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BELL ROAD PROJECT DRAINAGE STUDY

CALCULATIONS

DRAINAGE AREAS 8, 9 and 10

A530.804

Greiner Engineering

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Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL ROAD PROJECT DRA. OF STUDY
Description: E123061 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 6
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-801C

Area: 0.3 square miles

Upstream Elevation: 1525 Hydraulic Length: ~~9800~~ 5400 feet

Downstream Elevation: 1480 Slope: ~~0.0047~~ .0083 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	50	COP	~~R-7~~	PARK	B	79/79	
	20	"	R1-7	UNDEV	"	"/84	
	10	"	R-3	"	"	"/85	
	20	"	Rural	"	"	"/79	

Weighted CN= 79/81

Large or Elongated Watersheds

Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$

N= 0.03 L= ~~480~~ 1.02 m; Lc ~~0.85~~ 0.51 m;

S= ~~25~~ 44 ft/mi

Lag= ~~0.46~~ 0.27 hours

Lag time used

Small, Uniform Watersheds

Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{\frac{1}{2}}$

L= _____ ft CN= _____

S= _____ % Lag= _____ hours

Adjust Lag:

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-806

Area: .05 square miles

Upstream Elevation: 1479 Hydraulic Length: ~~2500~~ 1680 feet

Downstream Elevation: 1467 Slope: ~~0.0048~~ 71 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.035	70%		R1-18	UNDEV.	B	79/80	
.015	30%		C-2	"	B	79/92	

Weighted CN= 79/84

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ mi Lc _____ mi	L= ~~2500~~ 1680 ft CN= 79
S= _____ ft/mi	S= ~~.48~~ 71 % Lag= ~~0.98~~ 0.59 hours
Lag= _____ hours	Adjust Lag ↑ Lag time used

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-807

Area: .09 square miles

Upstream Elevation: 1490

Downstream Elevation: 1469

Hydraulic Length: ~~5500~~ 3120 feet

Slope: ~~0.0038~~ 0.0067 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.006	7%		R1-18	~~Existing~~ UNDEV	B	~~80~~ 79	S.F.
.02	15 ~~22~~%		C-2	"	B	92	Commercial
.064	78%		R1-8	" UNDEV	B	~~82~~ 79	S.F. Res

Weighted CN= ~~(84.06) 84~~ 81/84

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= 0.035 L= 1.04 mi Lc 0.55 mi	L= 3120 ft CN= 81
S= 20 ft/mi	S= .67 % Lag= 0.93 hours
Lag= 0.38 hours	Adjust Lag: Lag time used

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-810

Area: .01 square miles

Upstream Elevation: 1529 Hydraulic Length: ~~1300~~ 960 feet

Downstream Elevation: 1520 Slope: ~~0.0094~~ 0.0084 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.002	~~80~~ 20%		R-3	~~Existing~~ UNDEV	B	~~79~~ 85	Multiple Family
.009	~~20~~ 80%		Rural	"	B	79	

Weighted CN= (80.2) ~~80~~ 79/~~84~~

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= _____ L= _____ mi Lc _____ mi	L= ~~1300~~ 960 ft CN= 79
S= _____ ft/mi	S= ~~.94~~ % Lag= ~~0.49~~ 0.33 hours
Lag= _____ hours	Adjust Lag: ↑ Lag time used

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Job BELL ROAD PROJECT DRAINAGE STUDY
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BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation Q810

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) 5500 FT.

Channel Slope (S) 0.0086 FT./FT.

Channel Roughness (N) 0.035

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 0 ft.

Side Slopes (Z) 6

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-811

Area: .12 square miles

Upstream Elevation: 1524 Hydraulic Length: ~~5800~~ 3120 feet

Downstream Elevation: 1491 Slope: ~~0.0057~~ 0.0106 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.04	20%		R-3	UNDEV	D	79/85	Multi-family
.04	20%		R1-8	DEV	B	82	Single Family Res
.17	68%		R1-18	UNDEV	B	79/80	Single Family Res

Weighted CN= 80/81

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ mi Lc _____ mi	L= ~~5800~~ 3120 ft CN= 80
S= _____ ft/mi	S= 1.80 % Lag= ~~1.72~~ 0.77 hours
Lag= _____ hours	Adjust Lag:
	0.9% (~~1.72~~ 0.77) = ~~1.69~~ 0.75
	Lag time used

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 811

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) ~~6000~~ 3600 FT.

Channel Slope (S) ~~0.0038~~ 0.0067 FT./FT.

Channel Roughness (N) 0.030

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 0 ft.

Side Slopes (Z) 6

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 812AN

Area 0.15 square miles

Upstream Elevation 1524 Hydraulic Length 3800 feet

Downstream Elevation 1500 Slope 0.0063 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
See 812A							

Weighted CN= 79/81

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{.5}$
N= 0.03 L= 0.72 mi Lc 0.36 mi	L= 3800 ft CN= 79
S= 33.3 ft/mi	S= .63 % Lag= 1.20 hours
Lag= 0.22 hours	Adjust Lag:
use	

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Job BELL ROAD PROJECT DRAINAGE STUDY
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 812AS

Area 0.16 square miles

Upstream Elevation 1500 Hydraulic Length 2900 feet

Downstream Elevation 1475 Slope 0.0086 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See 812A

Weighted CN= 79/81

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{.5}$
N= 0.03 L= 0.55 mi Lc 0.27 mi	L= 2900 ft CN= 79
S= 45.4 ft/mi	S= .86 % Lag= 0.83 hours
Lag= 0.17 hours	Adjust Lag:
use	

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-8/2B

Area: 0.1 square miles

Upstream Elevation: 1505 Hydraulic Length: ~~5800~~ 3600 feet

Downstream Elevation: 1475 Slope: ~~0.0052~~ 83 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	15	COP	RH8	DEV	B	80	
	85	COP	RH8	UNDEV	B	79/80	

