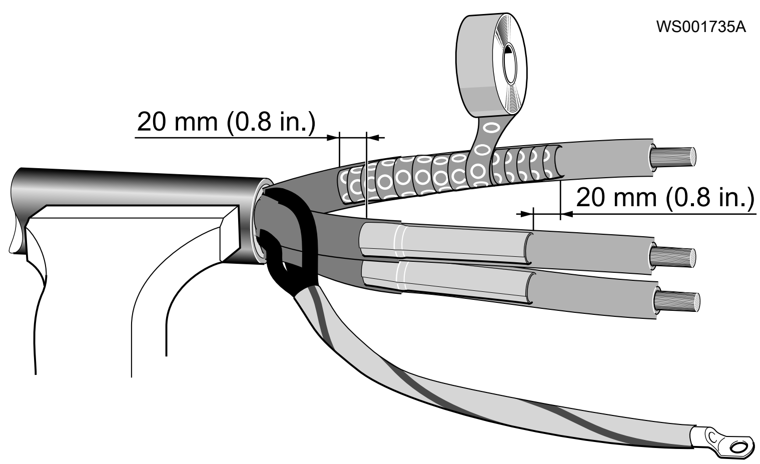


5. Attach the FSD (stress-grading pad) to the leads.

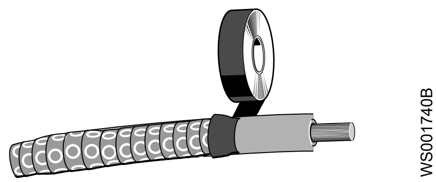


1. FSD, stress-grading pad

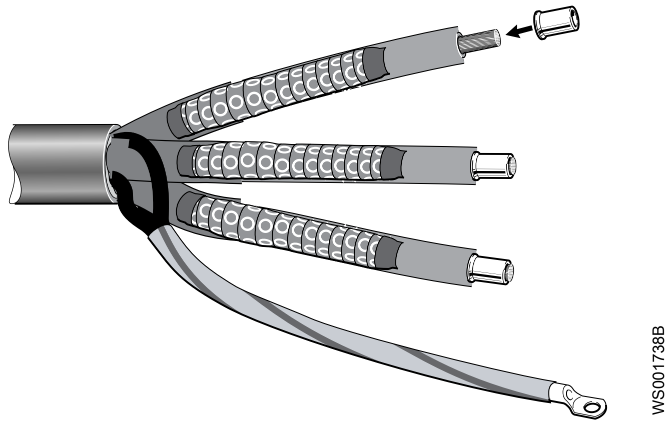
6. Apply four turns of IV (insulating self-bonding) tape with half overlap.
   Stretch the tape until the markings are circular.



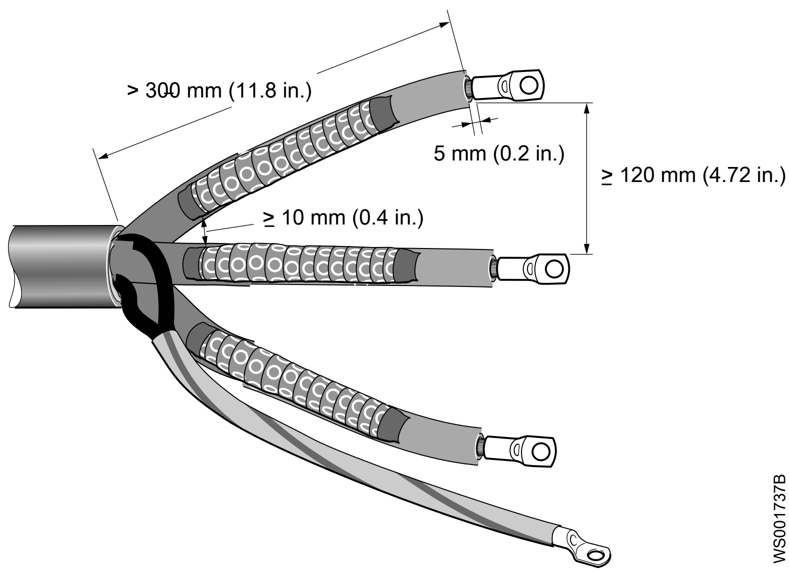
7. Fasten the IV tape ends with electrical tape.



8. Fasten the connection shoes and connection eyes to the leads.



Example of cable end at electrical panel:



Dimensions shown are the recommended distances.

4.6 Cable charts

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable dry at all times.

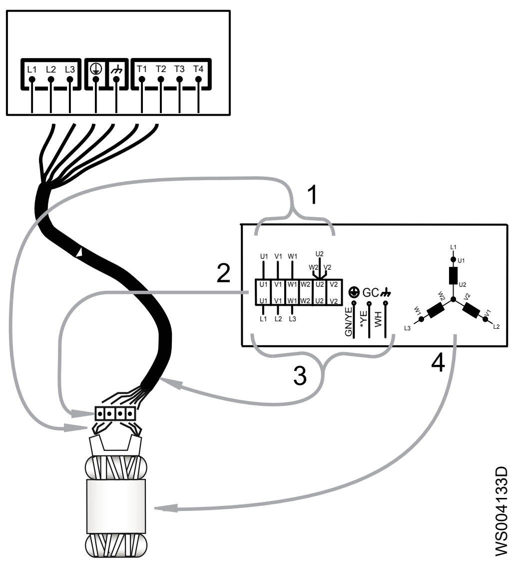
Stator leads connection to terminal board

Terminal board	Stator leads connection to terminal board			
	3 leads Y	6 leads D	6 leads Y	6 leads Y/D
U1	U	U1	U1	U1
V1	V	V1	V1	V1
W1	W	W1	W1	W1
W2	-	W2	W2	W2
U2	-	U2	U2	U2
V2	-	V2	V2	V2

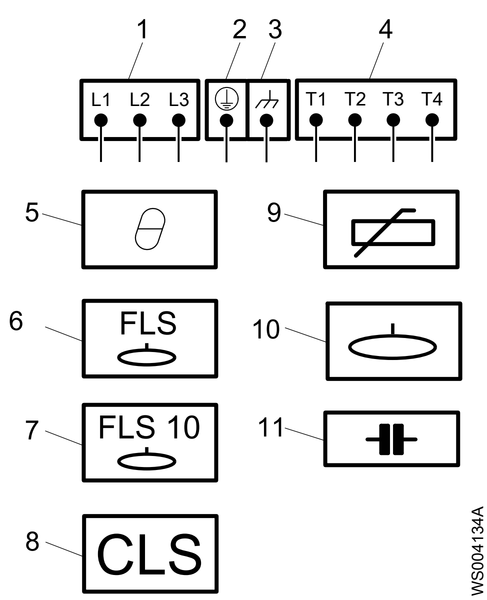
WS007848A

Connection locations

The figures in this section illustrate how to interpret the connection strip symbols.



1. Stator leads
2. Terminal board
3. Power cable leads
4. Stator (internal connection illustrated)



1. Starter equipment and mains leads (L1, L2, L3)
2. ground (earth)
3. Functional ground
4. Control leads (T1, T2, T3, T4)
5. Thermal contact
6. FLS
7. FLS 10
8. CLS
9. Thermistor
10. Level sensor
11. Capacitor

3-phase connection, screened

If a separate control cable is used, then the control cores in the power cable are never used.

The following figure shows screened SUBCAB cable without a separate ground conductor. The ground conductor is made of stranded ground cores. T1 and T2 are twisted together.

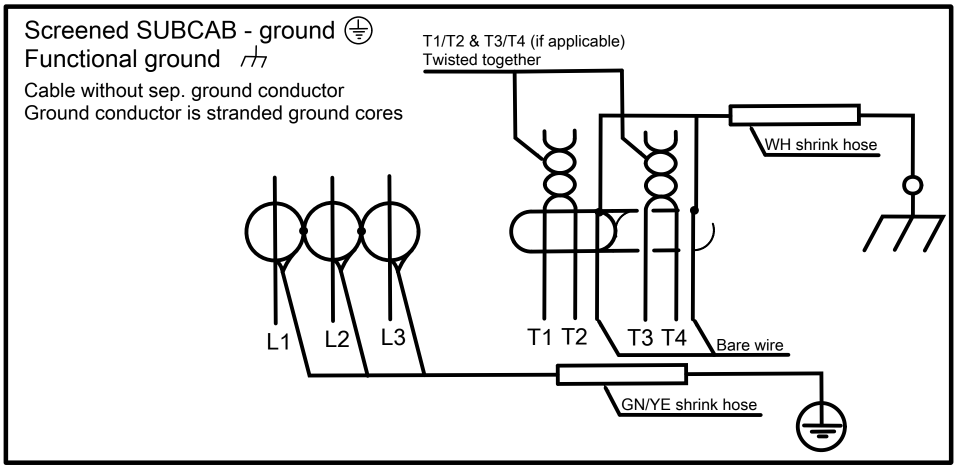


Figure 27: Without separate ground conductor

The following figure shows screened SUBCAB with a functional ground. T1 and T2 are twisted together.

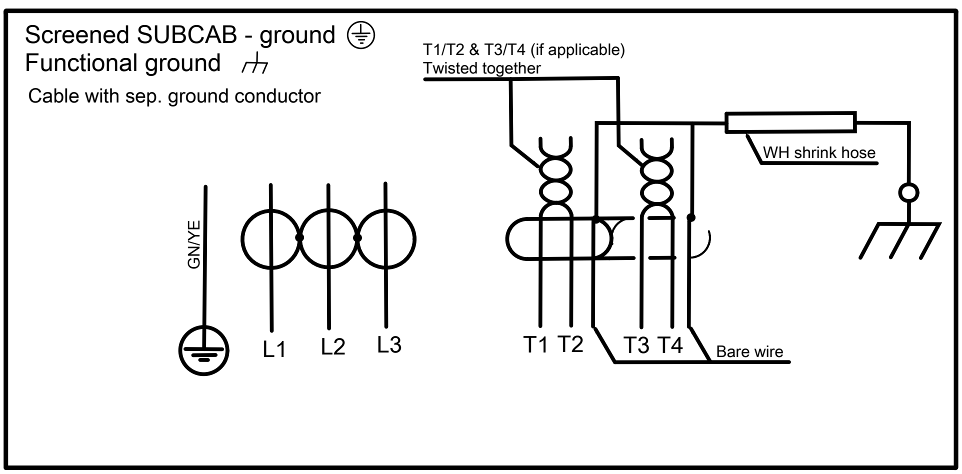


Figure 28: With functional ground

4.6.1 Colors and markings of leads

MOTOR CONNECTION
COLORS AND MARKING OF MAIN LEADS

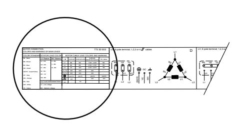
773 30 00 (REV 4)

COLOR STANDARD
BK - Black
BN - Brown
BU - Blue
GN - Green
GN/YE - Green/Yellow
GY - Grey
OG - Orange
RD - Red
WH - White
YE - Yellow

STATOR LEAD COLORS	
LV Stators	MV Stators
U1 - RD	U - BK
U2 - GN	V - BK
V1 - BN	W - BK
V2 - BU	
W1 - YE	
W2 - BK	

VOLTAGE DENOMINATIONS
LV - Low voltage
MV - Medium voltage

MOTOR CABLE LEAD COLORS AND MARKING				
3 ~	SUBCAB	SUBCAB AWG	SUBCAB S6x95+95+S(4x0.5)	MV cables
L1	BN	RD	1 WH , 4 WH	BK
L2	BK	BK	2 WH , 5 WH	BK
L3	GY	WH	3 WH , 6 WH	BK
T1, T2	WH	WH	WH	-
T3, T4	WH	WH	WH	-
⏚	GN/YE	GN/YE	GN/YE	GN/YE
⏦	WH	-	WH	WH
GC	-	YE	-	-



WS004335C

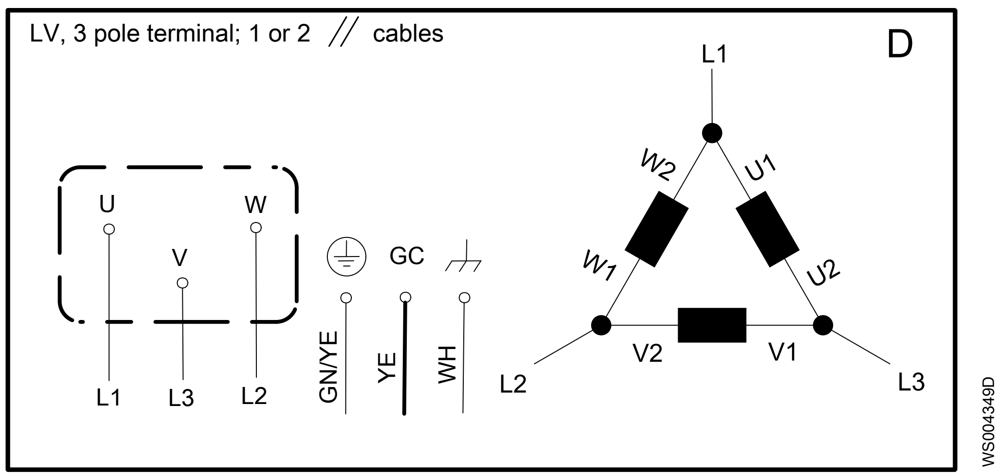
Color code standard

Code	Description
BN	Brown
BK	Black
WH	White
OG	Orange
GN	Green
GNYE	Green-Yellow
RD	Red
GY	Grey
BU	Blue
YE	Yellow

