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AKS ENGINEERING & FORESTRY
WWW.AKS-ENG.COM
P: (503) 563-6151 F: (503) 563-6152

November 13, 2017

Wendy L. Marshall, PE
City of Oregon City
Development Projects Manager
625 Center Street
Oregon City, OR 97045

RE: Sanitary Sewer Service Capacity
Lindsay Anne Estates Too – 28 Lot Subdivision
Clackamas County Assessor's Information: Map 32E18, Tax Lot 1400
± 6.33 Acres

Wendy:

The purpose of this sanitary sewer analysis is to demonstrate the actual design wastewater flow from this development has the same (or less than) the predicted future wastewater flow (per the City of Oregon City Sanitary Sewer Master Plan dated November 2014).

Per the City of Oregon City Sanitary Sewer Master Plan dated November 2014, the wastewater flow calculation is based on the following:

- Gross area: 6.33 acres
- Net area: 5.06 acres (assuming 20% of the gross site area would be used for streets, easements, and other utilities)
- Number of lots: 25 (LDR = 5 dwellings per net acre)
- Total wastewater flow: 13.94 gpm (see attached Exhibit A-1)

Per the actual designed development, the wastewater flow calculation should be based on the following:

- Gross area: 6.33 acres
- Net area: 3.48 acres (actual net area after subtracting the streets, stormwater facility, and the area of the PGE transmission line easement – see attached Exhibit A-2)
- Number of lots: 28
- Total wastewater flow: 14.09 gpm (see attached Exhibit A-1)

Per the Future Developed Parcels Map (see attached Exhibit B) in the City of Oregon City Sanitary Sewer Master Plan November dated 2014, all future lots in the Anastyn Estates subdivision are assumed to flow to Settler's Point pump station. However, when Rian Park Development, Inc. developed Anastyn Estates (the same developer for Lindsay Anne Estates Too), the site was designed such that the wastewater flow for Lot 2 does not flow to the Settler's Point pump station (see attached Exhibits C and D). The predicted wastewater flow to Settler's Point pump station from Lot 2 of Anastyn Estates is available as extra wastewater flow for Lindsay Anne Estates Too.

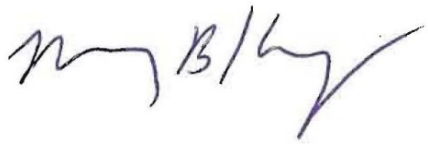
Wastewater flow calculation from Lot 2 of Anastyn Estates:

- Net area: 0.15 acres
- Number of lots: 1
- Total wastewater flow: 0.52 gpm (see attached Exhibit A-1)

The actual design wastewater flow for Lindsay Anne Estates Too is 13.57 gpm (14.09 gpm minus 0.52 gpm), which is less than the predicted future wastewater flow per the City of Oregon City Sanitary Sewer Master Plan dated November 2014.

Sincerely,

AKS ENGINEERING & FORESTRY, LLC



Montgomery B. Hurley – PE, PLS, Principal

Sanitary Sewer Flow Calculation

		Lindsay Anne Estates Too (Per Sanitary Sewer Master Plan)	Lindsay Anne Estates Too (Actual Design Scenario)	Lot 2 of Anastyn Estates (Actual Built Scenario - Not Flow to Settler's PS)
Gross area (acre):		6.33		
Net area - 80% of Gross area[a] (acre):		5.06		
No. of lots[a] (5 lot per acre):		25		
Actual net area[b] (acre):			3.48	0.15
Actual No. of lots:			28	1
People per lot[a]:	2.5			
Unit flow[a] (gpcd):	80			
Peaking Factor[a]:	3			
I/I[c] (gpad):	1000			
Domestic Flow (gpm):		10.42	11.67	0.42
I/I Flow (gpm):		3.52	2.42	0.10
Total Wastewater Flow (gpm):		**13.94**	**14.09**	**0.52**

[a] Per Section 3.5.1 Future Base Flows in the City of Oregon City Sanitary Sewer Master Plan dated November 2014

[b] Per Attachment A - Future Development Flow Method - Analysis Step 21 in the City of Oregon City Sanitary Sewer Master Plan dated November 2014

[c] Per Section 3.5.2 Future Wet Weather Flows in the City of Oregon City Sanitary Sewer Master Plan dated November 2014