Weighted CN= 79/80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= 0.03 L= ~~1.10~~ 0.68 m; Lc ~~0.66~~ 0.41 m;	L= _____ ft CN= _____
S= ~~2.744~~ ft/m;	S= _____ % Lag= _____ hours
Lag= ~~0.34~~ 0.22 hours	Adjust Lag:
Lag time used	

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-815B

Area: 0.07 square miles

Upstream Elevation: 1525

Downstream Elevation: 1509

Hydraulic Length: ~~4000~~ 2400 feet

Slope: ~~0.0040~~ .67 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	COP	R1-18	UNDEV	B	68	IRR PASTURE

Weighted CN= ~~68~~ 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= ____ L= ____ m; Lc ____ m;	L= ~~4000~~ 2400 ft CN= 68
S= ____ ft/m;	S= .67 % Lag= ~~2.14~~ 1.10 hours
Lag= ____ hours	Adjust Lag

Lag time used

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 815B

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) ~~5000~~ 2400 FT.

Channel Slope (S) ~~0.0042~~ .0193 FT./FT.

Channel Roughness (N) 0.03

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 0 ft.

Side Slopes (Z) 6

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Job: BELL ROAD PROJECT DRAINAGE STUDY
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-815C

Area: 0.25 square miles

Upstream Elevation: 1508 Hydraulic Length: ~~6200~~ 3840 feet

Downstream Elevation: 1482 Slope: ~~0.0042~~ 0.0193 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	COP	R-18	UNDEV	B	79	

Weighted CN= 79/80

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= _____ L= _____ m; Lc _____ m;	L= ~~6200~~ 3840 ft CN= 79
S= _____ ft/m;	S= ~~.42~~ 1.93 % Lag= ~~2.18~~ 0.69 hours
Lag= _____ hours	Adjust Lag

Lag time used

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: QB-820

Area: .03 square miles

Upstream Elevation: 1530 Hydraulic Length: ~~1300~~ 960 feet

Downstream Elevation: 1521 Slope: 0.0069 / 94 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.03	100%		R1-18	~~Existing~~ UNDEV	B	~~80~~ 79	S.F. Residential

Weighted CN= ~~80~~ 79 / 100

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= _____ L= _____ m; Lc _____ m;	L= ~~1300~~ 960 ft CN= 79
S= _____ ft/m;	S= ~~.69~~ .94 % Lag= ~~0.49~~ 0.33 hours
Lag= _____ hours	Adjust Lag

lag time used

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 820

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) ~~6700~~ 4560 FT.

Channel Slope (S) 0.003761 FT./FT.

Channel Roughness (N) 0.03

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 0 ft.

Side Slopes (Z) 6

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Job: BELL ROAD PROJECT DRAINAGE STUDY

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-819

Area: .07 square miles

Upstream Elevation: 1499 Hydraulic Length: ~~2500~~ 1560 feet

Downstream Elevation: 1488 Slope: ~~0.0044~~ 71 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.008	12%		C-0	AG ~~UNDEV~~ ~~Existing~~	B	68 ~~88~~	IRR Pasture @present ~~Commercial~~
.02	25 ~~31~~%		C2	"	B	92	Comercial
.04	50%		R1-18	~~H~~ UNDEV	B	79 ~~80~~	S.F. Resid.
	13%		School		B	90	

Weighted CN= (84.68) ~~85~~ 82/85

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = ... 00 S$^{1/2}$
N=_____ L=_____ mi Lc_____ mi	L= 25
S=_____ ft/mi	S= .4 / 7
Lag=_____ hours	Adju

Lag time

N/A _____ hours

0.45

0.83

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-815A

Area: 0.14 square miles

Upstream Elevation: 1526 Hydraulic Length: ~~4600~~ 3000 feet

Downstream Elevation: 1502 Slope: ~~0.0052~~ 80 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.14	100%		R1-18	Existing	B	80	Single Family Resid

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= ____ L= ____ m; Lc ____ m;	L= ~~4600~~ 3000 ft CN= 80
S= ____ ft/m;	S= ~~.52~~ 80 % Lag= ~~1.49~~ 0.86 hours
Lag= ____ hours	Adjust Lag: .88(~~1.49~~ 0.86) 0.75 ← Lag time used

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 815A

Overland Flow Length (L) 2000 ft.

Slope (S) 0.0052 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 2600 FT.

Channel Slope (S) 0.0080 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) ____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 30 ft.

Side Slopes (Z) 0

RK

L = 4500

S = 0.0035

N = 0.016

TRAP

40

0

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Job BELL ROAD PROJECT DRAINAGE STUDY

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation Q8-817

Area .09 square miles

Upstream Elevation 1524 Hydraulic Length ~~3500~~ 2400 feet

Downstream Elevation 1505 Slope 0.00~~54~~ 79 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.09	100%		R1-10	Existing	B	~~81~~ ok ~~82~~	S.F. Resid.

Weighted CN= ~~81~~ ok ~~82~~

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = 100 S$^{1/2}$
N=_____ L=_____m; Lc_____m;	L=35
S=_____ft/m;	S= .5 _hours
Lag=_____hours	

Lag time

N/A

Adjus

.83

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Job BELL ROAD PROJECT DRAINAGE STUDY
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BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 817

Overland Flow Length (L) 500 ft.

Slope (S) 0.005479 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~3000~~ 2400 FT.

Channel Slope (S) 0.005479 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 35 ft.