4.6.2 Power wiring diagrams: Drive units up to 1.1 kV

4.6.2.1 D-connection, 3-pole terminal

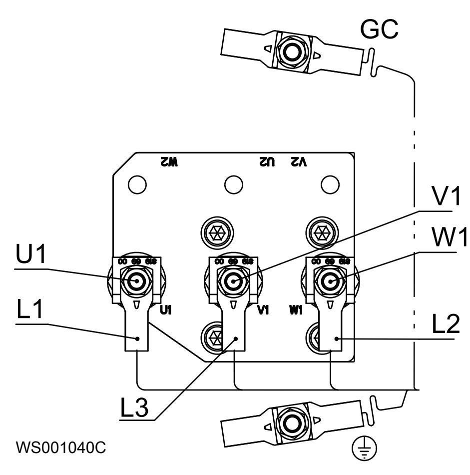
Schematic diagram



Drive units with small connection housing

Drive units:

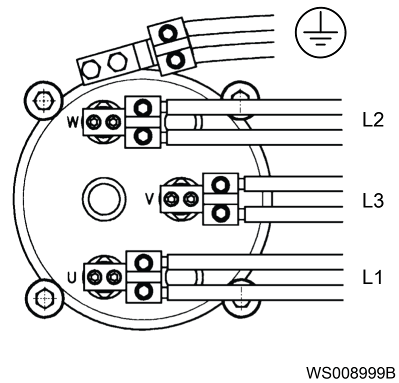
- 605/615, 665/675
- 705/715, 735/745, 765/775 with small connection housing
- 706/716, 736/746, 766/776 with small connection housing



Drive units with large connection housing

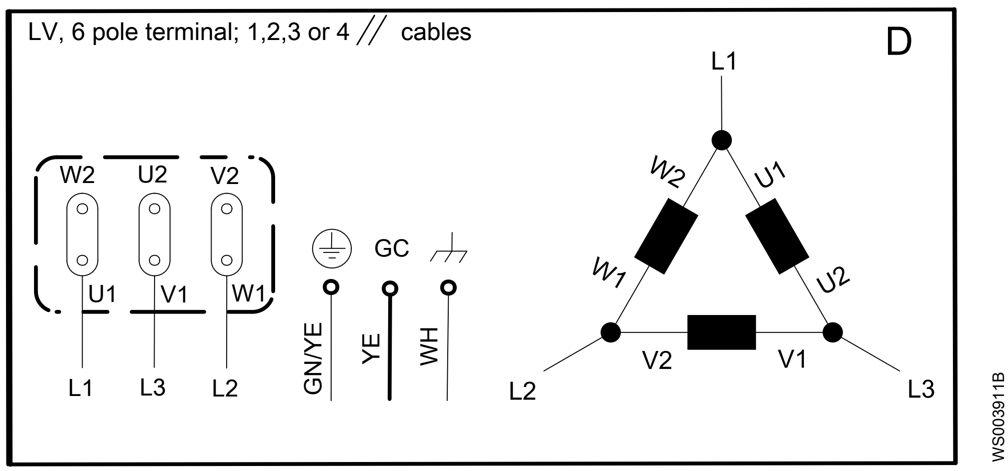
Drive units:

- 705/715, 735/745, 765/775 with large connection housing
- 706/716, 736/746, 766/776 with large connection housing
- 805/815, 835/845, 865/875
- 806/816, 836/846, 866/876
- 905/915, 935/945
- 906/916, 936/946



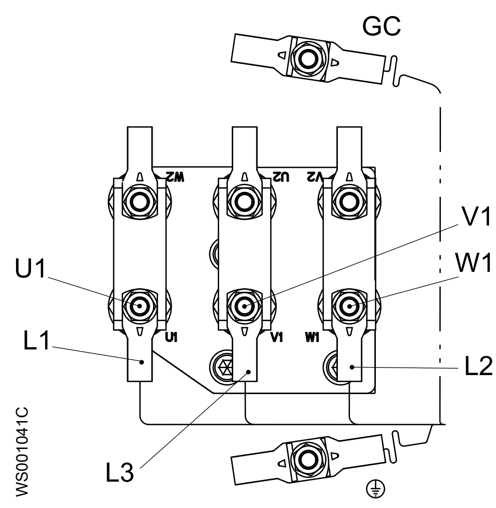
4.6.2.2 D-connection, 6-pole terminal; 1 cable

Schematic diagram



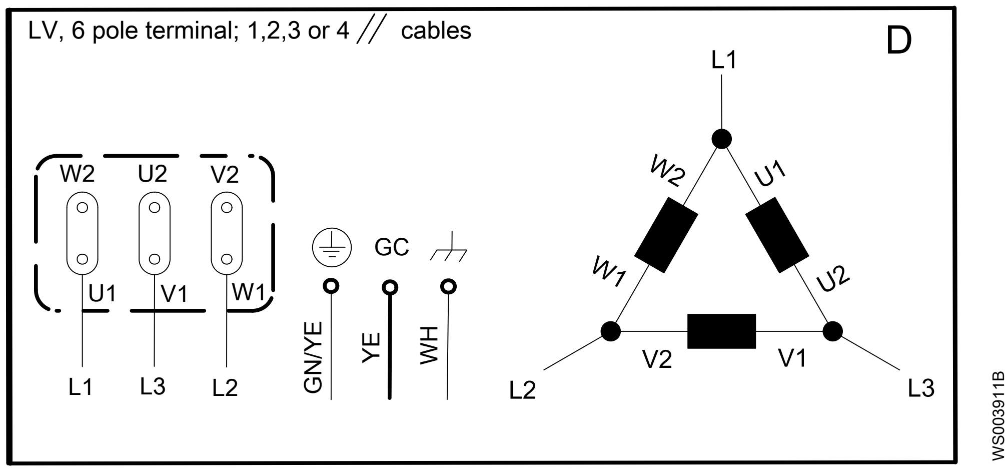
Drive units:

- 605/615, 665/675
- 705/715, 735/745, 765/775 with small connection housing
- 706/716, 736/746, 766/776 with small connection housing



4.6.2.3 D-connection, 6-pole terminal; 2 cables

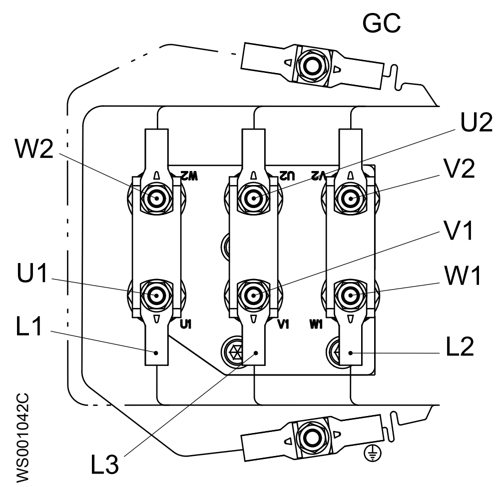
Schematic diagram



Drive units with small connection housing

Drive units:

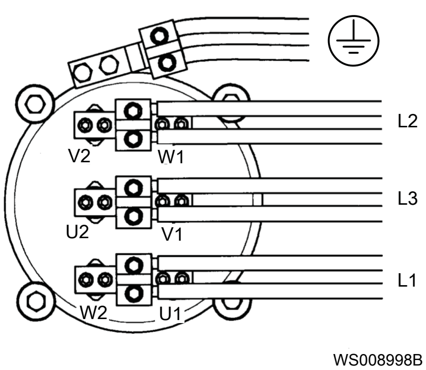
- 605/615, 665/675
- 705/715, 735/745, 765/775 with small connection housing
- 706/716, 736/746, 766/776 with small connection housing



Drive units with large connection housing

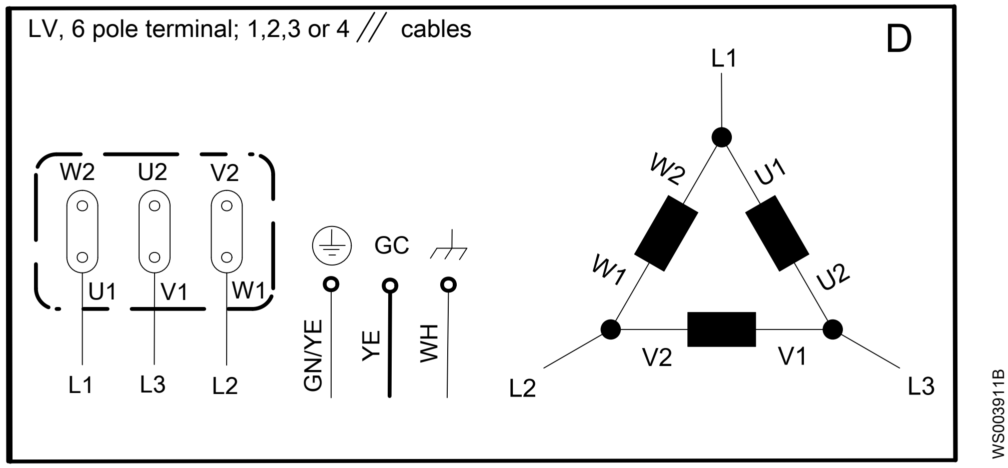
Drive units:

- 705/715, 735/745, 765/775 with large connection housing
- 706/716, 736/746, 766/776 with large connection housing
- 805/815, 835/845, 865/875, 885/895
- 806/816, 836/846, 866/876, 886/896
- 905/915, 935/945
- 906/916, 936/946



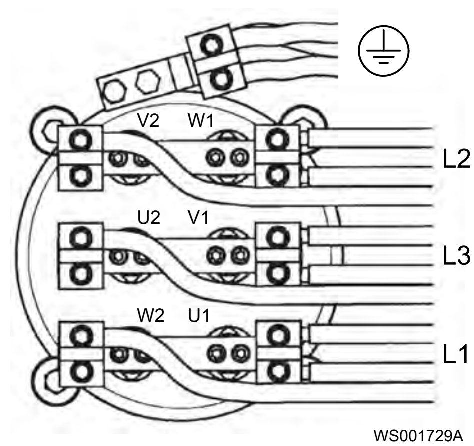
4.6.2.4 D-connection, 6-pole terminal; 3 cables

Schematic diagram



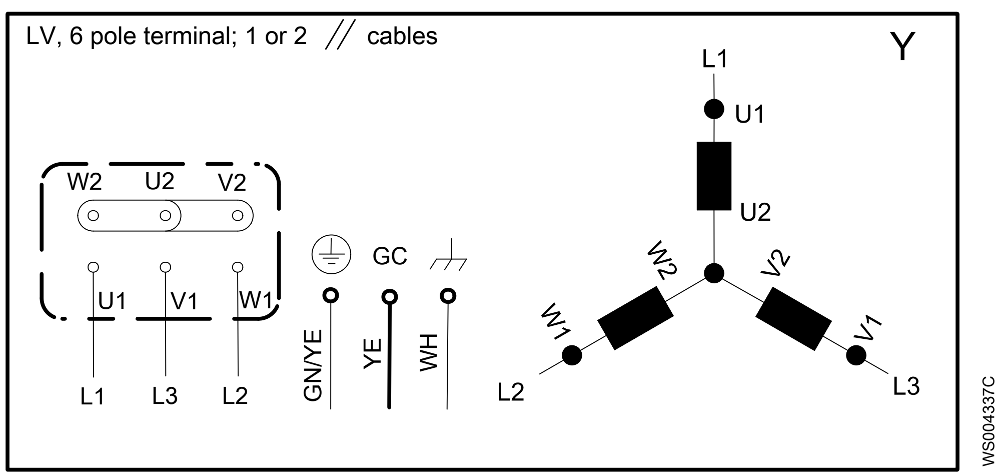
Drive units:

- 705/715, 735/745, 765/775 with large connection housing
- 805/815, 835/845, 865/875, 885/895
- 806/816, 836/846, 866/876, 886/896
- 905/915, 935/945
- 906/916, 936/946



4.6.2.5 Y-connection

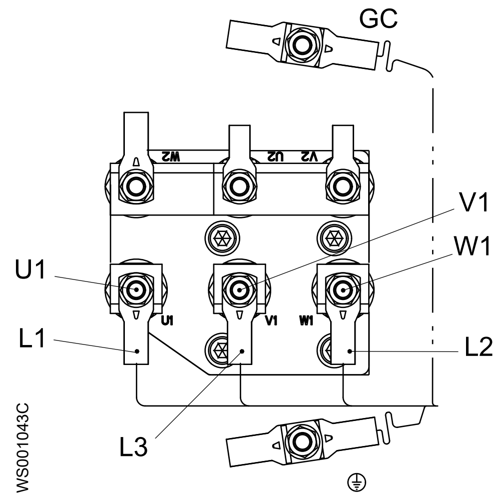
Schematic diagram



Drive units with small connection housing: 1 cable

Drive units:

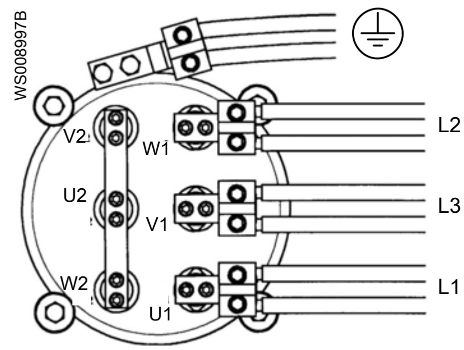
- 605/615, 665/675
- 705/715, 735/745, 765/775 with small connection housing
- 706/716, 736/746, 766/776 with small connection housing