EXHIBIT A-1

Net Area Calculation

Lot	Area (sf)
1	4,860
2	4,998
3	29,075
4	5,054
5	4,914
6	5,500
7	5,500
8	5,500
9	5,054
10	4,914
11	4,873
12	5,012
13	5,013
14	4,966
15	5,100
16	5,117
17	5,005
18	5,054
19	5,551
20	5,549
21	5,550
22	5,054
23	5,010
24	6,491
25	5,049
26	5,338
27	5,822
28	16,721

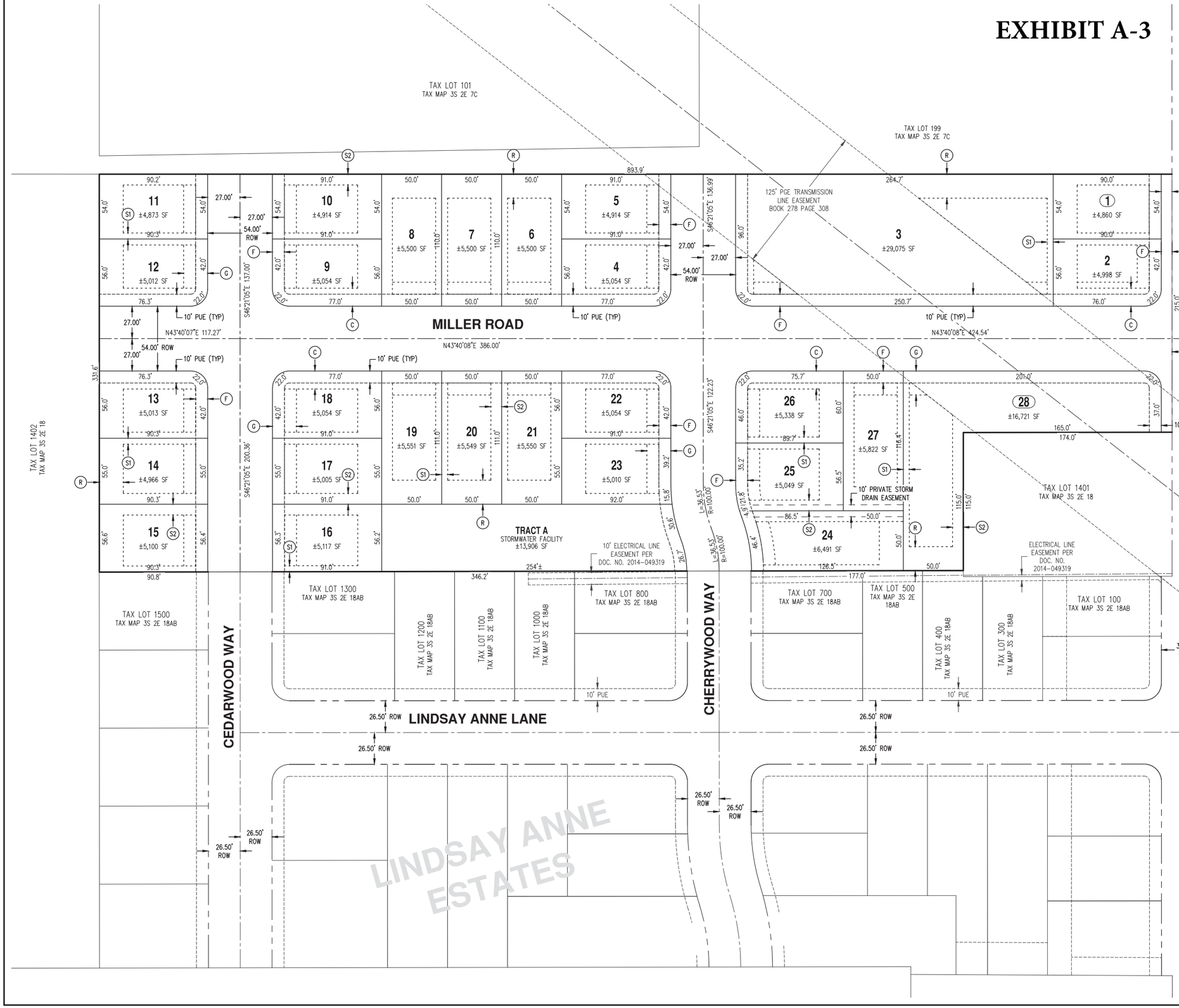
Total Lot Area: 181,644 sf

Total PGE Easement Area: 30,078 sf

Total Net Area: **151,566** sf
3.48 acres

EXHIBIT A-2

EXHIBIT A-3



SETBACK LEGEND

- (F) 10' MINIMUM FRONT YARD SETBACK
- (G) 20' MINIMUM GARAGE SETBACK
- (S1) *5' MINIMUM SIDE YARD SETBACK (ONE SIDE)
- (S2) *9' MINIMUM SIDE YARD SETBACK (ONE SIDE)
- (C) 15' CORNER SIDE YARD SETBACK
- (R) 20' REAR YARD SETBACK

*5' AND 9' INTERIOR SIDE YARD SETBACKS CAN BE SWAPPED (TYPICAL). ONE SIDE YARD HAS TO BE A MINIMUM OF 5', THE OTHER SIDE YARD SETBACK HAS TO BE A MINIMUM OF 9'.