Side Slopes (Z) 0

RK

L = ~~4500~~ 3000

S = 0.00361

N = 0.027

TRAP

0

6

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation Q8-816

Area .21 square miles

Upstream Elevation 1514 Hydraulic Length ~~7500~~ 4560 feet

Downstream Elevation 1486 Slope ~~0.0037~~ .0061 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.21	100%		R1-18	Existing	B	80	S.F. Residential

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/Sc^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.03 L= ~~1.42~~ 0.06 mi Lc ~~0.72~~ ~~0.39~~ 0.50 mi	L= _____ ft CN= _____
S= ~~20~~ 32.2 ft/mi	S= _____ % Lag= _____ hours
Lag= ~~0.41~~ ~~0.04~~ 0.27 hours	Adjust Lag:
↑ Lag time used	

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 816

Overland Flow Length (L) 2000 ft.

Slope (S) 0.0037 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 4500 FT.

Channel Slope (S) 0.0037 FT./FT.

Channel Roughness (N) 0.030

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 0 ft.

Side Slopes (Z) 6

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Job: BELL ROAD PROJECT DRAINAGE STUDY
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-818

Area: .05 square miles

Upstream Elevation: 1501 Hydraulic Length: ~~2500~~ 1560 feet

Downstream Elevation: 1488 Slope: ~~0.0052~~ 0.0083 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.02	29%		C-O	Existing	B	88	Commercial
.05	71%		R1-18	"	B	80	SF. Residential

Weighted CN= ~~(82.3)~~ 82

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= _____ L= _____ mi Lc _____ mi	L= ~~2500~~ 1560 ft CN= 82
S= _____ ft/mi	S= ~~.52~~ .83 % Lag= ~~0.86~~ 0.47 hours
Lag= _____ hours	Adjust Lag: 0.47, 0.89 (0.86) 0.42 ↑ Lag time used

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: mc Date: 8-26 Sheet No. 48
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-822

Area: .02 square miles

Upstream Elevation: 1494 Hydraulic Length: ~~1200~~ 840 feet

Downstream Elevation: 1490 Slope: ~~0.0033~~ 48 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.02	100%		R1-18	Existing	B	80	S.F. Residential

Weighted CN= 80

Large or Elongated Watersheds

Lag = 24n (L Lca/S^0.5)^0.38

N= _____ L= _____ mi Lc _____ mi

S= _____ ft/mi

Lag= _____ hours

Lag time

N/A

ersheds

- 9)^0.7/1900 S^½

80

~~0.64~~ 0.40 hours

0.28

F) = 0.45

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123061 J0501
Calculated by MC Date 8-26 Sheet No. 49
Checked by Date of

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 822

Overland Flow Length (L) 40 ft.

Slope (S) 0.00348 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 1160 FT.

Channel Slope (S) 0.00348 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) ____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 35 ft.

Side Slopes (Z) 0

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 46
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: QB-821

Area: .12 square miles

Upstream Elevation: 1515 Hydraulic Length: ~~4500~~ 3300 feet

Downstream Elevation: 1492 Slope: 0.0051 feet/feet
71

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
1/2	100%		R1-18	Existing	B	80	S.F. Residential

Weighted CN= 80 ✓

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag 1900 S^½
N=_____ L=_____mi Lc_____mi	L= 4 Lag time —
S=_____ft/mi	S= . ___hours
Lag=_____hours	N/A
	Adj 0.70
	~~1.05~~

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 821

Overland Flow Length (L) 50 ft.

Slope (S) 0.0081 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~6900~~ 3250 FT.

Channel Slope (S) 0.0081 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 35 ft.

Side Slopes (Z) 0

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: M.C Date: 8-26 Sheet No. 50
Checked by: Date: of

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-823

Area: .12 square miles

Upstream Elevation: 1517 Hydraulic Length: ~~4000~~ 2760 feet

Downstream Elevation: 1492 Slope: 0.0063 91 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.12	100%		R1-18	Existing	B	80	S.F. Residential

Weighted CN= 80

Large or Elongated Watersheds	[illegible] ds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag time)$^{0.7}$/1900 S$^{\frac{1}{2}}$
N=_____ L=_____mi Lc_____mi	0
S=_____ft/mi	N/A ~~.24~~ 2.75 hours
Lag=_____hours	0.53 = ~~0.86~~ = ~~0.43~~ 0.27

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by MC Date 8-26 Sheet No. 51

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 823

Overland Flow Length (L) 40 ft.

Slope (S) 0.0063 ft./ft.

Roughness Factor (N) 91 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~2000~~ 2720 FT.

Channel Slope (S) 0.0063 91 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 40 ft.

Side Slopes (Z) 0

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

Calculated by: M.C. Date: 8-26 Sheet No. 52

Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-824

Area: .04 square miles

Upstream Elevation: 1503 Hydraulic Length: ~~3000~~ 2040 feet

Downstream Elevation: 1493 Slope: 0.00~~33~~ 49 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.04	100%		R1-18	Existing	B	80	S.F. Residential

Weighted CN= 80

Large or Elongated Watersheds	Sm
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	La
N=_____ L=_____m; Lc_____m;	L=
S=_____ft/m;	S=
Lag=_____hours	

Lag time

N/A

.7/1900 S$^{\frac{1}{2}}$

7

3 hours

0

A

0.57

) = ~~0.95~~

0.29

) = ~~0.47~~

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description E123061 J0501
Calculated by MC Date 8-26 Sheet No 53
Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 824

Overland Flow Length (L) 100480 ft.

Slope (S) 0.0033 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~3900~~ 1920 FT.

Channel Slope (S) 0.0033 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 25 ft.