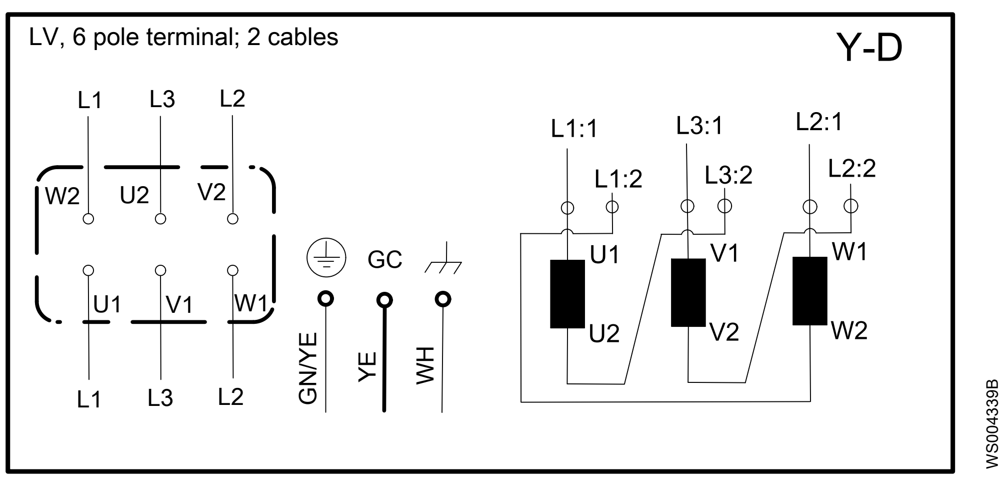
Drive units with large connection housing: 2 cables

Drive units:

- 705/715, 735/745, 765/775 with large connection housing
- 706/716, 736/746, 766/776 with large connection housing
- 805/815, 835/845, 865/875, 885/895
- 806/816, 836/846, 866/876, 886/896
- 905/915, 935/945
- 906/916, 936/946



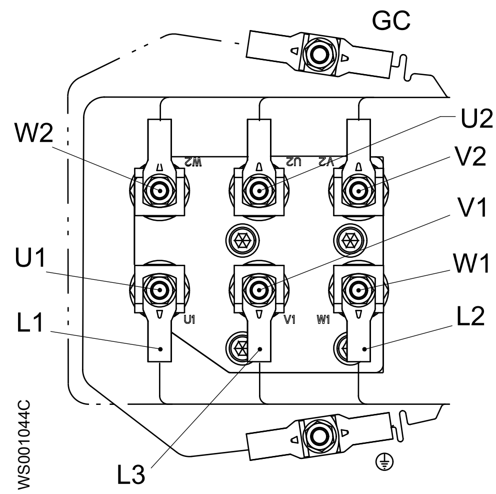
4.6.2.6 Y/D-connection



Drive units with small connection housing

Drive units:

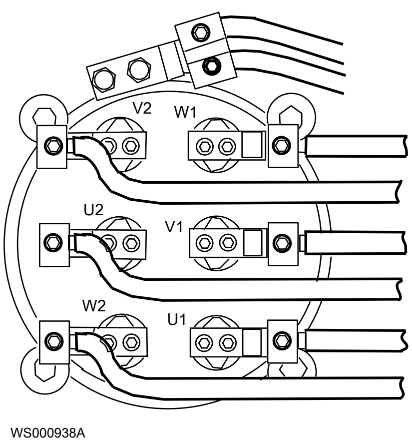
- 605/615, 665/675
- 705/715, 735/745, 765/775 with small connection housing
- 706/716, 736/746, 766/776 with small connection housing



Drive units with large connection housing

Drive units:

- 705/715, 735/745, 765/775 with large connection housing
- 706/716, 736/746, 766/776 with large connection housing
- 805/815, 835/845, 865/875, 885/895
- 806/816, 836/846, 866/876, 886/896
- 905/915, 935/945
- 906/916, 936/946



4.6.3 Power wiring diagram: Drive units 1.2–6.6 kV

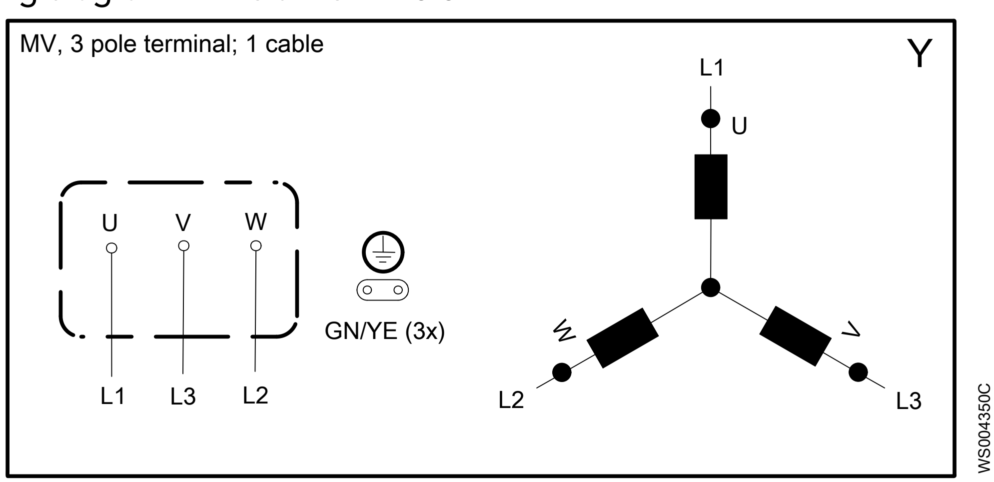
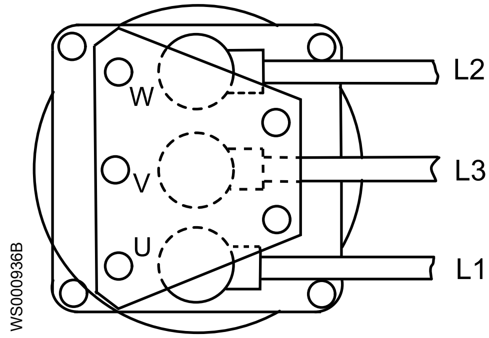


Figure 29: Wiring diagram for medium-voltage (1.2–6.6 kV) drive units

Medium-voltage drive units:

- 862/872, 882/892
- 863/873, 883/893



4.7 Check the impeller rotation

CAUTION: Crush Hazard

The starting jerk can be powerful. Make sure nobody is close to the unit when it is started.

If the propeller rotates in the wrong direction, then the pump lifts up and rotates, which can damage the cables.

1. Start the motor.
2. Stop the motor after a few seconds.
3. Check the propeller rotation.

   The correct direction of propeller rotation is clockwise when you look at the pump from above.

   Direction of propeller rotation. Generic pump shown.

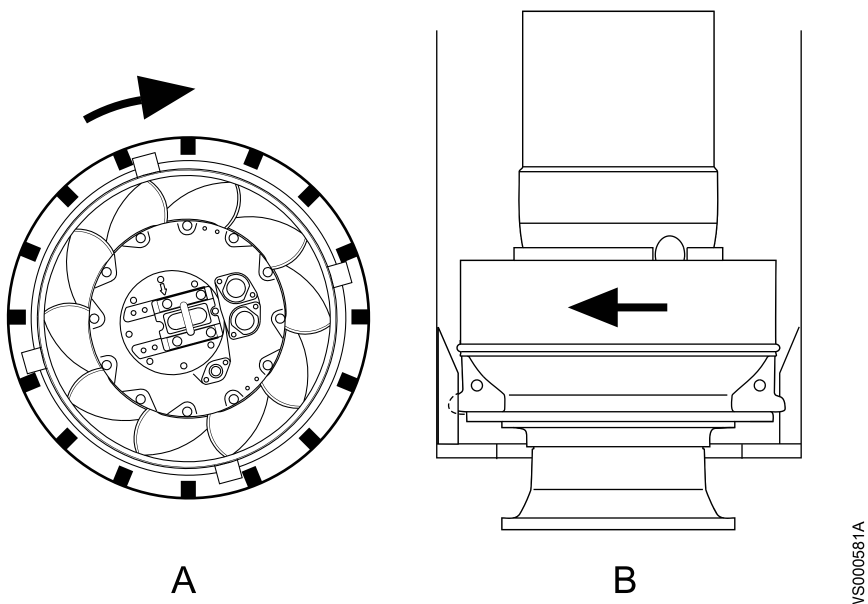


Figure 30: Top view (A) and side view (B)

4. If the impeller/propeller rotates in the wrong direction, then check that the phase leads are correctly connected. See *Power cable phase sequence* on page 58.

   After reconnecting phase leads, do this procedure again.

5 Operation

5.1 Precautions

Before taking the unit into operation, check the following:

- All recommended safety devices are installed.
- The cable and cable entry have not been damaged.
- All debris and waste material has been removed.

NOTICE:

Never operate the pump with the discharge line blocked, or the discharge valve closed.

WARNING: Crush Hazard

Risk of automatic restart.

Distance to wet areas

WARNING: Electrical Hazard

Risk of electrical shock or burn. You must connect an additional ground- (earth-) fault protection device to the grounded (earthed) connectors if persons are likely to come into contact with liquids that are also in contact with the pump or pumped liquid.

CAUTION: Electrical Hazard

Risk of electrical shock or burn. The equipment manufacturer has not evaluated this unit for use in swimming pools. If used in connection with swimming pools then special safety regulations apply.

Noise level

NOTICE:

The sound power level of the product is lower than 70 dB(A). However, in some installations the resulting sound pressure level may exceed 70 dB(A) at certain operating points on the performance curve. Make sure that you understand the noise level requirements in the environment where the product is installed. Failure to do so may result in hearing loss or violation of local laws.

5.2 Estimate zinc anode replacement intervals

The mass and surface area of the zinc anodes are designed to protect the pump surface for 1 year in sea water with an average temperature of 20°C (68°F). Shorter inspection intervals and anode replacement can be required, depending upon the water temperature and the chemical composition as well as the presence of other metals in the vicinity of the pump.

The rate of zinc consumption, and the appropriate inspection intervals, can be estimated by measuring how much zinc is consumed during the first two months following installation.

Anodes are replaced when the anode mass is reduced to a selected fraction of its initial mass. The recommended interval for the selection fraction is 0.25–0.50 (25–50%).

1. Remove, weigh, and reinstall one or more of the exterior zinc anodes before starting up the pump.
2. After two months, remove and weigh the same zinc anode or anodes again.

3. Divide the lapsed time in days (between steps 1 and 2) by the anode weight loss in grams to get the calculated anode consumption rate (days/gram).

   If multiple anodes were weighed, then use the anode which has lost the most weight for this calculation.
4. Calculate future replacement intervals so that they occur when the selected fraction of zinc is remaining.

5.3 Start the pump

CAUTION: Crush Hazard

The starting jerk can be powerful. Make sure nobody is close to the unit when it is started.

1. Check that:
   a) The monitoring equipment works.
   b) The starter equipment is installed according to the instructions from the manufacturer.
   c) All the alarms function.
   d) The lubricant is at the correct level.
2. Remove the fuses or open the circuit breaker, and check that the impeller can be rotated freely.

   WARNING: Crush Hazard

   Never put your hand into the pump housing.

   Make sure that the locking device has been removed. See *The locking device* on page 35.

   Make sure that the propeller rotates in the correct direction. See *Check the impeller rotation* on page 72.
3. Conduct insulation test phase to ground. To pass, value must exceed 5 megohms. See *Checking insulation and sensors* on page 79.
4. Start the pump.

Check that:

- The machine works without noise or vibration.
- All electrical values are correct.
- All accessories work correctly.

Record any abnormalities.

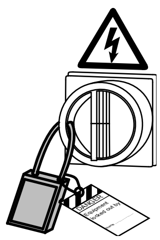
6 Maintenance

6.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 4 have been read and understood.

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

CAUTION: Thermal Hazard

Allow surfaces to cool before starting work, or wear heat-protective clothing.

The following requirements apply:

- Make sure that all safety guards are in place and secure.
- Make sure that equipment is in place so that the unit cannot roll or fall over during the maintenance process.
- Make sure that you have a clear path of retreat.
- Never work alone.
- Check the explosion risk before you weld or use electrical hand tools.
- Before starting work, make sure that the work area is well-ventilated.
- Do not open any vent or drain valves or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Depressurize and empty the coolant system for T and Z installations, and all installations with external cooling.

Ground continuity verification

A ground (earth) continuity test must always be performed after service.

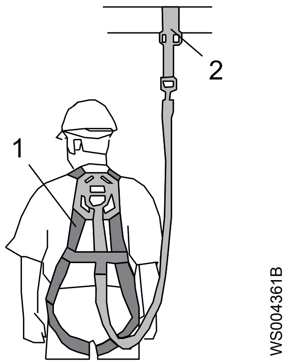
6.1.1 Falling

CAUTION: Fall Hazard

Slips and falls can cause severe injuries. Watch your step.