PRELIMINARY SUBDIVISION PLAT NOTE:

THE PURPOSE OF THIS PRELIMINARY PLAT IS TO SHOW THE LOT DIMENSIONS FOR PLANNING PURPOSES. THIS IS NOT A FINAL PLAT AND IS NOT TO BE USED FOR SURVEYING PURPOSES.

ZONE R-6

NET AREA: 181,644 SQUARE FEET ±
AVERAGE LOT AREA: 6,487 SQUARE FEET ±

LINDSAY ANNE ESTATES

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12965 SW HERMAN RD STE 100
TUALATIN, OR 97062
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aks-eng.com

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LINDSAY ANNE ESTATES TOO
OREGON CITY OREGON
CLACKAMAS COUNTY TAX MAP 3-2E-18
TAX LOT 1400

PRELIMINARY SUBDIVISION PLAT WITH BUILDING SETBACKS

DESIGNED BY:	VHN
DRAWN BY:	NMC
CHECKED BY:	MBH
SCALE:	AS NOTED
DATE:	08/07/2017

REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JULY 13, 2004
MONTGOMERY B. HURLEY
NOT FOR CONSTRUCTION
RENEWAL DATE: 6/30/19

REVISIONS

JOB NUMBER
5837

SHEET
P1-03

AKS DRAWING FILE: 5837 PLAT.DWG | LAYOUT: P1-03

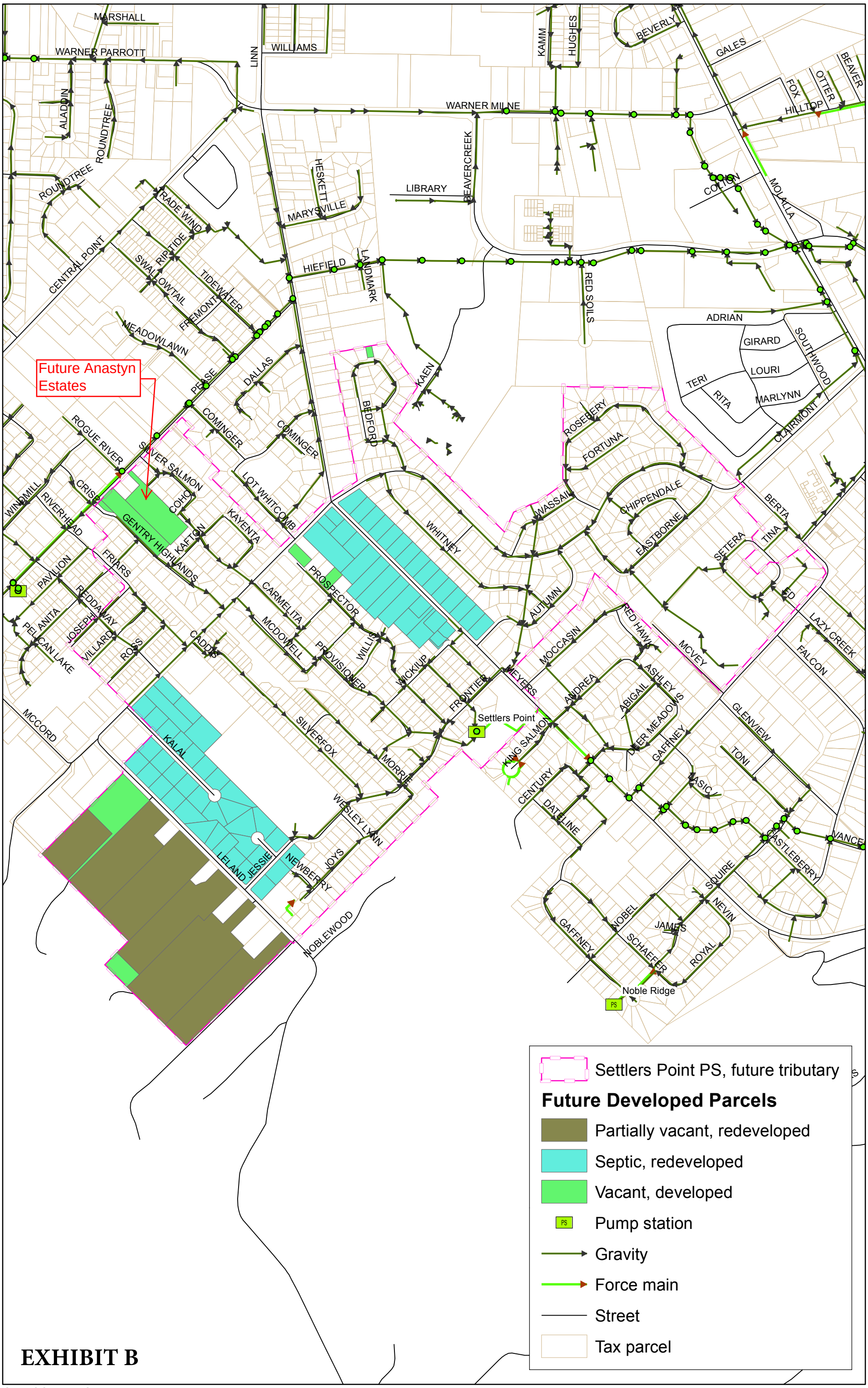


EXHIBIT B

City of Oregon City
Settlers Point Pump Station - Future, Additional Sewer Flow

March 2014

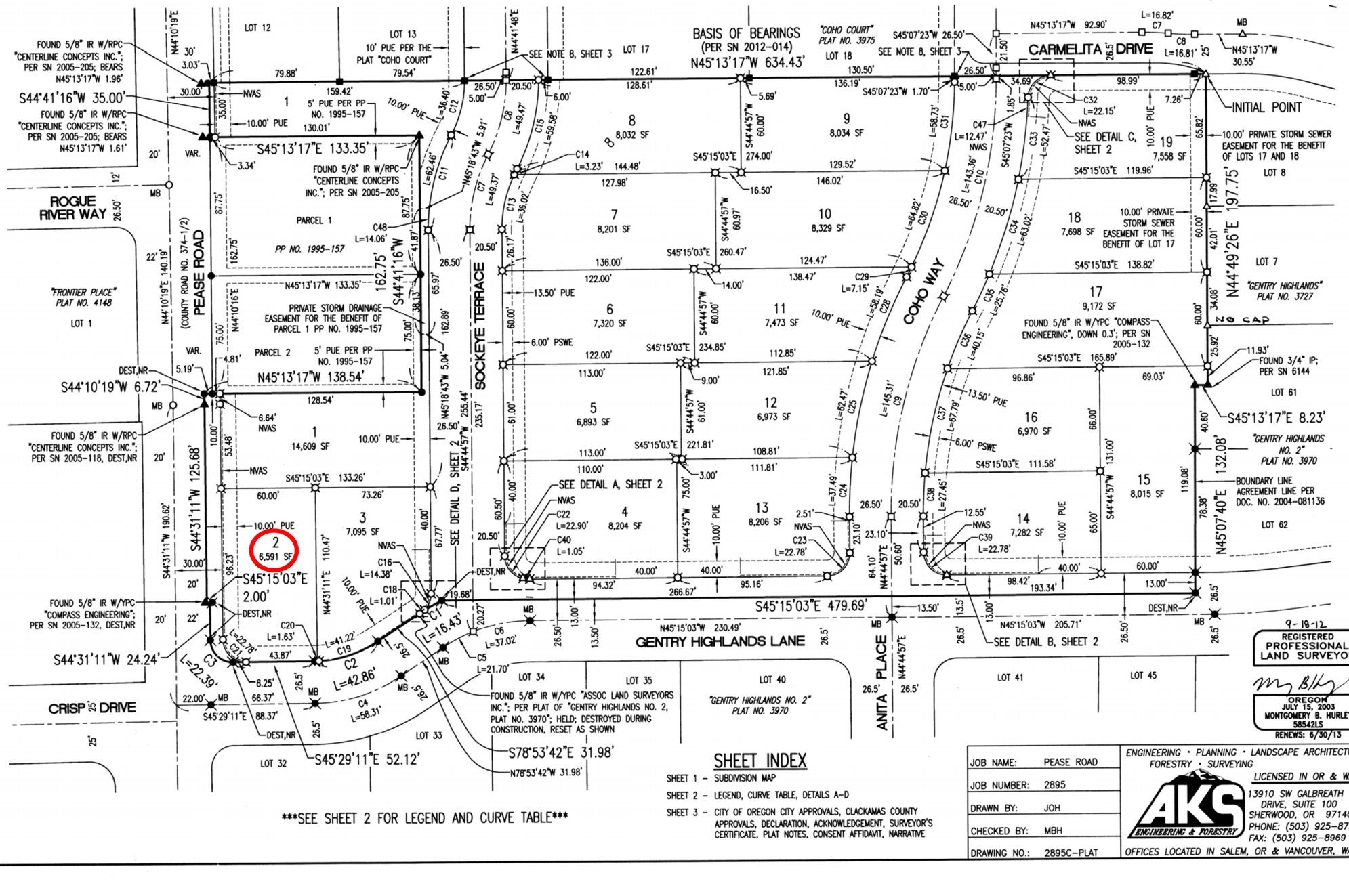
BOOK 143 PAGE 003
4351 SHEET 1 OF 3

ANASTYN ESTATES

A REPLAT OF PARCEL 3 OF PARTITION PLAT NO. 1995-157, TRACT 'E' OF "GENTRY HIGHLANDS NO. 2" PLAT NO. 3970, AND A TRACT OF LAND LOCATED IN THE NORTHEAST 1/4 OF SECTION 7, TOWNSHIP 3 SOUTH, RANGE 2 EAST, WILLAMETTE MERIDIAN, CITY OF OREGON CITY, CLACKAMAS COUNTY, OREGON
CITY OF OREGON CITY CASE FILE NUMBER TP 11-02
SEPTEMBER 7, 2012

SCALE 1" = 40 FEET

PREPARED FOR
RIAN PARK DEVELOPMENT, INC.
15239 S. LAKERIDGE WAY
OREGON CITY, OR 97045



SEE SHEET 2 FOR LEGEND AND CURVE TABLE

SHEET INDEX

9-18-12
REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JULY 15, 2003
MONTGOMERY B. HURLEY
58542LS
RENEWS: 6/30/13