Side Slopes (Z) 0

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

Calculated by: M.C. Date: 8-26 Sheet No. 54

Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation Q8-825

Area .05 square miles

Upstream Elevation 1504 Hydraulic Length ~~3000~~ 1440 feet

Downstream Elevation 1495 Slope ~~0.0045~~ 0.0063 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.05	100%		R1-18	Existing	B	80	S.F. Residential

Weighted CN= 80 ✓

Large or Elongated Watersheds

Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$

N= _____ L= _____ m; Lc _____

S= _____ ft/m;

Lag= _____ hours

Lag time

N/A

Watersheds

0/CN - 9)$^{0.7}$/1900 S$^{\frac{1}{2}}$

= 80

ag= ~~0.82~~ 0.54 hours

(~~0.82~~ 0.54) = ~~0.59~~ 0.38

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Job BELL ROAD PROJECT DRA

Description E123061 J0501

Calculated by MC Date 8-26

Checked by _____ Date _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

D
A
U
D

VK CARD

Drainage Area Designation 825

Overland Flow Length (L) ~~100~~ 360 ft.

Slope (S) ~~0.004563~~ ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

L
S
S
M

RK CARD

Channel Length (L) ~~1900~~ 1200 FT.

Channel Slope (S) ~~0.004563~~ FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) ____ square miles (leave blank if = to total Are

Shape (TRAP, DEEP, CIRC) TRAP

W

Channel Bottom Width or Diameter (WD) 25 ft.

Side Slopes (Z) 0

I
L
N
S
L

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123069 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 1
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-800

Area: 0.02 square miles

Upstream Elevation: 1462 Hydraulic Length: ~~1200~~ 960 feet

Downstream Elevation: 1456 Slope: ~~0.095~~ 0.0063 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	Maricopa County	CS	graded	B	92	

Weighted CN= 92

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= ~~1200~~ 960 ft CN= 92
S= _____ ft/m;	S= ~~0.5~~ 0.63 % Lag= ~~0.34~~ 0.25 hours
Lag= _____ hours	Adjust Lag: ↑ Lag time used

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by M. C. Date 8-26 Sheet No. 2

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation Q8-801A

Area 0.22 square miles

Upstream Elevation 1478 Hydraulic Length ~~7400~~ 4500 feet

Downstream Elevation 1459 Slope ~~0.0026~~ .0042 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.16	73	COP	R1-6	DEV	B	84	
.04	18		R-3	"		85	
.01	4.5		R-4	"		86	
.01	4.5		CO	"		88	

Weighted CN= 84

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ ... $^{0.7}$ ... S$^{1/2}$
N=_____ L=_____ mi Lc_____ mi	L= ~~7400~~ 4500
S=_____ ft/mi	S= ~~.26~~ .42 ... urs
Lag=_____ hours	Lag time N/A
	Adjust
	0.6 ... .95
	.5 ... rs

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by M.C. Date 8-26 Sheet No. 3

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation C8-801A

Overland Flow Length (L) ~~2100~~ 1200 ft.

Slope (S) 0.0042 ft./ft.

Roughness Factor (N) 0.016

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~5300~~ 3 FT.

Channel Slope (S) 0.0042 FT./FT.

Channel Roughness (N) 0.027

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 20 ft.

Side Slopes (Z) 4

route u.s. hydrograph

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: MC Date: 8-26 Sheet No. 8
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-802B

Area: 0.07 square miles

Upstream Elevation: 1478.5 Hydraulic Length: ~~3200~~ 1800 feet

Downstream Elevation: 1471 Slope: 0.0047B feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.07			PARK	UNDEV	B	80	

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= ~~3200~~ 1800 ft CN= 80
S= _____ ft/m;	S= ~~.23~~ .44 % Lag= ~~1.68~~ 0.77 hours
Lag= _____ hours	Adjust Lag: ↑ Lag time used

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123061 J0501
Calculated by MC Date 8-26 Sheet No. 9
Checked by Date of

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 802 B

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) ~~5000~~ 2900 FT.

Channel Slope (S) 0.003 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) ~~25~~ 3 ft.

Side Slopes (Z) 0

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: MC Date: 8-26 Sheet No. 7
Checked by: Date: of

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-80217

Area: .07 square miles

Upstream Elevation: 1476 Hydraulic Length: ~~4000~~ 2000 feet

Downstream Elevation: 1464 Slope: 0.00~~3~~59 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.07	100	COP	R-14	School	B	90	
	70	"					

Weighted CN= 90

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L_2000^0.8 (1000/CN - 9)^0.7/1900 S^½
N= ____ L= ____ mi Lc ____ mi	L= ~~4000~~ 2000 ft CN= 90
S= ____ ft/mi	S= .~~3~~ 59 % Lag= ~~1.23~~ .51 hours
Lag= ____ hours	

Adjust Lag:

0.8(~~1.23~~ .51) = ~~0.99~~ 0.40 hrs

Lag time used

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

Calculated by: MC Date: 8-26 Sheet No. 10

Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-803A

Area: 0.16 square miles

Upstream Elevation: 1512 Hydraulic Length: ~~7500~~ 3600 feet

Downstream Elevation: 1484 Slope: 0.0070 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	5		R-4	DEV	B	86	
	30		R-3	"	B	85	
	65		R1-8	"	B	82	

Weighted CN= 83

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}$
N= _____ L= _____ m; Lc _____ m;	L= ~~7500~~ 3600
S= _____ ft/m;	S= ~~.37~~ .70
Lag= _____ hours	

½

ırs

Lag time N/A

Adjust

.66

.5

0.32

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by M.C. Date 8-26 Sheet No. 11

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 80317

Overland Flow Length (L) 10040 ft.

Slope (S) 0.0037 (70) ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~7500~~ 3600 FT.

Channel Slope (S) 0.0037 (70) FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 40 ft.

Side Slopes (Z) 0

RK C

L= ~~3000~~ 1560
S= 0.0023
N= 0.035
TRAP
0
6

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: MC Date: 8-26 Sheet No. 12
Checked by: _____ Date: _____ of: _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: QB-803B

Area: 0.08 square miles

Upstream Elevation: 1489 Hydraulic Length: ~~3400~~ 2160 feet

Downstream Elevation: 1476 Slope: 0.0038 / 60 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	COP	R1-8	DEV	B	82	

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=_____ L=_____m; Lc_____m;	L= ~~31~~ 21
S=_____ft/m;	S= ~~.3~~ .6 _____hours
Lag=_____hours	Lag time N/A
	Adj
	0.52 ~~2.94~~ hrs

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by MC Date 8-30 Sheet No. 13

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 8031B

Overland Flow Length (L) 100 ft.