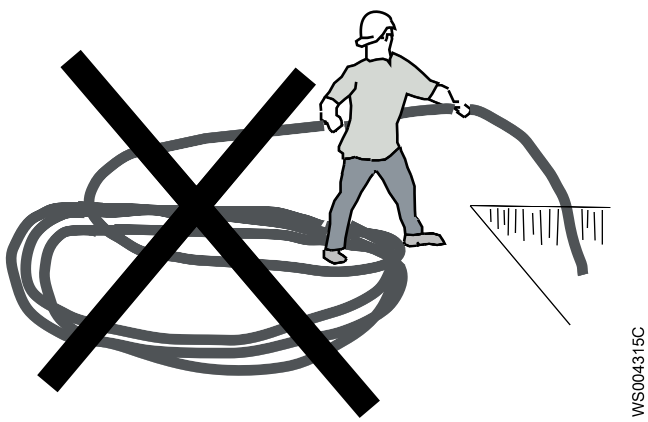
To minimize the risk of falling, observe the following:

- Use appropriate personal protection equipment when working in or near open basins, shafts, or trenches.



1. Fall protection harness
2. Anchoring point

- Make sure that all safety guards are in place and secure, and that there is a suitable barrier around the work area.
- Wear clean slip-resistant shoes.
- Make sure that any ladders or climbing equipment that is used is correctly sized and in good working condition.
- Never stand in coiled cables, ropes or wires, or between them and the open shaft or basin.



6.2 Service

Regular inspection and service of the pump makes sure that operation will be more reliable.

Every time the site is visited, visually examine the accessories and sump for corrosion, wear or damage.

Table 23: Service intervals

Type of service	Purpose	Interval
Initial inspection	To make a check up of the pump condition by an authorized Xylem service representative and, based on the result and findings from these measures, to determine the intervals for periodical inspection and major overhaul for the specific installation.	In the first year of operation.

Type of service	Purpose	Interval
Periodical inspection	To prevent operational interruptions and machine breakdown. Measures to secure performance and efficiency are defined and decided for each individual application. It can include such things as impeller trimming, wear part control and replacement, control of zinc-anodes and control of the stator.	12,000 hours or 3 years, whichever comes first. Applies to normal applications and operating conditions at media (liquid) temperatures < 40°C (104°F).
Major overhaul	To secure a long operating lifetime for the product. It includes the replacement of key components and the measures that are taken during an inspection.	24,000 hours or 6 years, whichever comes first. Applies to normal applications and operating conditions at media (liquid) temperatures < 40°C (104°F).

NOTICE:

Shorter intervals may be required when the operating conditions are extreme, for example with very abrasive or corrosive applications or when the liquid temperatures exceed 40°C (104°F).

6.2.1 Inspection

CAUTION: Compressed Gas Hazard

Air inside may cause parts or liquid to be propelled with force. Be careful when opening.

Regular inspection and service of the pump makes sure that the operation is more reliable.

For seal lubricant information, see *Lubricants used in the drive units* on page 81.

Do the following to service the pump:

Part to service	Action
Pump exterior	Check the entire pump and the cables for external mechanical damage.
Cable	1. If the outer jacket is damaged, replace the cable. 2. Check that the cables do not have any sharp bends and are not pinched. 3. Check that the leads and cable entry screws are correctly connected and tightened to the correct torque.
Lifting handle	Check the lifting handle for corrosion or other damage.
Junction box	1. General: Check that it is clean and dry. If it is wet: a. Check the cable entry. b. Replace the O-rings. Fit new O-rings to all O-ring seal joints which are opened during inspection. 2. Terminal board: Check that the connections are properly secured.
Junction box insulation: Drive units up to 1.1 kV	Check the condition and function. See *Check the insulation, up to 1 kV drives or generators* on page 80.

Part to service	Action
Junction box insulation: Drive units 1.2–6.6 kV	Check the condition and function. See *Check the insulation, 1.2–6.6 kV drives* on page 80.
Stator housing Drive units with oil as the seal lubricant.	1. Check that it is clean and dry. – If there is oil in the stator housing, then drain and clean it. Check the stator housing again after one week of operation. If there is still oil in the stator housing, then change the seals. – If there is water in the stator housing and there was water in the oil, change the seals immediately. – If there is water in the stator housing, but there was no water in the oil, check all other connections. 2. Replace the O-rings.
Oil housing Drive units with oil as the seal lubricant	1. Check the oil quality: – If there is water in the oil, then drain the oil and replace with new oil. After one week of operation, check the oil quality again. – If the oil is free from water, then fill the oil to the correct level, if necessary. 2. Replace the filling plug O-rings.
Hydraulic parts	1. Check the general condition of the impeller or propeller and the wear ring. 2. Replace if necessary. 3. If applicable, check O-ring.
Zinc anodes	Check and change if necessary.
Screw joints	Check all externally accessible screw joints, and tighten if necessary to the correct torque. See *Torque values* on page 91.
Electrical cabinets	Check that it is clean and dry.
Connection to power	Check that the connections are properly secured.
Level regulators	Check the condition and function. See *Check the leakage detectors* on page 80.
Temperature sensors	Check the condition and function. See *Check the temperature sensors* on page 80.

After any service involving the power connections, you must check the rotation before operating the pump. See *Check the impeller rotation* on page 72.

6.2.2 Major overhaul

1. Perform a complete inspection service. See *Inspection* on page 77.
2. Do these additional steps:

Part to service	Action
Motor: insulation check Drive units up to 1.1 kV	Check that the resistance between earth and phase lead is more than 5 MΩ. Use a 500 VDC or 1000 VDC insulation and continuity tester.
Motor: insulation check 1.2–6.6 kV drive units	1. Check that the resistance between earth and phase lead is more than the minimum for the motor voltage. Recommended test voltage: 2500 VDC The resistance value is related to the motor voltage and must have minimum value of 5 MΩ/kV at a temperature of 25°C (77°F). For example, for a 6 kV motor the resistance between earth and phase lead must be more than 30 MΩ.
Cable	Check that the rubber sheathing is undamaged. Change if necessary.
Oil housing	Change the lubricant. For lubricant information, see *Lubricants used in the drive units* on page 81.

Part to service	Action
General dismantling and cleaning	1. Dismantle the pump completely. 2. Clean all the parts. 3. Reassemble after replacing bearings, O-rings, and seals.
Bearings	Replace the bearings with new bearings.
O-rings and other rubber sealing parts	Replace O-rings and other rubber sealing parts.
Seals	Replace with new seals.
Sensors	Check the following: 1. Stator temperature sensors 2. Bearing temperature sensors 3. FLS and CLS sensors See *Check the temperature sensors* on page 80 and *Check the leakage detectors* on page 80.
Impeller or propeller	Check the general impeller or propeller status. Change if necessary. Check general wear ring status. Change if necessary.
Zinc anodes	Check their condition. Replace if necessary.
Screw joints	Check all externally accessible screw joints and tighten if necessary to the correct torque. See torque table and Parts List.
Lifting handle	Check its condition. Replace if necessary.
Painting	Touch up any painting if necessary.
Rotational direction	Check the impeller or propeller rotation direction. See *Check the impeller rotation* on page 72.
Voltage and amperage	Check the running values.
Electrical cabinets or panels	Check that it is clean and dry.
Connection to power	Check the cable connections. Tighten if necessary.
Overload protection and other protections	Check the correct settings.
Level regulators	Check condition and function.

After any service involving the power connections, check the rotation before operating the pump. See *Check the impeller rotation* on page 72.

6.2.3 Checking insulation and sensors

It is important that the checks for motor insulation, temperature sensors and leakages sensors are performed correctly and using appropriate tools. Parts of the unit, for example temperature sensors or the PEM, can be damaged if a megger or other device is used to apply a voltage higher than 2.5 V.

Use the following table to choose the appropriate procedures.

Item	Section
Motor insulation, drive units or generators up to 1 kV	*Check the insulation, up to 1 kV drives or generators* on page 80
Motor insulation, drive units or generators 1.2–6.6 kV	*Check the insulation, 1.2–6.6 kV drives* on page 80
Thermal contacts	*Check the temperature sensors* on page 80
PTC thermistors	
Pt100	
FLS leakage detector	*Check the leakage detectors* on page 80
CLS leakage detector	

6.3 Check the insulation, up to 1 kV drives or generators

1. Check that the resistance between earth and phase lead is more than 5 MΩ.
   Use a 500 VDC or 1000 VDC megger.
2. Keep a record of the results.

6.4 Check the insulation, 1.2–6.6 kV drives

1. Check that the resistance between earth and phase lead is above the minimum for the motor voltage.

Motor rating	Recommended test voltage
1.0 – 2.5 kV AC	1.0 – 2.5 kV DC
2.5 – 6.6 kV AC	2.5 – 5 kV DC

   The resistance value is related to the motor voltage and should have minimum value of 5 MΩ/kV at a temperature of 25°C (77°F).

   For example, for a 6 kV motor the resistance between earth and phase lead should be more than 30 MΩ.
2. Keep a record of the results.

6.5 Check the temperature sensors

If the unit is connected to the MAS monitoring system, then it is recommended that the sensors be checked in the MAS unit. Otherwise, use a multimeter.

The different types of temperature sensors are:

- Thermal switches
- PTC thermistors
- Pt100

NOTICE:
Do not use a megger or other device applying a higher voltage than 2.5 V.

1. Disconnect the sensor wires.
2. Check the status of the sensor and wiring by measuring the resistance according to the values in *Product Description* on page 18.
3. Measure between each sensor lead and ground (earth) to establish that the resistance is infinite (or at least several megohms).

6.6 Check the leakage detectors

If the unit is connected to the MAS monitoring system, then it is recommended that the sensors be checked in the MAS unit. Otherwise, use a multimeter.

1. Check the float switch (FLS) in the stator housing, according to the values in *Product Description* on page 18.
2. Check the float switch (FLS) in the junction box or connection housing.
3. If the drive unit is equipped with a CLS water-in-oil sensor in the oil housing, then check the CLS by following this procedure.
   a) Connect the CLS to a 12 VDC supply.
   The sensor must have the correct polarity to be checked. However, a switched plus and minus does not damage the sensor.
   b) Use the multimeter as an ammeter and connect it in series with the sensor.
   c) If the sensor is accessible, then check: the alarm function by gripping the sensor with the hand.

Skin tissue and blood contain a high content of water.

For interpretation of the CLS measurement results, see *Product Description* on page 18.

6.6.1 FLS

Table 24: Float switch sensor (FLS)

Description	Measured value	Fault values
The float switches are leakage sensors. The float switches are located in the lower part of the stator housing and in the junction box.	Resistance. 2 sensor variants: FLS: • Normal: 1530 ohm • Alarm: 330 ohm FLS 10: • Normal: 1200 ohm • Alarm: 430 ohm	> 10% (approx.) deviation from rated ohm values indicates sensor fault, or fault in the wiring.

6.7 Lubricants used in the drive units

Drive units	Seal lubricant
605, 615, 665, 675	Oil For instructions about changing the oil, see *Change the oil* on page 81.
705, 715, 735, 745, 765, 775	
706, 716, 736, 746, 766, 776	
805, 815, 835, 845, 865, 875, 885, 895 862, 872, 882, 892	
806, 816, 836, 846, 866, 876, 886, 896 863, 873, 883, 893	
905, 915, 935, 945, 965, 975 950, 960, 985, 995, 988, 998	
906, 916, 936, 946, 966, 976 951, 961, 986, 987, 996, 997	

6.8 Change the oil

To check which pumps use oil as the seal lubricant, see *Lubricants used in the drive units* on page 81.

The pump is delivered with a tasteless, odorless, medical white oil of a paraffin type that fulfills FDA 172.878.

Examples of suitable oil types are the following:

- Statoil MedicWay 32™
- BP Enerpar M 004™
- Shell Ondina 927™
- Shell Ondina X430™

The amount of oil is given in the table. Fill up the oil to the bottom thread.

Table 25:

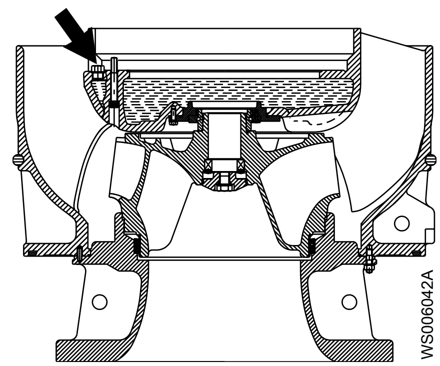
Hydraulic unit	Volume of oil
L3356	19 L (20.1 quarts). If an oil-reduction is necessary, fill up the oil to the bottom thread and then suck out 4 L (4.3 quarts)
L3400	20 L (21.2 quarts)
L3602	25 L (26.4 quarts)

Empty the oil

1. Unscrew the oil plugs.

CAUTION: Compressed Gas Hazard

Air inside the chamber may cause parts or liquid to be propelled with force. Be careful when opening. Allow the chamber to de-pressurize before removal of the plug.



2. Pump out the oil.

   Use the oil drainage pump 83 95 42. Make sure that the plastic tube goes all the way to the bottom of the oil housing.

Fill with oil

1. Fill up with the new oil.
2. Insert and tighten plugs with the new O-rings and plugs.

   Tightening torque: 80 Nm (60 lbf·ft)
3. Check the paint; if damaged, repaint.

6.9 Horizontal lifting

Two sets of lifting equipment must be used to lift the unit for repair work.

If the unit is turned upside-down, so that the hydraulic end is at the top, then use two slings or straps at the hydraulic end. The two slings or straps must be put directly opposite each other, so that the unit can hang between them.

The drive unit must never stand on the shaft unit or the impeller or propeller. Damage to the impeller or propeller, seals, or bearings can result from standing the drive unit on the impeller or propeller or shaft.

Use the following method to lift the unit in the horizontal position.