JOB NAME:	PEASE ROAD
JOB NUMBER:	2895
DRAWN BY:	JOH
CHECKED BY:	MBH
DRAWING NO.:	2895C-PLAT

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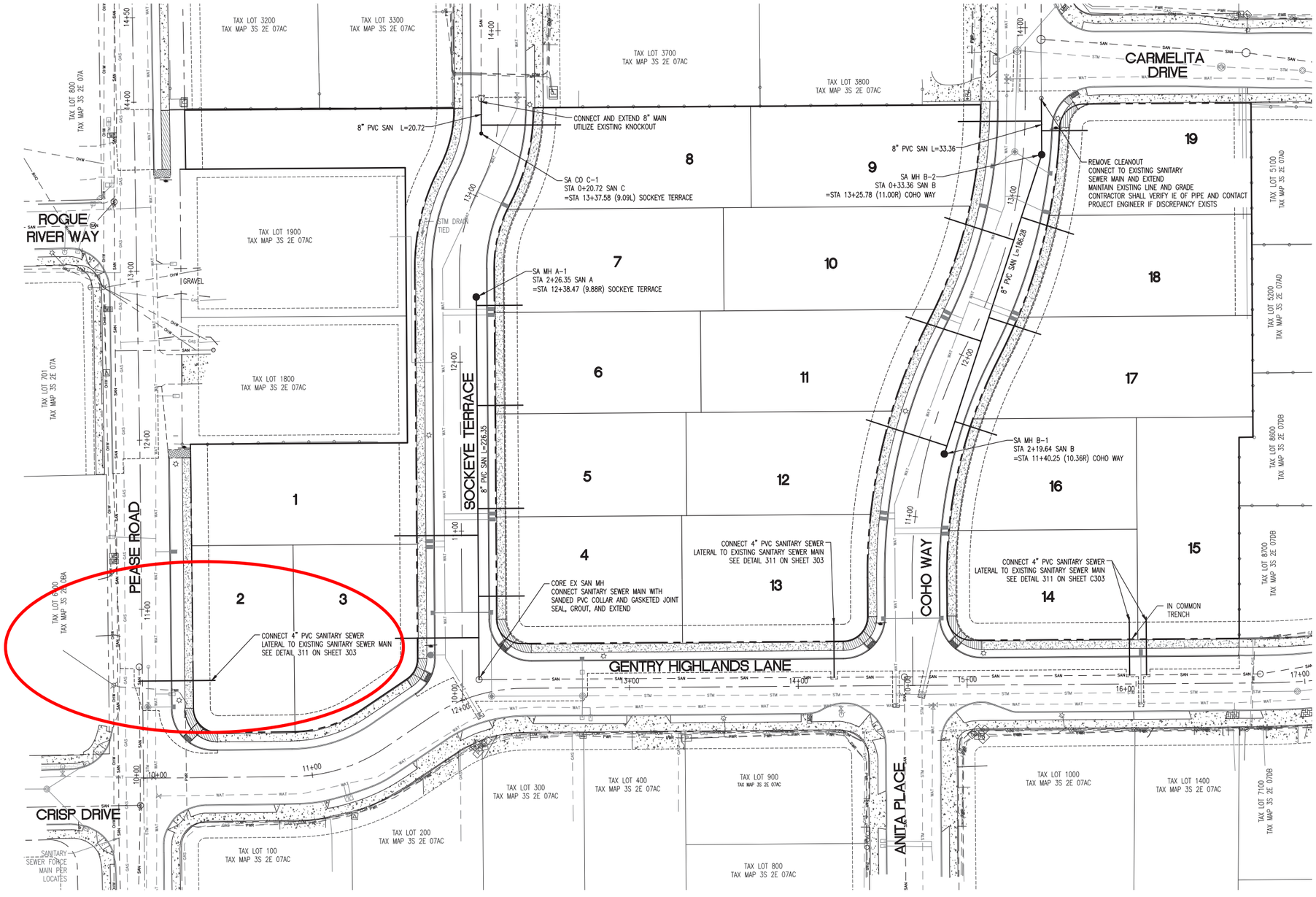
FORESTRY · SURVEYING
AKS ENGINEERING & FORESTRY
LICENSED IN OR & WA
13910 SW GALBREATH DRIVE, SUITE 100
SHERWOOD, OR 97140
PHONE: (503) 925-8799
FAX: (503) 925-8969
OFFICES LOCATED IN SALEM, OR & VANCOUVER, WA

EXHIBIT C

SCALE 1" = 30 FEET

30 0 12 18 24 30



NOTES:

1. SANITARY SEWER PIPE SHALL BE PVC, CONFORMING TO ASTM 3034 SDR 35.
2. TRENCH BACKFILL SHALL BE CLASS B 3/4"-0" GRANULAR WITHIN THE STREET AND NATIVE OUTSIDE THE STREET.
3. SANITARY SEWER LATERALS SHALL COMPLY WITH THE UNIFORM PLUMBING CODE.
4. SANITARY SEWER LATERALS SHALL BE 4" PVC UNLESS OTHERWISE NOTED.
5. INSTALL WATERTIGHT CAP AT SERVICE LATERAL END.