Slope (S) 0.0060 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~7900~~ 6000 FT.

Channel Slope (S) 0.0038 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) ____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 40 ft.

Side Slopes (Z) 0

RK

L= 2500
S= 0.0048
N= 0.027
TRAP
40
6

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 14
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-804A

Area: .05 square miles

Upstream Elevation: 1528 Hydraulic Length: ~~2800~~ 1920 feet

Downstream Elevation: 1512 Slope: ~~0.0057~~ 0.0083 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.05	100%		Rural	UNDEV	B	79	

Storm Records
4.99
43rd Ave & Indian School

Weighted CN= 79

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= _____ L= _____ m; Lc _____ m;	L= ~~2800~~ 1920 ft CN= 79
S= _____ ft/m;	S= ~~.57~~ .83 % Lag= ~~0.99~~ 0.61 hours
Lag= _____ hours	

Adjust Lag:

Lag time used

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by M.C. Date 8-26 Sheet No. 15

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 80417

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) 3000 FT.

Channel Slope (S) 0.0035 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 50 ft.

Side Slopes (Z) 0

RK
L = 3000
S = 0.0035
N = 0.027
TRAP
0
6

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 16
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-804B

Area: 0.04 square miles

Upstream Elevation: 1526 Hydraulic Length: ~~2200~~ 1440 feet

Downstream Elevation: 1510 Slope: 0.0077B feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.04			Rural	UNDEV	B	79	

Weighted CN= 79

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= ~~2200~~ 1440 ft CN= 79
S= _____ ft/m;	S= ~~.73~~ 1.1 % Lag= ~~0.72~~ 0.42 hours
Lag= _____ hours	Adjust Lag: ↑ Lag time used

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 18
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-805

Area: .14 square miles

Upstream Elevation: 1511 Hydraulic Length: ~~4700~~ 3000 feet

Downstream Elevation: 1488 Slope: ~~0.0049~~ .0077 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.14	100%		R1-8	Existing	B	~~82~~ ~~84~~ 82	Single Family

Weighted CN= ~~82~~ ~~84~~ 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= 0.02 L= 0.89 mi Lc 0.45 mi	L= 30
S= 26 ft/mi	S= .7 hours
Lag= 0.18 hours	Lag time N/A
	Adjust. 2.60

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 805

Overland Flow Length (L) 10040 ft.

Slope (S) 0.0049 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~4700~~ 3000 FT.

Channel Slope (S) 0.0049 FT./FT.

Channel Roughness (N) 0.028

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 40 ft.

Side Slopes (Z) 0

RK
L= 5500
S= 0.0038
N= 0.027
TRAP
0
6

Route U.S. hydrograph from 804B

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 22
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: QB-808

Area: .03 square miles

Upstream Elevation: 1528 Hydraulic Length: ~~2000~~ 1200 feet

Downstream Elevation: 1514 Slope: ~~0.007~~ 0.0117 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.015	50%		Rural	Existing	B	79	
.015	50%		R-2	"	B	85	2 Family Res.

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ mi Lc _____ mi	L= ~~2000~~ 1200 ft CN= 82
S= _____ ft/mi	S= 1.17 % Lag= ~~0.62~~ 32 hours
Lag= _____ hours	Adjust Lag: 0.8(.32) = ~~0.50~~ 0.26 ↑ Lag time used

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description E123061 J0501
Calculated by MC Date 8-27 Sheet No.
Checked by Date of

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation Q808

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) 7900 FT.

Channel Slope (S) 0.0086 FT./FT.

Channel Roughness (N) 0.035

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 0 ft.

Side Slopes (Z) 6

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: M.C. Date: 8-26 Sheet No. 23
Checked by: Date: of

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-809

Area: .07 square miles

Upstream Elevation: 1527 Hydraulic Length: ~~1800~~ 1200 feet

Downstream Elevation: 1516 Slope: 0.0082 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.017	33%		R-2	Existing	B	85	2 Family
.026	67%		R-3	"	B	85	Multiple Family

Weighted CN= 85

Large or Elongated Watersheds

Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$

N= L= m; Lc m;

S= ft/m;

Lag= hours

Small, Uniform Watersheds

Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{\frac{1}{2}}$

L= ~~1800~~ 1200 ft CN= 85

S= .82 % Lag= ~~0.55~~ 0.33 hours

Adjust Lag:

0.66(0.~~55~~ 33) = ~~0.36~~ 0.21

Lag time Used

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description E123061 J0501
Calculated by MC Date 8-27 Sheet No.
Checked by Date of

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation Q809

Overland Flow Length (L) _____ ft.

Slope (S) _____ ft./ft.

Roughness Factor (N) _____

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) 7800 FT.

Channel Slope (S) 0.0086 FT./FT.

Channel Roughness (N) 0.035

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 0 ft.