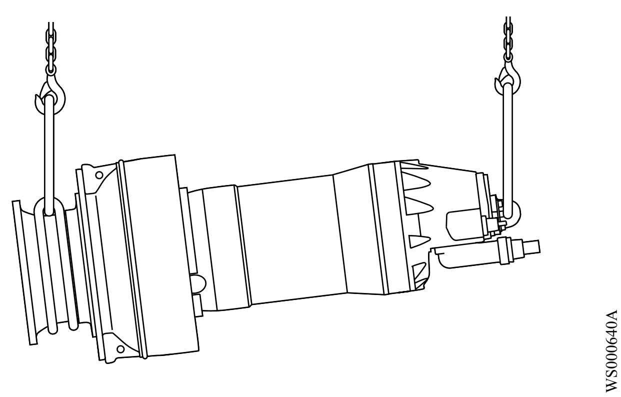


Figure 31: Lift unit for repair work. Generic pump shown.

6.10 Replace the wear parts

When the clearance between the impeller skirt and the pump housing wear ring exceeds 2 mm (0.08 in.) one or more of the following replacements must be made.

6.10.1 Replace the pump housing wear ring

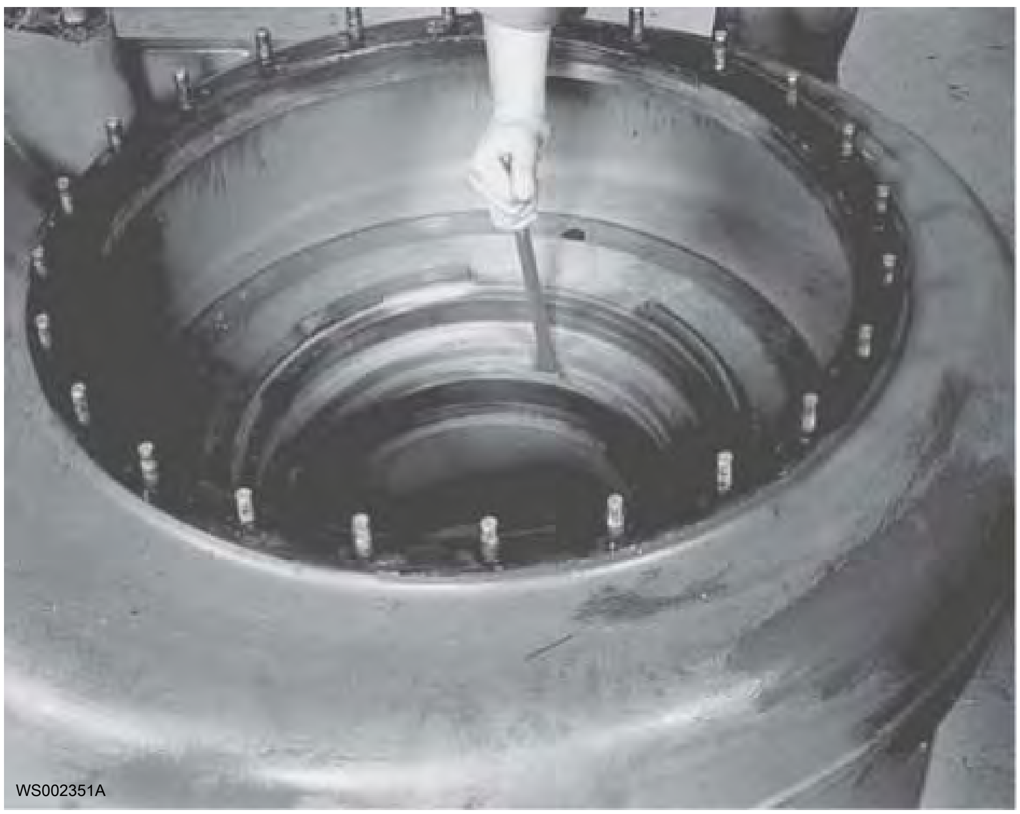
If the wear ring is made of brass this procedure will be easier if the suction cover is first heated, and/or the wear ring is cooled down.

1. Remove the screws that fasten the pump housing to the drive unit.
2. Lift off the drive unit from the pump housing.
3. Lay the drive unit in a horizontal position.

WARNING: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

4. Remove the wear ring by using a crow bar.



5. Drive in the new wear ring.

   To prevent deformation, use a maul and a wooden block.

6.10.2 Replace the impeller wear ring

1. Disconnect and lift off the drive unit with pump housing from the suction cover.
2. Lay the drive unit in a horizontal position.

WARNING: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

3. Knock off the wear ring from the impeller.

If necessary, use a grinder to make grooves in the wear ring.

4. Heat the new wear ring and press it onto the impeller.

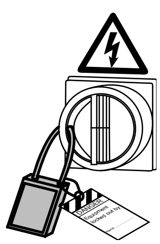
6.11 Replace the impeller

Before you replace the impeller, you must drain the oil in the oil housing. See applicable steps in *Empty the oil* on page 82.

6.11.1 Rotating propeller

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



6.11.2 Remove the impeller

CAUTION: Cutting Hazard

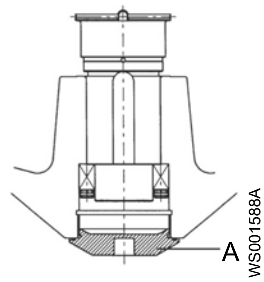
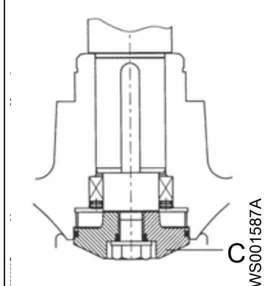
Worn parts can have sharp edges. Wear protective clothing.

1. Do the following.
   a) Disconnect and lift off the drive unit from the pump housing.
   b) Lay the drive unit on its side.

CAUTION: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

2. Depending on which pump model you have, do one of the following:

Pump	Action
L3356	Remove the impeller-sealing washer (A) using the Allen key hole in the washer. (The washer is threaded into the impeller hub.) Use a 19 mm Allen key. 
L3400 or L3602	Remove the impeller screw by inserting the puller screw 576 84 00 in the thread of the impeller-sealing washer (C).  

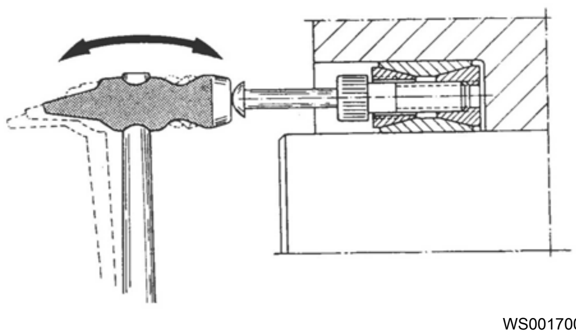
The locking assembly is now accessible for removal.

6.11.3 Remove the locking assembly

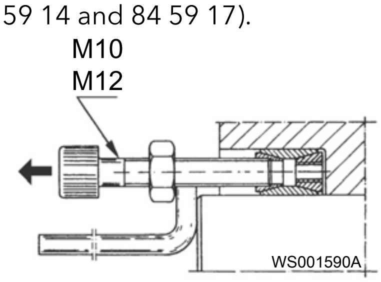
1. Remove the locking assembly:
    a) Loosen the screws on the locking assembly evenly and in sequence.
    See *Sequence for tightening or loosening locking assembly bolts* on page 89.

b) If the locking assembly is still locked, then do as follows:

   1. Loosen the inner ring by tapping it lightly, as shown in the illustration.



   2. If tapping did not loosen the ring, then replace the three "light-colored" screws with three M10 draw-bolts (for 84 59 12 and 84 59 13) or M12 draw-bolts (for 84 59 14 and 84 59 17).



c) Remove the locking assembly.

2. Pull off the impeller:

   a) Fit the tools that are required for impeller removal according to the tool list for the appropriate pump. See *Tools* on page 92.

   b) Pull off the impeller.

      Use the hydraulic unit with the partially threaded screw in the Basic kits for removal.

6.11.4 Install the impeller

When installing a stainless steel impeller onto a stainless steel shaft, the shaft end should be greased with National Chemsearch THREAD-EZE. Make sure that no grease is on the contact surfaces of the locking assembly.

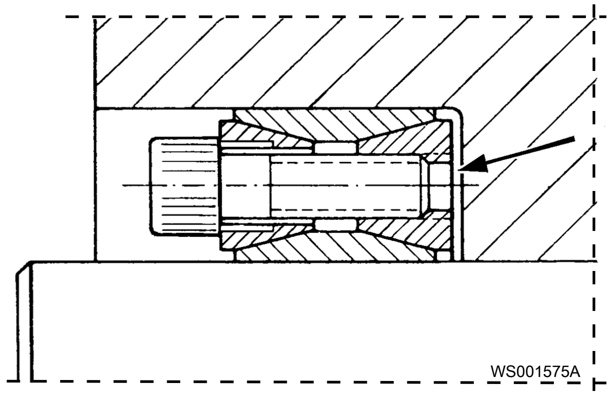
1. Make sure that the end of the shaft is clean and free of burrs.

   Polish off any flaws with fine emery cloth.
2. Grease the end of the shaft and the impeller hub.
3. Place the impeller on the shaft and fit the hydraulic tool with the M16 screw.
4. Use the appropriate washer to press the impeller in place.
5. Remove the hydraulic tool.
6. Go on to *Install the locking assembly* on page 87.

6.11.5 Install the locking assembly

1. Fit the locking assembly in place:
   a) Apply a thin layer of grease at the surface indicated by the arrow in the illustration below.

      Do not use oil containing molybdenum disulphide (MoS_2).



b) Fit the locking assembly (well-oiled) in the impeller hub without tightening any screws.

2. Fit the impeller:
   a) Place the washer over the locking assembly.

      See *Tools* on page 92 for the washer for the respective pump.

      For the correct position, use an Allen key through one of the slots in the washer and into one of the "light-colored" screws in the locking assembly.
   b) Fit the impeller screw, or the screw unit (with hydraulic tool if applicable), through the center hole in the washer and into the shaft end.

      See *Tools* on page 92 for the screw/screw unit for the respective pump.
   c) Tighten the center screw so that the washer keeps the locking assembly and the impeller in place.

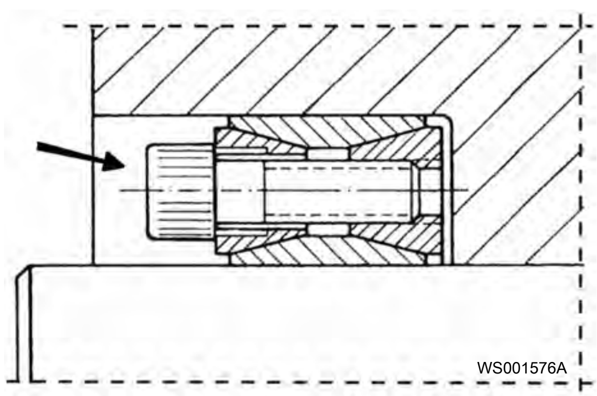
   d) When the impeller is firmly seated, slightly tighten the three "light-colored" screws in the locking assembly through the slots in the washer.

      This keeps the impeller in place against the shaft shoulder.

e) Remove the center screw and the washer.

3. Tighten the locking assembly screws evenly in three stages, following the sequence and tightening torques that are given in *Sequence for tightening or loosening locking assembly bolts* on page 89.
4. Fill the space with grease, allowing space for the sealing washer.

   The space to be filled with grease is indicated by the arrow in the illustration below.



5. Fit the impeller sealing washer and tighten the impeller screw.

After installing the impeller you must do the following:

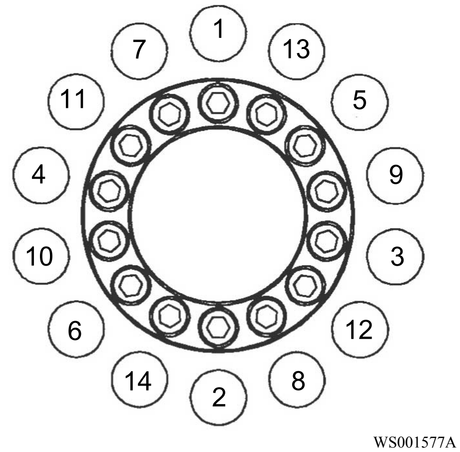
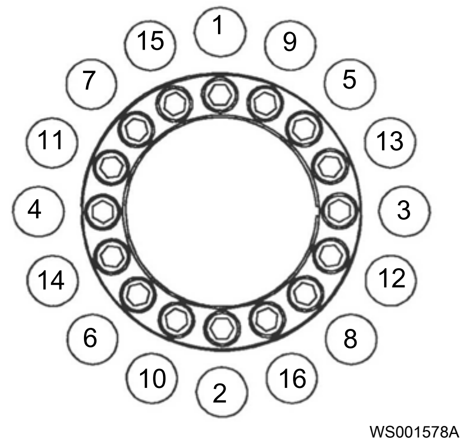
1. Check that the impeller can be rotated by hand.
2. Check the zinc anodes (if applicable) to make sure that they are large enough and intact. Replace after approximately 75% consumption.
3. Fit the drive unit with pump housing to the suction cover. Do not forget the O-ring between pump housing and suction cover.

More extensive repairs require special tools and should be carried out by a service technician authorized by Xylem.

6.11.6 Sequence for tightening or loosening locking assembly bolts

Bolt sequence

The following illustrations show the sequence used for tightening or loosening the impeller locking assembly bolts.