6. A 2"x4" WOOD MARKER SHALL BE PLACED AT THE LATERAL END FROM THE PIPE INVERT TO TWO FEET ABOVE THE GROUND. THE 2"x4" TOP SHALL BE PAINTED GREEN AND MARKED WITH AN "S" AND THE DEPTH OF THE LATERAL MEASURED FROM GROUND TO INVERT OF PIPE. CONTRACTOR WILL BE REQUIRED TO EXCAVATE SERVICE LATERAL ENDS FOR DEPTH VERIFICATION PRIOR TO PROJECT COMPLETION IF THE DEPTH TO INVERT IS NOT PROPERLY NOTED ON THE LATERAL MARKER. THE CURB LINE SHALL HAVE AN "S" STAMPED ON THE TOP OF THE CURB AT THE LATERAL CROSSING.

AS-BUILT DISCLAIMER:
AS-BUILT INFORMATION IS BASED ON A COMBINATION OF FIELD SURVEY INFORMATION, SPOT INSPECTION INFORMATION, CITY-PROVIDED INFORMATION, AND CONTRACTOR-PROVIDED INFORMATION. THE ENGINEER ONLY CERTIFIES INFORMATION WHICH COULD BE FIELD-VERIFIED AFTER CONSTRUCTION WAS COMPLETED.