Side Slopes (Z) 6

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Job: BELL ROAD PROJECT DR
Description: E123061 J0501
Calculated by: M.C. Date: 8/26
Checked by: _____ Date: _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-812A

Area: 0.31 square miles

Upstream Elevation: 1524 Hydraulic Length: ~~4,500~~ 6600 feet

Downstream Elevation: 1474.5 Slope: 0.004 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.19	70%		R1-8	UNDEV	B	79/82	Res.
.13	78%		R1-18	"	B	79/80	Res.
.01	5		R-4	DEV	B	86/	Multi Family
.01	2		C-O	UNDEV	B	79/92	Commercial
	5		R1-18	DEV	B	80/	

Weighted CN= 79/81

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= 0.03 L= ~~2.18~~ 1.25 m; Lc ~~0.05~~ 0.57 m;	L= _____ ft CN= _____
S= ~~21~~ 39.2 ft/m;	S= _____ % Lag= _____ hours
Lag= ~~0.51~~ 0.31 hours	Adjust Lag:
Lag time used	

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

Calculated by: MC Date: 8-26 Sheet No. 29

Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q8-813

Area: 0.02 square miles

Upstream Elevation: 1486 Hydraulic Length: ~~1700~~ 960 feet

Downstream Elevation: 1478 Slope: 0.0047 83 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	COP	PPS	STATION	B	92	

Weighted CN= 92

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (10
N=_____ L=_____m; Lc_____m;	L= ~~1700~~ 960 ft C
S=_____ft/m;	S= .47 % 83
Lag=_____hours	Adjust Lag:
	0.75

Lag Time N/A

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by MC Date 8-26 Sheet No. 30

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 813

Overland Flow Length (L) 40 ft.

Slope (S) 0.00483 ft./ft.

Roughness Factor (N) 0.016

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~1700~~ 920 FT.

Channel Slope (S) ~~0.0047~~ 83 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 100 ft.

Side Slopes (Z) 6

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by M.C. Date 8-26 Sheet No. 31

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation Q8-814

Area 0.03 square miles

Upstream Elevation 1490 Hydraulic Length ~~2500~~ 1440 feet

Downstream Elevation 1479 Slope 0.0044 feet/feet

76

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	COP	R-5	DEV	B	86	

Weighted CN= 86

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{\frac{1}{2}}$
N= _____ L= _____ m; Lc _____ m;	L= ~~250~~ 144
S= _____ ft/m;	S= ~~.4~~ .76 _____ hours
Lag= _____ hours	Lag time
	Adjus N/A 0.30 ~~0.57~~

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by MC Date 8-26 Sheet No. 32

Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation 814

Overland Flow Length (L) 40 ft.

Slope (S) 0.004476 ft./ft.

Roughness Factor (N) 0.03

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) ~~2000~~ 1400 FT.

Channel Slope (S) 0.0074 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 40 ft.

Side Slopes (Z) 0

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Job Bell Road Project Drainage Study
Description Write-up on existing drainage structures in Area 8.
Calculated by RB Date 12-2-86 Sheet No. ____
Checked by RH Date 12/3/86 of ____

Existing drainage structures
in Drainage Area 8, - East and West

The drainage structures in Area 8 were evaluated to determine if any of the structures had the capacity to handle the 10-year discharge. Most of the structures were inadequate for the 10-year event. However, the last three structures on the east end of Area 8 were very close to being able to handle Q10. These are the only structures that should be considered to remain. However, there will be an on-site system in this area which could be in conflict with these structures and the problem of the pipes being silted in exists

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Job: Bell Road Project Drainage Study
Description: Existing Drainage Structures in Area 8
Calculated by: RB Date: 12-2-86 Sheet No. 1
Checked by: RH Date: 12/3/86 of

Analyze the capacity of the following structures:

29"x18" CMP ⇒ Area = 2.9 ft² (28"x20") Eq. Dia = 24"
36"x22" CMP ⇒ Area = 4.5 ft² (35"x24") Eq. Dia = 30"
43"x27" CMP ⇒ Area = 6.5 ft² (42"x29") Eq. Dia = 36".

Assume: available head = 6'
inlet control w/ headwalls.

with HW = 6', HW/D = 3 Qcap = 35 cfs
HW/D = 2.4 Qcap = 52 cfs
HW/D = 2.0 Qcap = 72 cfs

Assume available head = 4'
inlet control w/ headwalls.

HW/D = 4/2 = 2 Qcap = 26 cfs
HW/D = 4/2.5 = 1.6 Qcap = 38 cfs
HW/D = 4/3 = 1.3 Qcap = 50 cfs.

Use the following capacities:

28"x20" CMP ⇒ Qcap = 26
35"x24" CMP ⇒ Qcap = 38
42"x29" CMP ⇒ Qcap = 50 cfs.

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Job Bell Rd. Project Drainage Study
Description Concept plan. Alt. 3
Q100 DA 8
Calculated by R.H Date 11/17/86 Sheet No.
Checked by Date of

Alt. 3 Alternate 3 consists of the same storm sewer and open channels described in alternate 2 with the addition of 2 detention Basins. The size and location of the basins are: A 25 acre-ft basin North of Grovers Ave. east of 37th st. and a 30 acre-ft basin south of Bell and west of Tatum Blvd.

R.O.W. Requirements - Additional R.O.W. for this alternate consists of a total of 24.94 acres at a total cost of $2,598,800, using same criteria for land acquisition as described in alt. 2.

Utilities Conflicts in Area 8, Alt. 2+3

Same utilities conflicts covered in alternate 1 apply to alternate 2+3 with the following exception:

The 56th st. system of alternate 1. has been replaced by the 52nd st. system. Therefore the only conflict of utilities along the outfalls seems to be along the 48th st. outfall as mentioned in alt. 1.

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Job: Bell Road Project Drainage Study
Description: Quantities + Cost
Area 8 Alternate 3 Q100 DA 8
Calculated by: RB Date: 11-13-86 Sheet No. 1
Checked by: YMO Date: 11/14/86 of

36 SI SYSTEM.

36" RCP
L = 1375'
Unit Cost 69.
Total Cost 94875.

42" RCP
L = 1500'
Unit Cost 83.
Total Cost 124500.

2-6'x5' RCB
L = 13400
Unit Cost 306
Total Cost 4100400

25 ~~a-f~~ (35A-F)
retention site
350' x 350' x 10'
(430' x 430')
Unit cost 2.50
Total cost ~~113,425~~
142,315

Exc. = ~~45370 yd³~~ 56,926 c.y.
R/W = 6 acres.
Parkland - no acquisition cost.