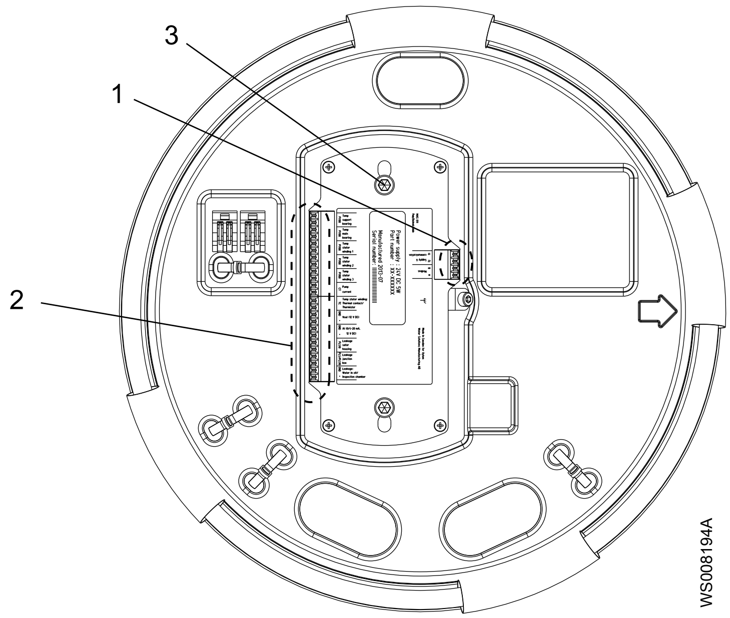
<table>
<tr><th>Locking assembly</th><th>Sequence for tightening or loosening bolts</th></tr>
<tr><td>84 59 12</td><td rowspan="3">
</td></tr>
<tr><td>84 59 13</td></tr>
<tr><td>84 59 14</td></tr>
<tr><td>84 59 17</td><td>
</td></tr>
</table>

Tightening torques

The table below gives the torque which should be used in each stage of the bolt-tightening process.

<table>
<tr><th>Locking assembly</th><th>Torque for tightening bolts</th></tr>
<tr><td>84 59 12</td><td rowspan="2">• Stage 1: 12 Nm (8.8 ft-lb)
• Stage 2: 24 Nm (18 ft-lb)
• Stage 3: 35 Nm (26 ft-lb)</td></tr>
<tr><td>84 59 13</td></tr>
<tr><td>84 59 14</td><td>• Stage 1: 24 Nm (18 ft-lb)
• Stage 2: 48 Nm (35 ft-lb)
• Stage 3: 70 Nm (52 ft-lb)</td></tr>
<tr><td>84 59 17</td><td>• Stage 1: 24 Nm (18 ft-lb)
• Stage 2: 48 Nm (35 ft-lb)
• Stage 3: 70 Nm (52 ft-lb)</td></tr>
</table>

6.12 Pumps with MAS 801: Replace the PEM



1. PEM communication terminals
2. PEM control terminals
3. Screws securing PEM

1. Disconnect the communication terminals.
2. Disconnect the control terminals on the PEM.
   For specially-approved pumps, do not disconnect T3 and T4 from the separate plinth.
3. Disconnect the functional ground.
4. Remove the two screws securing the PEM.
5. Lift out the PEM.
6. Fit the new PEM into place. Secure with two screws.
7. Connect the functional ground.
8. Connect the control terminals.
   For specially-approved pumps, do not use connections 51 and 63 on the PEM. For EX-pumps, T3 and T4 must be connected to the separate plinth.
9. Connect the communication terminals.
10. To download information to the PEM, see the System Installation and Operation (SIO) Manual for the MAS 801 monitoring equipment.

6.13 Torque values

All screws and nuts must be lubricated to achieve correct tightening torque. Screws that are screwed into stainless steel must have the threads coated with suitable lubricants to prevent seizing.

If there is a question regarding the tightening torques, then contact a sales or authorized service representative.

Screws and nuts

Table 26: Stainless steel, A2 and A4, torque Nm (ft-lbs)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
50	1.0 (0.74)	2.0 (1.5)	3.0 (2.2)	8.0 (5.9)	15 (11)	27 (20)	65 (48)	127 (93.7)	220 (162)	434 (320)
70, 80	2.7 (2)	5.4 (4)	9.0 (6.6)	22 (16)	44 (32)	76 (56)	187 (138)	364 (268)	629 (464)	1240 (915)
100	4.1 (3)	8.1 (6)	14 (10)	34 (25)	66 (49)	115 (84.8)	248 (183)	481 (355)	–	–

Table 27: Steel, torque Nm (ft-lbs)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
8.8	2.9 (2.1)	5.7 (4.2)	9.8 (7.2)	24 (18)	47 (35)	81(60)	194 (143)	385 (285)	665 (490)	1310 (966.2)
10.9	4.0 (2.9)	8.1 (6)	14 (10)	33 (24)	65 (48)	114 (84)	277 (204)	541 (399)	935 (689)	1840 (1357)
12.9	4.9 (3.6)	9.7 (7.2)	17 (13)	40 (30)	79 (58)	136 (100)	333 (245)	649 (480)	1120 (825.1)	2210 (1630)

Hexagon screws with countersunk heads

For hexagon socket head screws with countersunk head, maximum torque for all property classes must be 80% of the values for property class 8.8 above.

6.14 Tools

Tools

Beside ordinary tools, the following tools are required to perform the necessary maintenance of the pump.

Part number	Denomination	Range of use	
83 95 42	Oil drainage pumps	Drainage pumps for emptying oil housing	
84 13 68	Hydraulic unit, 200 kN	Bearing removal	584 83 00

L3356

Part number	Denomination	Range of use
432 43 00	Washer. Included in Basic Kit II.	
436 19 00	Basic Kit II	
436 74 00	Impeller tool	
582 65 00	Stand unit	Rotor removal
588 92 00	Mounting unit	Washer mounting

L3400

Part number	Denomination	Range of use
332 91 00	Tool for removing stop spring	
399 41 00	Mounting tool set	Seal mounting, for shaft Ø 75 mm and 90 mm
576 83 01	Washer	For shaft Ø 75 mm
576 83 02	Washer	For shaft Ø 90 mm
576 84 00	Puller screw	
584 81 00	Washer	
587 72 00	Impeller tool	For shaft Ø 75 mm and shaft Ø 90 mm
587 94 00	Basic Kit V	

L3602

Part number	Denomination	Range of use
332 91 00	Tool for removing stop spring	

Part number	Denomination	Range of use
399 41 00	Mounting tool set	Seal mounting, for shaft Ø 75 mm and 90 mm
576 83 01	Washer	For shaft Ø 75 mm
576 83 02	Washer	For shaft Ø 90 mm
576 83 03	Washer	For shaft Ø 110 mm
576 84 00	Puller screw	
584 81 00	Washer	
587 73 00	Impeller tool	For shaft Ø 110 mm
587 94 00	Basic Kit V	

7 Troubleshooting

Introduction

DANGER: Electrical Hazard

Troubleshooting a live control panel exposes personnel to hazardous voltages. Electrical troubleshooting must be done by a qualified electrician.

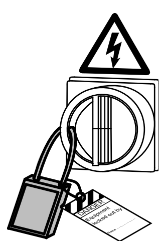
Follow these guidelines when troubleshooting:

- Disconnect and lock out the power supply except when conducting checks that require voltage.
- Make sure that no one is near the unit when the power supply is reconnected.
- When troubleshooting electrical equipment, use the following:
  - Universal instrument multimeter
  - Test lamp (continuity tester)
  - Wiring diagram

7.1 The pump does not start

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
An alarm signal has been triggered on the control panel.	Check that: • The impeller rotates freely. • The sensor indicators do not indicate an alarm. • The overload protection is not tripped. If the problem still persists: Contact a sales or authorized service representative.
The pump does not start automatically, but can be started manually.	Check that: • The start level regulator is functioning. Clean or replace if necessary. • All connections are intact. • The relay and contactor coils are intact. • The control switch (Man/Auto) makes contact in both positions. Check the control circuit and functions.

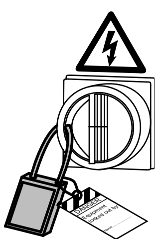
Cause	Remedy
The installation is not receiving voltage.	Check that: • The main power switch is on. • There is control voltage to the start equipment. • The fuses are intact. • There is voltage in all phases of the supply line. • All fuses have power and that they are securely fastened to the fuse holders. • The overload protection is not tripped. • The motor cable is not damaged.
The impeller is stuck.	Clean: • The impeller • The sump in order to prevent the impeller from clogging again.

Always state the serial number of the product, see *Product Description* on page 18.

7.2 The pump does not stop when a level sensor is used

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



Cause	Remedy
The pump is unable to empty the sump to the stop level.	Check that: • There are no leaks from the piping and/or discharge connection. • The impeller is not clogged. • The non-return valve(s) are functioning properly. • The pump has adequate capacity. For information: Contact a sales or authorized service representative.
There is a malfunction in the level-sensing equipment.	• Clean the level regulators. • Check the functioning of the level regulators. • Check the contactor and the control circuit. • Replace all defective items.
The stop level is set too low.	Raise the stop level.

Always state the serial number of the product, see *Product Description* on page 18.

7.3 The pump starts-stops-starts in rapid sequence

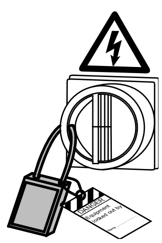
Cause	Remedy
The pump starts due to back-flow which fills the sump to the start level again.	Check that: • The distance between the start and stop levels is sufficient. • The non-return valve(s) work(s) properly. • The length of the discharge pipe between the pump and the first non-return valve is sufficiently short.
The self-holding function of the contactor malfunctions.	Check: • The contactor connections. • The voltage in the control circuit in relation to the rated voltages on the coil. • The functioning of the stop-level regulator. • Whether the voltage drop in the line at the starting surge causes the contactor's self-holding malfunction.

Always state the serial number of the product, see *Product Description* on page 18.

7.4 The pump runs but the motor protection trips

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The motor protection is set too low.	Set the motor protection according to the data plate and if applicable the cable chart.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The drive unit is not receiving full voltage on all three phases.	• Check the fuses. Replace fuses that have tripped. • If the fuses are intact, then notify a certified electrician.
The phase currents vary, or they are too high.	Contact a sales or authorized service representative.
The insulation between the phases and ground in the stator is defective.	• Drive units up to 1 kV: See *Check the insulation, up to 1 kV drives or generators* on page 80. • Drive units 1.2–6.6 kV: See *Check the insulation, 1.2–6.6 kV drives* on page 80.

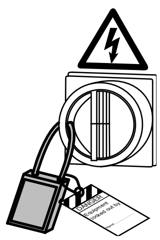
Cause	Remedy
The density of the pumped fluid is too high.	Make sure that the maximum density is 1100 kg/m3 (9.2 lb/US gal) • Change the impeller, or • Change to a more suitable pump • Contact a sales or authorized service representative.
There is a malfunction in the overload protection.	Replace the overload protection.

Always state the serial number of the product, see *Product Description* on page 18.

7.5 The pump delivers too little or no water

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The impeller rotates in the wrong direction.	If it is a 3-phase pump, then transpose two phase leads.
One or more of the valves are set in the wrong positions.	• Reset the valves that are set in the wrong position. • Replace the valves, if necessary. • Check that all valves are correctly installed according to media flow. • Check that all valves open correctly.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The pipes are obstructed.	Clean out the pipes to ensure a free flow.
The pipes and joints leak.	Find the leaks and seal them.
There are signs of wear on the impeller, pump, and casing.	Replace the worn parts.
The liquid level is too low.	• Check that the level sensor is set correctly. • Depending on the installation type, add a means for priming the pump, such as a foot valve.

Always state the serial number of the product, see *Product Description* on page 18.

8 Technical Reference

8.1 Application limits

Table 28: Process data

Parameter	Value
Liquid temperature	Max. +40°C (+105°F)
Depth of immersion	Max. 20 m (65 ft)
pH of pumped liquid	pH 5.5–14
Liquid density	Max. 1100 kg/m^3 (9.17 lb per gal.)

8.2 Drive units overview

The following table shows the range of drive units for large submersible pumps. Not all drive units can be used for a particular pump. For drive unit—hydraulic unit compatibility, see the compatibility charts or the Product Data for the drive unit.

Drive units	Not Explosion-proof	Explosion-proof	HE Motor	Voltage Range		Cooling System				Connection House	
				LV, up to 1 kV	MV, 1.2–6.6 kV	External	Integrated	Direct	Internal Closed-loop	Small	Large
605, 665	X			X		X	X	X		X	
615, 675		X		X		X	X	X		X	
705, 735, 765	X			X		X	X	X		X	X
706, 736, 766	X		X	X				X	X	X	X
715, 745, 775		X		X		X	X	X		X	X
716, 746, 776		X	X	X				X	X	X	X
805, 835, 865	X			X		X	X	X			X
885	X			X				X			X
806, 836, 866	X		X	X				X	X		X
886	X		X	X				X			X
815, 845, 875		X		X		X	X	X			X
895		X		X				X			X
816, 846, 876		X	X	X				X	X		X
896		X	X	X				X			X
862, 882	X				X	X	X	X			X
863, 883	X				X			X	X		X
872, 892		X			X	X	X	X			X
873, 893		X			X			X	X		X
905, 935, 965	X			X		X	X	X			X
915, 945, 975		X		X		X	X	X			X
906, 936, 966	X		X	X				X	X		X
916, 946, 976		X	X	X				X	X		X

Drive units	Not Explosion-proof	Explosion-proof	HE Motor	Voltage Range		Cooling System				Connection House	
				LV, up to 1 kV	MV, 1.2–6.6 kV	External	Integrated	Direct	Internal Closed-loop	Small	Large
950, 985, 988	X				X	X	X	X			X
960, 995, 998		X			X	X	X	X			X
951, 986, 987	X		X		X			X	X		X
961, 996, 997		X	X		X			X	X		X

8.3 Pt100 resistance

This table shows the relationship between temperature (°C) and resistance (ohms).