EXHIBIT D

10170.20

SANITARY SEWR PLAN

ANASTYN ESTATES
SUBDIVISION AS-BUILTS
OREGON CITY
CLACKAMAS COUNTY TAX MAP 3S 2E 07AC
TAX LOTS 1500, 1600, 2000

AKS ENGINEERING & FORESTRY
ENGINEERING · PLANNING
SURVEYING · FORESTRY
13910 SW GALBREATH DR.
SUITE 100
SHERWOOD, OR 97140
PHONE: (503) 925-8799
FAX: (503) 925-8869

DESIGNED BY:	MBH
DRAWN BY:	BDT
CHECKED BY:	MBH
DRAWING NO.:	A1-C301
SCALE:	AS NOTED

PREPARED FOR:
RIAN PARK DEVELOPMENT
15239 S LAKERIDGE WAY
OREGON CITY, OR 97045

DATE: 1-4-13

REGISTERED PROFESSIONAL ENGINEER
58542PE
OREGON
JULY 9, 2009
MONTGOMERY B. HURLEY
RENEWAL DATE: 6/30/13

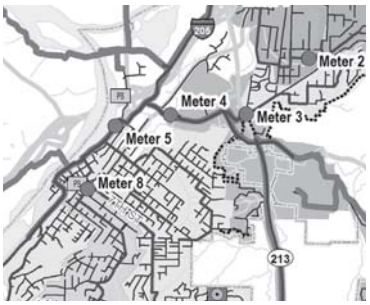
JOB NUMBER
2895

SHEET
C301

Prepared for
City of Oregon City

Sanitary Sewer Master Plan

November 2014



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3.5 Future Flows

Base flows and RDII from future developments were estimated and routed through the model to estimate future capacity deficiencies in the trunk sewer system. Three types of future development areas were included in the analysis:

- Large future development areas at the boundaries of the City's urban growth area: South End Road, Park Place, and Beavercreek Road.
- Expected development areas within the city limits. This category includes all parcels identified by the City excluding those considered to be un-developable (e.g., existing parks) and lots considered not to have future development potential (e.g., small single residential lots with existing connections to the sewer system).
- Individual land parcels within the city limits with redevelopment potential. These consist of both vacant parcels and parcels where the existing land use is less dense than the parcel zoning. This category also includes individual parcels in unincorporated areas (within the urban growth area) with single family residential land use. It was assumed these parcels are currently serviced by onsite septic systems and will connect to the sanitary sewer system in the future.

3.5.1 Future Base Flows

Future average daily base flows were estimated from industry standard rates for each land use designation. For the large development areas, the proposed gross acreage for each land use designation was provided by the City. For parcels with areas greater than 1 acre, the net acreage was calculated assuming that 20 percent of the gross acreage would be used for local roads, easements, and other utilities. Table 3-2 lists the rates used to develop future base flows.

Table 3-2. Future Sewer Base Flow Unit Rates

Land use	Unit type	Unit flow
Residential[a,b]	Gallons per capita per day	80
Commercial[c]	Gallons per acre per day (gpad)	1,000
Industrial[c]	gpad	2,000

[a] *An average of 2.5 people per household was assumed.*

[b] *Development densities specified in the 2004 Oregon City Comprehensive Plan were used to determine the number of dwellings per acre. LDR = 5 dwellings per acre, MDR = 10 dwellings per acre, HDR = 22 dwellings per acre.*

[c] *Unit flow rates for commercial and industrial areas were based on industry standard.*

3.5.2 Future Wet Weather Flows

RDII from future areas was calculated by estimating the amount of future sewered areas and applying an infiltration/inflow (I/I) rate of 1,000 gpad. I/I was not applied to parcels within the city limits that are already developed, because it was assumed the I/I contribution from these parcels already would be accounted for in the existing conditions model.