Total Cost of System ~~$4433200.~~
$4,462,090

AH3

Earthen Channels for 40th St. Outfall.

L=800'
B=2.5'
D=3'
Z=4

Cross Section Area = 43.5 ft²

Volume = $\frac{43.5 \times 800}{27}$ = 1289 yd³

Unit Cost = 2.50/yd³
Total Cost = $3223.

Pipes for 40th St. Outfall

L=900'
54" RCP

Unit Cost = $124/L.F.
Total Cost = $111600.

L=1000' (on-site)
18" RCP

Unit Cost = 29/L.F.
Total Cost = $29,000.

RCB's for 40th St. Outfall

L=15300'
3.2-8'x5' RCB

Unit Cost = $~~409~~ 614
Total cost = ~~6,257,700~~ 9,394,200

Total Cost for 40TH ST. System = $~~6,401,523~~ 9,538,000

Earthen Channels for 44ST System.

L=1050'
B=2
D=2.9
Z=4

Cross Section Area. = 39.44 ft²
Volume = $39.44 \times \frac{1050}{27} = 1534$ yd³

Unit Cost = 2.50 / cu.yd.
Total Cost = $3835.

L=950'
B=2
D=1.5
Z=4

Cross Section Area = 12 ft²
Volume = $12 \times \frac{950}{27} = 422$ yd³

Unit Cost = 2.50
Total Cost = $1056.

RCB's for 44 ST. system.

L=16500'
2-8'x4' RCB

Unit Cost = 381/L.F.
Total Cost = $6,286,500

Pipes for 44.ST. system.

On-site

L=900'
18" RCP

Unit Cost = 29/L.F.
Total Cost = $26100

Total Cost for 44ST. system. $6,317491

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Job: Bell Road Project Drainage Study
Description: Quantities & Cost. Q100
DA 8
Calculated by: RB Date: 11-13-86 Sheet No.
Checked by: Date: of

48ST system

36" RCP L=520'	Unit Cost 69 Total Cost 35880
48" RCP L=1320'	98 129360
2-6X6 RCB L=250'	326 81500
60" RCP L=18000	140 2520000
30 a-f detention 7 ac.	land 1225000 exc 113426 1338426(?)
18" RCP L=2000' on-site.	29 58000

DIMENSIONS
(AVG. END AREA METHOD FOR VOLUME)

Total Cost of system 4163166(?)

(10) Pipes for 52nd St. system.

L=2200'
18" RCP

Unit cost = 29/LF
Total Cost = $63800.

Earthen channels for 52nd St. system.

1) L=360
B=2
D=4
Z=4

Cross section Area = 72 ft²
Volume = $72 \times \frac{360}{27} = 960 yd^3$

Unit cost = 2.50
Total Cost = $2400.

2) L=800'
B=30
D=3
Z=4

Cross Section Area = 126 ft²
Volume = $126 \times \frac{800}{27} = 3733 yd^3$

Unit Cost = 2.50
Total Cost = $9333.

3) L= 570
B=27
D=3
Z=4

Cross Section Area = 117 ft²
Volume = $117 \times \frac{570}{27} = 2470 yd^3$

Unit Cost = 2.50
Total Cost = $6175.

4) L=1900
B=14
D=3.5
Z=4

Cross Section Area = 98 ft²
Volume = $98 \times \frac{1900}{27} = 6896 yd^3$

Unit Cost = 2.50
Total Cost = $17,241

(5) L = 275
B = 13
D = 3.5
Z = 4

Cross Section Area = 94.5 ft²
Volume = 94.5 × 275/27 = 963 yd³

Unit Cost = 2.50
Total Cost = $2406.

(6) L = 830'
B = 2
D = 4
Z = 4

Cross Section Area = 72 ft²
Volume = 72 × 830/27 = 2213 yd³

Unit Cost = 2.50
Total Cost = $5533.

(7) L = 1280
B = 2
D = 3
Z = 4

Cross section Area = 42 ft²
Volume = 42 × 1280/27 = 1991 yd³

Unit Cost = 2.50
Total Cost = $4978.

(8) L = 810
B = 2
D = 2.7
Z = 4

Cross Section Area = 34.6 ft²
Volume = 34.6 × 810/27 = 1038 yd³

Unit Cost = 2.50
Total Cost = $2595.

(9) L = 850
B = 2
D = 2.1
Z = 4

Cross Section Area = 21.84
Volume = 21.84 × 850/27 = 688 yd³

Unit Cost = 2.50
Total Cost = $1720.

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Job: Bell Road Project Drainage Study
Description: Cost & Quantities Summary.
Q100 DA 8
Calculated by: RB Date: 11-14-86 Sheet No. 1
Checked by: _____ Date: _____ of _____

Alternate 3

	Location	Structure	Quantity	Unit Cost	Total Cost
	west of 36 ST.	36" RCP	1375 LF	69	94875
	east of 36 st.	42" RCP	1500 LF	83	124500
✓	36 ST. OUTFALL	2-6'x5' RCB	13400 LF	306	4100400
	N. of Bell at Paradise Valley Pk.	Detention Pond	25 a-f.	2.50/cu yd excav. (no acquisition cost)	113425
	east of 40 ST	earth channel	1289 yd³	2.50	3223
✓	west of 40 st.	54" RCP	900 L.F	124.	111600
	east of (on-site) 40 st	18" RCP	1000 LF	29	29000
✓	40 st outfall	2-8'x5' RCB	15300 LF	409	6257700
	east of 44 st.	earth channel	1534 yd³	2.50	3835
	east of 44 st.	earth channel	422 yd³	2.50	1056
	west of 44 st.	18" RCP (on-site)	900 LF	29.	26100
	along N. side of Bell.	36" RCP	50 LF	69	3450.
	along N. side of Bell	36" RCP	50 LF	69	3450.
✓	44 ST Outfall	2-8'x4' RCB	16500 LF	381	6286500.