T, °C	R, ohms	T, °C	R, ohms	T, °C	R, ohms	T, °C	R, ohms	T, °C	R, ohms
0	100.00	33	112.83	66	125.54	99	138.12	132	150.57
1	100.39	34	113.22	67	125.92	100	138.50	133	150.95
2	100.78	35	113.61	68	126.31	101	138.88	134	151.33
3	101.17	36	113.99	69	126.69	102	139.26	135	151.70
4	101.56	37	114.38	70	127.07	103	139.64	136	152.08
5	101.95	38	114.77	71	127.45	104	140.02	137	152.45
6	102.34	39	115.15	72	127.84	105	140.39	138	152.83
7	102.73	40	115.54	73	128.22	106	140.77	139	153.20
8	103.12	41	115.93	74	128.60	107	141.15	140	153.58
9	103.51	42	116.31	75	128.98	108	141.53	141	153.95
10	103.90	43	116.70	76	129.37	109	141.91	142	154.32
11	104.29	44	117.08	77	129.75	110	142.29	143	154.70
12	104.68	45	117.47	78	130.13	111	142.66	144	155.07
13	105.07	46	117.85	79	130.51	112	143.04	145	155.45
14	105.46	47	118.24	80	130.89	113	143.42	146	155.82
15	105.85	48	118.62	81	131.27	114	143.80	147	156.19
16	106.24	49	119.01	82	131.66	115	144.17	148	156.57
17	106.63	50	119.40	83	132.04	116	144.55	149	156.94
18	107.02	51	119.78	84	132.42	117	144.93	150	157.31
19	107.40	52	120.16	85	132.80	118	145.31	151	157.69
20	107.79	53	120.55	86	133.18	119	145.68	152	158.06
21	108.18	54	120.93	87	133.56	120	146.06	153	158.43
22	108.57	55	121.32	88	133.94	121	146.44	154	158.81
23	108.96	56	121.70	89	134.32	122	146.81	155	159.18
24	109.35	57	122.09	90	134.70	123	147.19	156	159.55
25	109.73	58	122.47	91	135.08	124	147.57	157	159.93
26	110.12	59	122.86	92	135.46	125	147.94	158	160.30
27	110.51	60	123.24	93	135.84	126	148.32	159	160.67
28	110.90	61	123.62	94	136.22	127	148.70	160	161.04
29	111.28	62	124.01	95	136.60	128	149.07		

T, °C	R, ohms		T, °C	R, ohms		T, °C	R, ohms		T, °C	R, ohms		T, °C	R, ohms
30	111.67		63	124.39		96	136.98		129	149.45			
31	111.94		64	124.77		97	137.36		130	149.82			
32	112.45		65	125.16		98	137.74		131	150.20			

8.4 Cable bending radius, weight and diameter

Control cables

Table 29: SUBCAB™ control cables

This table shows the minimum bending radius, weight, and outer diameter for SUBCAB control cables.

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
12x1.5 mm^2	190	0.53	Ø 18.2–21.2
24x1.5 mm^2	250	0.90	Ø 24.9–28.9
S12x1.5 mm^2	300	0.78	Ø 29.9–31.0
S24x1.5 mm^2	350	1.59	Ø 33.0–37.0

Power cables with power cores and control element

Table 30: Screened SUBCAB

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
S3x16 + 3x16/3 + S(4x0.5)	240	1.1	Ø 24–26
S3x25 + 3x16/3 + S(4x0.5)	290	1.4	Ø 29–31
S3x35 + 3x16/3 + S(4x0.5)	320	2.0	Ø 32–34
S3x50 + 3x25/3 + S(4x0.5)	380	3.0	Ø 38–40
S3x70 + 3x35/3 +2 S(2x0.5)	420	3.5	Ø 42–44
S3x95 + 3x50/3 + 2S(2x0.5)	440	4.6	Ø 44–47
S3x120 + 3x70/3 + 2S(2x0.5)	500	5.5	Ø 50–52
S6x95 + 95 + S(4x0.5)	570	7.6	Ø 57–60

Table 31: SUBCAB

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
4 G 16 + S(2x0.5)	260	1.13	Ø 26–28
4 G 25 + S(2x0.5)	320	1.7	Ø 32–34
4 G 35 + S(2x0.5)	350	2.24	Ø 35–37
3x50 + 2G35/2 + S(2x0.5)	350	2.6	Ø 35–37
3x70 + 2G35/2 + S(2x0.5)	380	3.3	Ø 38–41
3x95 + 2G50/2 + S(2x0.5)	470	4.5	Ø 47–50
3x120 + 2G70/2 + S(2x0.5)	540	5.7	Ø 54–56

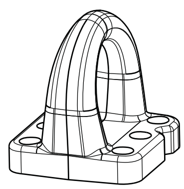
Medium voltage power cables, 1.2–15 kV

Table 32: (N)TSCGEWOEUS 1.2–15 kV

This table shows the minimum bending radius, weight, and outer diameter for (N)TSCGEWOEUS 1.2–15 kV cables.

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
3x25+3x25/3	410	2.51	Ø 41–44
3x50+3x25/3	460	3.47	Ø 46–49

8.5 Lifting eye bracket 494 01 01



494 01 01

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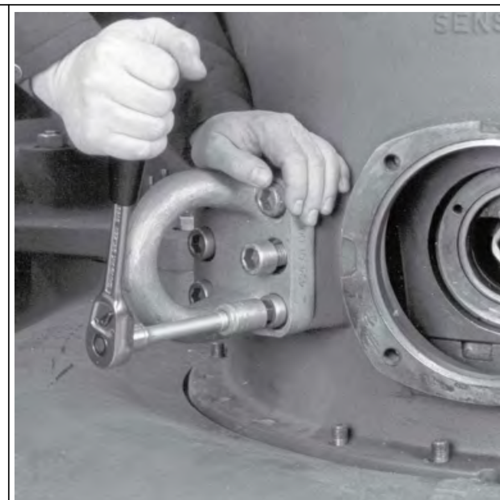

WS002323B

Xylem |ˈzīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

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CALCULATIONS

WSP USA

7650 Corporate Center Drive
Miami, FL 33126
(305) 514-3100

Date:	**April 5, 2021**
Project Name:	**Monroe County Sea Level Rise Pilot - Big Pine Key, Florida**
Project Number:	**193618A**
Prepared By:	**WR/SS**

PUMP STATION & INJECTION WELL CALCULATIONS

1. Data Collection:

Total drainage area:	A=	49.63	Ac.	Hydrologic location:		Zone 11
Pavement Area:	A_i=	17.97	Ac.	Design Frequency:	F=	5
Pervious Area:	A_p=	31.66	Ac.	Rainfall amount:	6	inches[1]
Seasonal High Water Table:	SHWT=	1.5	ft-NAVD[2]	Runoff coefficient:		
Mean High Water Table:	MHW=	-0.322	ft-NAVD	Impervious:	Ci=	0.95
Mean Highest High Water Table:	MHHW=	-0.081	ft-NAVD	Pervious:	Cp=	0.35
Mean Highest High Water Table:	*$MHHW_{40}$ =*	*0.36*	*ft-NAVD at year 2040*			
Minimum roadway grade:	G=	1	ft-NAVD			

Well design data:

Well capacity: q_w= 1000 gpm/ft of head

2. Determine the peak discharge rate into the well system:

Weighted runoff coefficient: $C = \frac{CiAi + CpAp}{A}$ = 0.567247632

Time of concentration: t_c= 37 minutes

Rainfall intensity: i= 3.95 in/hr (per FDOT IDF curves for tc= 37 min., for Zone 11)

1: From SFWMD rainfall map for 1-Day;5-year return period
2: Not used since project is controlled by tidal conditions.

Q= CiA = 111.20 cfs

= **49,911 GPM**
= 71,872,196 GPD
= 831.85 GPS

3. Determine the net hydraulic head required for a pressurized well system:

Number of pressurized wells: n_p= 12 wells

Safety factor: SF= 1.5

Pressurized net head: $H_p = \frac{SF*Q}{0.00223*qw*np} + \Delta H$ = 7.73 ft

(ΔH = 1.5 ft; head required to discharge thru tidal water)

Required head elevation: Head = $MHHW_{40} + H_p$ = 8.09 ft NAVD

CHECK: 8. ft NAVD > 8 ft NAVD

4. Determine the 90-second retention volume for each pressurized well:

Required detention volume: $V_{90s} = \frac{90*Q}{Np}$ = 834.0 ft^3 per well

Note: 90-second detention will be provided at proposed swales. Treatment units will also be used.
Total for all wells: 10008.21 ft^3

5. Calculate total pressurized net head:

Required pump discharge: Q_p= SF*Q = 166.80 cfs

Required head elevation for well discharge: Head = 8.09 ft NAVD
(from item 3 above)

The pump station will have to deliver a flow of 166.80 cfs with a maximum head of 8.09 ft NGVD plus the calculated static head (see below).

6. Calculate static head:

a. Force main pipe diameter estimate:
Velocity (V) = Q/A = $4Q/(\pi D^2)$

V =	Pipe Velocity	10	ft/sec	
Q =	Peak Flow	831.85	GPS	49911.2 gpm
D =	**Pipe Diameter**	**48.00**	**in**	
D =	Pipe Diameter	4.00	ft	

A = Pipe Cross-Sectional Area 12.57 ft^2

$D^2 = 4Q/(\pi (V))$ = 14.160 ft^2

Approximate Pipe Dia. (D) = 3.76 ft or 45.16 inches OK

b. Equivalent length of pipe for 48 -inch force main:

Pump Station - Force Main

	Quantity	Unit	Friction Loss*	Equivalent Length (ft)
Pump Discharge =	2	EA.	9.30	18.60
Manifold from 2 to 1 FM (T-fitting) =	1	EA.	60.00	60.00
FM Length[3] =	1150	LF	1.00	1150.00
Well Discharge (T-fitting)=	12	EA.	10.00	120.00
			Total Equivalent Length=	**1,349**

c. Wet well design:

Assume:
Wet Well Volume (V) = (Q * T)/4

	number of pumps	4 pumps
T =	Time for one pump cycle	5 minutes
V =	Wet Well Volume	X gallons
Q =	Pump Rate (peak flow per pump)	12,477.81 GPM
S =	Peak Daily Flow	49,911.25 GPM

$$V = \frac{12{,}477.81 \quad x \quad 5}{4}$$

V = 15,597 gallons
2,085 ft^3

Wet Well Dimensions 18 ft x 12 ft

Area of Wet Well (A) = 216 ft^2

Depth between LEAD PUMP ON and PUMP OFF level (H) = V / A
H = 10 ft

3: Assumes 100-ft spacing between wells; based on PCCP.

d. Liquid level regulators: Force Main El -5.4

Assume:		
Rim Elevation =	3.20 ft NAVD	
Invert Elevation =	-6.20 ft NAVD	22.40
High Water Alarm Elevation=	-6.20 ft NAVD	
LAG Pump on Elevation =	-7.20 ft NAVD	
LEAD Pump on Elevation =	-8.20 ft NAVD	
Pumps off Elevation =	-18.20 ft NAVD	
Low Water Alarm Elevation=	-18.70 ft NAVD	
Bottom of wet well elevation=	-19.20 ft NAVD	

TOTAL WELL DEPTH: 22.40 FT

e. Calculate static head:

Static Head = Invert elevation of FM - Pumps off Elevation

Static Head = 12.80 ft for Pumps Station

7. Total head:

Pump station must be designed to account for the total static head plus the total pressurized net head (calculated in item 5 above):

8.09 + 12.80 = **20.89 FT of head**

8. Total dynamic head loss:

Equivalent pipe length			1349	ft
Force main pipe diameter			48	in
Total Head			20.89	ft
Tie-In Pressure			0.00	ft
C (PCCP)			120	
Lift Station Flow (GPM)	Static Head + Tie-In Pressure (ft)	Velocity Head $V^2/2g$ (ft)	48" Storm Force Main losses (ft) max	Total Dynamic Head (ft)
27000	20.89	0.36	2.05	22.95
30000	20.89	0.44	2.50	23.39
35000	20.89	0.60	3.32	24.21
40000	20.89	0.78	4.25	25.14
49911	20.89	1.22	6.40	**27.29**
50000	20.89	1.22	6.42	27.31
55000	20.89	1.48	7.66	28.55

Notes:

1. The following formula was used to calculate the Total Dynamic Head (TDH):

Hazen & Williams formula:

$$hf = \frac{10.44 * (L) * (Q)^{1.85}}{(C)^{1.85} * (D)^{4.87}}$$

Where:

hf = head loss (ft.)