16. ID those parcels located in concept plan areas
    a. Add field, type string, named “CONCEPT”
    b. Select by location parcels in “taxlot_model” with their centroid within any of the 3 concept plan polygons provided by the City.
    c. Field calculate “CONCEPT”=”YES”
17. Determine area of constrained land on each parcel
    a. Union “taxlot_model” and selection of “All_Constraints” that intersects “BASE_UGB_Fill”
        i. Resulting fc is named “taxlot_constrained_union”
        ii. Note: Set definition query on “All_Constraints” of "Building" = 'N'. This omits buildings from the constrained layer.
    b. Union “taxlot_constrained_union” and selection of “Vacant_Lands” that intersects “BASE_UGB_Fill”
        i. Resulting fc is named “taxlot_cnstrnd_vacant_union”
    c. Calculate vacant area slices
        i. Add field, type double, named “AREA_CONSTR”
        ii. Select features in “FID_All_Constraints” <> -1. This is all the constrained features.
        iii. Calculate geometry of “AREA_CONSTR” attribute, which represents “constrained land” area
        iv. Add field, type double, named “AREA_CONSTR_PRTL”
        v. Select features in “FID_All_Constraints” = -1 AND “FID_Vacant_Lands”<> ”-1”. This is vacant land that is also constrained (i.e. vacant and constrained land overlap).
        vi. Calculate geometry of “AREA_CONSTR_PRTL” attribute, which represents “constrained vacant land” area
    d. Dissolve “taxlot_cnstrnd_vacant_union” based on “TLID” attribute
        i. During dissolve, calculate sum of “AREA_CONSTR” and “AREA_CONSTR_PRTL” attributes.
        ii. Resulting fc is named “taxlot_cnstrnd_vcnt_union_dissolv”
    e. Transfer constrained land information to the “taxlot_model” fc
        i. Add field to “taxlot_model” fc named “CONSTR_AREA” – type Double.
        ii. Add field to “taxlot_model” fc named “CONSTR_VAC_AREA” – type Double.
        iii. Join “taxlot_constrained_union_Dissolv” fc to “taxlot_model” fc based on “TLID” attribute
        iv. Calculate “CONSTR_AREA” = “AREA_CONSTR”
            1. Select null values and set to 0
        v. Calculate “CONSTR_VAC_AREA” = “AREA_CONSTR_PRTL”
            1. Select null values and set to 0
18. Estimate net developable acres
    a. Add field to “taxlot_model”, type double, named “NET_DEV_ACRES”
    b. Select those parcels where only the vacant portion will be developed. Select features from “taxlot_model” where “DEV_MOD” = “YES_PARTIAL”
    c. Field calculate “NET_DEV_ACRES” = (“AREA”* “PRCNT_VACANT”- “CONSTR_VAC_AREA”) /43560
    d. Switch the selection
    e. Field calculate “NET_DEV_ACRES” = ([AREA]- [“CONSTR_AREA”])/43560
19. Identify Model Junction where development drains
    a. Add field to “taxlot_model”, type long, named “MANHOLE”
    b. Use “Tax_parcel_redevelopment_5” as a start – join this fc based on Tlid
20. Flow assumptions
    a. MFR is 5 units
21. Estimate ex and future flow

a. Add fields to “taxlot model”
    i. LU_UNIT_Q, type long
    ii. LU_UNIT_Q_TYPE, type text
    iii. EX_Q, type double
    iv. ZONE_UNIT_Q, type long
    v. ZONE_UNIT_Q_TYPE, type text
    vi. FUT_Q, type double
    vii. “AREA_RED”, type double
b. Create lookup tables
c. Join tables
d. Estimate flow by following logic
    i. Existing
        1. If gpd, then same
        2. if gpad, then unit q by area
    ii. Future
        1. Select features with “NET_DEV_ACRES” > 1
        2. Field calc “AREA_RED” = 0.8
        3. Switch selection
        4. Field calc “AREA_RED” = 1.0
        5. if gpd, then unit q x (“NET_DEV_ACRES” x “AREA_RED” x 43560) / “ZONE_MINLOTSF”
        6. if gpad, then unit q x (“NET_DEV_ACRES” x “AREA_RED”)
e. Identify areas where additional I/I could be expected (i.e. currently unsewered areas)
    i. Add field named “II_GPD”, type double
    ii. Select “SEPTIC” = “SEPTIC” and “VACANT_ID”=”VACANT” and “LANDUSE_COMPILE” = “RUR” and “LANDUSE_COMPILE” = “FOR” and “LANDUSE_COMPILE” = “AGR”
    iii. Field calc “II_GPD” = 1000 x “NET_DEV_ACRES”
        1. Assume 1,000 acre/day I/I
    iv. Switch selection, and calculate “II_GPD”= 0

22. Estimate additional flow
    a. Add field named “ADD_FLOW_GPD”, type double
        i. Select “SEPTIC” = “SEPTIC” and "DVLPMNT_MOD" = 'YES_PARTIAL'
        ii. Calc “ADD_FLOW_GPD” = “FUT_Q”
        iii. Select all features with no value for “ADD_FLOW_GPD”
        iv. Calc “ADD_FLOW_GPD” --

```
dim flow
if ([FUT_Q] + [II_GPD])  < [EX_FLOW] then
flow = 0
elseif ([FUT_Q]  - [EX_FLOW]) < 0 then
flow = 0
else
flow = [FUT_Q]  - [EX_FLOW]
end if
```