Q= flow (GPM)

L= equivalent length of pipe

C= Hazen Williams Coefficient

D= pipe diameter (in)

2. The following formula was used to calculate the Velocity:

Steady Flow:

$$V = \frac{Q}{A} = \frac{.4085 * (Q)}{D^2}$$

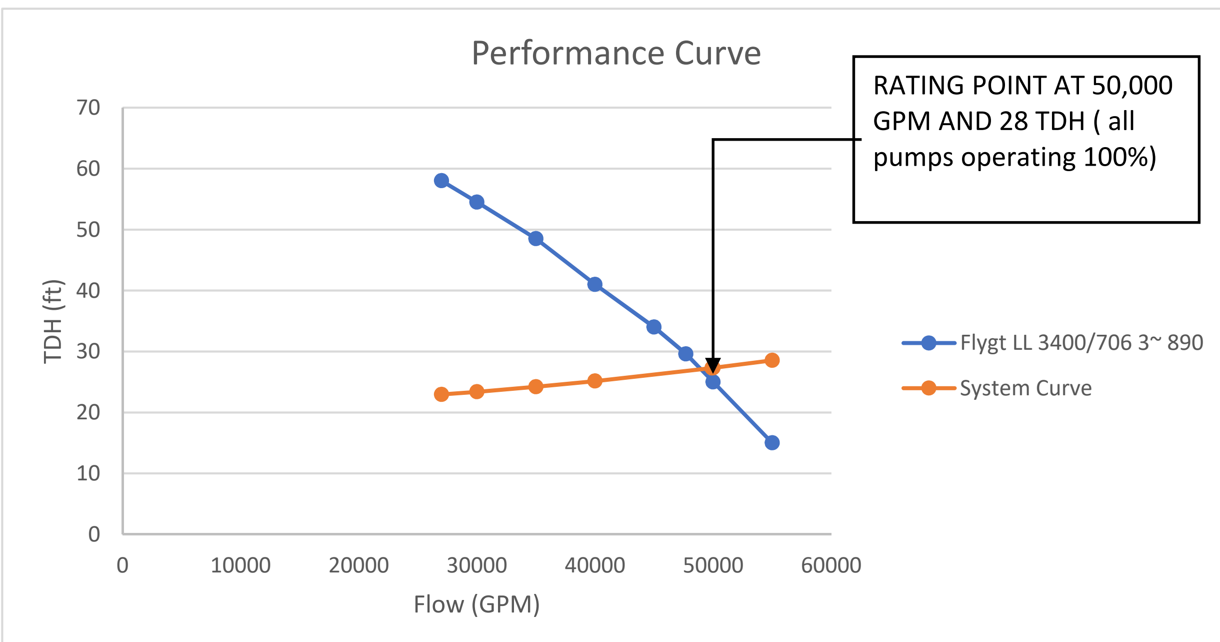
Where:

V= velocity (fps)

Q= discharge, flow (GPM)

A= cross sectional area (ft^2)

D= pipe diameter (in)



9. Calculate Time of Concentration for Basin:

Tc= (tsh + tsc + tch) * (60 min/ 1 hr)

tsh= sheet flow travel time (hr)

[0.007*(nol*Lsh)^0.8] / [(P2^0.5)*(Ssh^0.4)]

where:

nol=	overland flow roughness coefficient
Lsh=	sheet flow length (ft)
P2=	3yr, 24-hr rainfall depth (in)

sheet flow lengths:

						0.01
L=	80	ft in roadway	n=	0.011	S=	0.009
L=	20	ft in grass	n=	0.41	S=	**0.0099**
Lsh=	**100**		**nol=**	**0.0908**	**Ssh=**	

P2= 5 inches per SFWMD rainfall map

tsh= 0.116017 hrs

tsc= shallow concentrated flow time (hr)

Lsc / [3600*K*(Ssc^0.5)]

where:

Lsc=	shallow concentrated flow length (ft)
K=	16.13 for
Ssc=	shalow concentrated flow slope (ft/ft)

						0.01
L=	16	ft in roadway	n=	0.01	S=	0.009
L=	278	ft in grass	n=	0.41	S=	**0.0093**
Lsh=	**294**		**nol=**	**0.388231293**	**Ssh=**	

K=	20.32	
K=	16.13	
K=	**16.35803**	**inches**

tsc= 0.051658 hrs

tch= channel flow time (hr) (thru ditch)

Lch / [3600*(1.49/n)*R^(2/3)*Sch^(1/2)]

where:

Lch=	channel flow length (ft)
n=	Manning's
Sch=	channel flow slope (ft/ft)

0.01

L=	90	ft in road /driveway	n= 0.01	S=	0.009
L=	191.6	ft in grass	n= 0.035	S=	0.003
L=	85	ft in grass	n= 0.035	S=	**0.0073**
Lsh=	**366.6**	**ft**	**nol= 0.020747409**	**Ssh=**	

R= **0.249136** ft — hydraulic radius
6-ft on each side, 6" depth

tch_1= 0.041868 hrs

tch= channel flow time (hr) (thru pipe)

Lch / [3600*(1.49/n)*R^(2/3)*Sch^(1/2)]

where:
Lch= channel flow length (ft)
n= Manning's
Sch= channel flow slope (ft/ft)

					0.001
L=	2728	pipe	n= 0.016	S=	**0.0010**
Lsh=	**2728**		**nol= 0.016**	**Ssh=**	

R= **0.5** ft — hydraulic radius
full 24" dia. Pipe

tch_2= 0.408472 hrs

Tc= tsh + tsc + tch_1 + tch_2 = 0.618014878 hrs = 37.1 min

Force Main Calcs per FM section:

Before injection well #1:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	831.85	GPS
D =	**Pipe Diameter**	**48.00**	**in**
D =	Pipe Diameter	4.00	ft
A =	Pipe Cross-Sectional Ar	12.57	ft^2

D^2 = 4Q/(π (V)) = 14.160 ft^2

Approximate Pipe Dia. (D) = 3.76 ft or 45.16 inches OK

Before injection well #2:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	762.53	GPS
D =	**Pipe Diameter**	**48.00**	**in**
D =	Pipe Diameter	4.00	ft
A =	Pipe Cross-Sectional Ar	12.57	ft^2

D^2 = 4Q/(π (V)) = 12.980 ft^2

Approximate Pipe Dia. (D) = 3.60 ft or 43.23 inches OK

Before injection well #3:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	693.21	GPS
D =	**Pipe Diameter**	**48.00**	**in**
D =	Pipe Diameter	4.00	ft
A =	Pipe Cross-Sectional Ar	12.57	ft^2

D^2 = 4Q/(π (V)) = 11.800 ft^2

Approximate Pipe Dia. (D) = 3.44 ft or 41.22 inches OK

Before injection well #4:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = $4Q/(\pi D^2)$

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	623.89	GPS
D =	**Pipe Diameter**	**48.00**	**in**
D =	Pipe Diameter	4.00	ft
A =	Pipe Cross-Sectional A	12.57	ft^2

$D^2 = 4Q/(\pi (V))$ = 10.620 ft^2

Approximate Pipe Dia. (D) = 3.26 ft 39.11 inches OK

Before injection well #5:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = $4Q/(\pi D^2)$

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	554.57	GPS
D =	**Pipe Diameter**	**48.00**	**in**
D =	Pipe Diameter	4.00	ft
A =	Pipe Cross-Sectional A	12.57	ft^2

$D^2 = 4Q/(\pi (V))$ = 9.440 ft^2

Approximate Pipe Dia. (D) = 3.07 ft 36.87 inches OK

Before injection well #6:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = $4Q/(\pi D^2)$

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	485.25	GPS
D =	**Pipe Diameter**	**36.00**	**in**
D =	Pipe Diameter	3.00	ft
A =	Pipe Cross-Sectional A	7.07	ft^2

$D^2 = 4Q/(\pi (V))$ = 8.260 ft^2

Approximate Pipe Dia. (D) = 2.87 ft 34.49 inches OK

Before injection well #7:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	415.93	GPS
D =	**Pipe Diameter**	**36.00**	**in**
D =	Pipe Diameter	3.00	ft
A =	Pipe Cross-Sectional A	7.07	ft^2

D^2 = 4Q/(π (V)) = 7.080 ft^2

Approximate Pipe Dia. (D) = 2.66 ft 31.93 inches OK

Before injection well #8:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	346.61	GPS
D =	**Pipe Diameter**	**36.00**	**in**
D =	Pipe Diameter	3.00	ft
A =	Pipe Cross-Sectional A	7.07	ft^2

D^2 = 4Q/(π (V)) = 5.900 ft^2

Approximate Pipe Dia. (D) = 2.43 ft 29.15 inches OK

Before injection well #9:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	277.28	GPS
D =	**Pipe Diameter**	**36.00**	**in**
D =	Pipe Diameter	3.00	ft
A =	Pipe Cross-Sectional A	7.07	ft^2

D^2 = 4Q/(π (V)) = 4.720 ft^2

Approximate Pipe Dia. (D) = 2.17 ft 26.07 inches OK

Before injection well #10:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	207.96	GPS
D =	**Pipe Diameter**	**24.00**	**in**
D =	Pipe Diameter	2.00	ft
A =	Pipe Cross-Sectional A	3.14	ft^2

D^2 = 4Q/(π (V)) = 3.540 ft^2

Approximate Pipe Dia. (D) = 1.88 ft 22.58 inches OK

Before injection well #11:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	138.64	GPS
D =	**Pipe Diameter**	**24.00**	**in**
D =	Pipe Diameter	2.00	ft
A =	Pipe Cross-Sectional A	3.14	ft^2

D^2 = 4Q/(π (V)) = 2.360 ft^2

Approximate Pipe Dia. (D) = 1.54 ft 18.43 inches OK

Before injection well #12:

a. Force main pipe diameter estimate:

Velocity (V) = Q/A = 4Q/(π D^2)

V =	Pipe Velocity	10	ft/sec
Q =	Peak Flow	69.32	GPS
D =	**Pipe Diameter**	**24.00**	**in**
D =	Pipe Diameter	2.00	ft
A =	Pipe Cross-Sectional A	3.14	ft^2

D^2 = 4Q/(π (V)) = 1.180 ft^2

Approximate Pipe Dia. (D) = 1.09 ft 13.04 inches OK

RATING CURVE

Head Loss Calculation for Modification Of Pump Curve

Operational Table Flygt LL3400/706 3~890 (2 OF 4 PUMPS)

Equation-1 Head Loss (Hazen-Williams Formula) $H_{f=}$ $0.002083*L(100/C)^{1.85}(Q^{1.75}/ d^{4.8655})$

Equation-2 Head Loss by Fitting and Valves $H_{f=}$ $K(V^2/ 2g)$

Gravity		32.2	ft/sec^2
Resistence Coeficient		120	
Pipe Length (L)		20	ft
Diameter		48	In

Fitting	K	Count	Total Loss
90 Elbow	0.45	1	0.45
45 Elbow	0.21	0	0
22.5 Elbow		0	0
11.25 Elbow		0	0
check valve	1.3	1	1.3
plug valve	0.23	0	0
24"x16" 45 Wye	0.78	0	0
Reducer (24-32)	0.21	0	0
disch.elbow 28"x24"	0.83	0	0
Cross (branch flow)	0.78	1	0.78
Cross (line flow)	0.26	0	0
Reducer (16-24)	0.28	0	0
		Total	2.53

DUTY PUMP
ITT
PRODUCT:
CURVE No. PL-7050

FRICTION AND MINOR LOSSES CALCULATION

Flow Rate (Q)	Flow Rate (Q)	Velocity (V)	$H_{f\ Long)}$	Velocity head	H_f	Ht
(gpm)	(cfs)	(fps)	(ft)	(ft)	Fitting	
		48	**48**		All	
10000	**22.28**	1.77	0.01	0.049	0.124	**0.131**
15000	**33.42**	2.66	0.02	0.110	0.278	**0.294**
20000	**44.56**	3.55	0.03	0.195	0.494	**0.521**
25000	**55.70**	4.43	0.04	0.305	0.772	**0.812**
30000	**66.84**	5.32	0.05	0.439	1.112	**1.166**

RATING CURVE					
Flow Rate (Q) (cfs)	H (ft)	Ht	Result Head	Icpr Head Value	Flow Rate
22.28	**62.00**	0.131	61.9	-61.9	22.28
33.42	**56.00**	0.294	55.7	-55.7	33.42
44.56	**41.50**	0.521	41.0	-41.0	44.56
55.70	**24.50**	0.812	23.7	-23.7	55.70
66.84	**6.50**	1.166	5.3	-5.3	66.84

APPENDIX D

Amritt, Sarah H.

From: Najib Halwani <duke@jafferwells.com>
Sent: Friday, February 22, 2019 3:06 PM
To: Amritt, Sarah H.
Cc: Randy Habib; Reinefeld, Werner
Subject: RE: Well Capacities in Key Largo, FL & Big Pine Key, FL

Hi Sarah
Capacities in the Keys are in excess of 1000 GPM
Use 1000 GPM also note wells have to be constructed with SCHD 80 PVC casing inside a 30" DIA Hole with meat cement grout
Most wells have 60' of PVC casing and drill out to 120' BLS
Thanks
Duke

Najib B Halwani
President
AC Schultes Of Florida dba Jaffer Well Drilling
1451 SE 9 Ct
Hialeah FL 33010
Office 305 576 7363

From: Amritt, Sarah H. <Sarah.Amritt@wsp.com>
Sent: Friday, February 22, 2019 2:22 PM
To: Najib Halwani <duke@jafferwells.com>
Cc: Randy Habib <randy@jafferwells.com>; Reinefeld, Werner <Werner.Reinefeld@wsp.com>
Subject: Well Capacities in Key Largo, FL & Big Pine Key, FL

Good Afternoon Duke,

I hope all is well. By any chance, do you have any records of well capacities in Key Largo and Big Pine Key? Attached are the general locations of the project areas.

Thank you,

Sarah H. Amritt, P.E., ENV SP
Sr. Project Manager / Lead Engineer

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Mobile: +1 305 310 5776
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