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Job: Bell Road Project Drainage Study
Description: Costs & Quantities Summary, Q100 DA8
Calculated by: RB Date: 11-14-86 Sheet No. 2
Checked by: _____ Date: _____ of _____

Location	Structure	Quantity	Unit Cost	Total Cost
west of 48st.	36" RCP	520 LF	69	35880
Hot Bell along 48st.	48" RCP	1320 LF	98	129360
✓ crossing Bell @ 48st.	2-6x6 RCB	250 LF	326	81500
✓ 48st outfall.	60" RCP	18000 LF	140	2520000
✓ SW corner Bell & Tatum.	Detention Bnd	30 a-f	land 175,000/ac excav 2.50/yd³	1338426
east of 48st.	18" RCP (on-site)	2000	29	58000
east of 52st	18" RCP (on-site)	2200	29	63800.
west of 52st	earth channel	960 yd³	2.50	2400.
east of 52st	earth channel	3733 yd³	2.50	9333.
east of 52st	earth channel	2470 yd³	2.50	6175.
east of 52st	earth channel	6896 yd³	2.50	17241.
✓ east of 52st	earth channel	963 yd³	2.50	2406
✓ east of 52st.	earth channel	2213 yd³	2.50	5533.
✓ east of 52st.	earth channel	1991 yd³	2.50	4978.
east of 52st.	earth channel	1038 yd³	2.50	2595.
east of 52st.	earth channel	688 yd³	2.50	1720
✓ 52st outfall	3-8'x5' RCB	20700 LF	631	13,061,700

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Job: Bell Road Project Drainage Study
Description: Quantity & Cost Summary
Q100 DA 8
Calculated by: RB Date: 11-14-86 Sheet No. 3
Checked by: _____ Date: _____ of _____

along 57th N. of Bell	60" RCP	1320 LF	140	184800
along 58th Way N. of Bell	60" RCP	1320 LF	140	184800

The following structures are for drive entrances or cross-streets

	2-10X5RCB	80LF	546	43680
	2-10X5RCB	50LF	546	27300
	2-8X4RCB	50LF	381	19050
	2-8X4 RCB	50LF	381	19050
	2-8X4 RCB	80LF	381	30480
	2-8X4 RCB	80LF	381	30480
	2-6X5RCB	60LF	306	18360
	1-8X4 RCB	80LF	208	16640
	1-8X4 RCB	100LF	208	20800
on-site	18" RCP	3200LF	29	92800

AH.3

R/W reqmts for open channels

C

L = 800'
TW = 51
Buffer = 16
Area = $\frac{(51+16)(800)}{43560}$ = 1.23 ac
$215,250

L = 570
TW = 51
Buffer = 16
Area = $\frac{(51+16)(570)}{43560}$ = 0.88 ac
$154,000

40% C 60% R

L = 1050
TW = 25.2
Buffer = 16
Area = $\frac{(25+16)(1050)}{43560}$ 0.99 ac
$113850

L = 1900
TW = 42
Buffer = 16
Area = $\frac{(42+16)(1900)}{43560}$ 2.53 ac
$417450

10% R 90% C

R

L = 950
TW = 14
Buffer = 16
Area = $\frac{(14+16)(950)}{43560}$ = 0.65 ac.
$48750

L = 275
TW = 41
Buffer = 16
Area = $\frac{(41+16)(275)}{43560}$ = 0.36 ac.
$27,000

R PHX ✓

R

L = 360
TW = 34
Buffer = 16
Area = $\frac{(34+16)(360)}{43560}$ 0.41 ac
$30750

L = 830
TW = 34
Buffer = 16
Area = $\frac{(34+16)830}{43560}$ 0.95 ac
$71250

R PHX ✓

R

L = 800
TW = 54
Buffer = 16
Area = $\frac{(54+16)(800)}{43560}$ 1.29 ac.
$96750

L = 1280
TW = 26
Buffer = 16
Area = $\frac{(26+16)(1280)}{43560}$ = 1.23 ac
$92250

R 50% PHX " Co. ✓

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: R/W costs
Q100 DA 8
Calculated by: RB Date: 11-14-86 Sheet No. 2
Checked by: YMO Date: 11/14/86 of 2

L=810
TW=23.6
Buffer=16

(R)

$$\text{Area} = \frac{(24+16)(810)}{43560} = \boxed{0.74\text{ac}}$$
(55,500)

L=850
TW=18.8
Buffer=16

(R)

$$\text{Area} = \frac{(19+16)(850)}{43560} = \boxed{0.68\text{ac.}}$$
(51,000)

City of Phoenix R/W costs = 144375

Maricopa Co. R/W costs = $1,122,925

Greiner Engineering

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Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Road Project Drainage Study.
Description Q100 DA 8
Calculated by _____ Date _____ Sheet No. _____
Checked by _____ Date _____ of _____

Alt 3

Alt 3 Cost by jurisdiction.

Note: Items checked (✓) in summary are City of Phoenix Items.

City of Phoenix		Maricopa Co.
34,226,623.	35095601 ✓	868978.
+ R/W 144 375		+ R/W 1122925
$34,370,998		$1991903
	On-site 18" RCP 3200LF	+ 92800 = $2084703.

12-2-86 RB

Greiner Engineering

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Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Addendum to Q100 Alternates DA 8
Calculated by: RB Date: 12-2-86 Sheet No. 1
Checked by: _____ Date: _____ of _____

Add 3200 L.F. OF 18" RCP for on-site drainage on the east end of area 8.

Use Unit Cost = 29.00/ft.

3200 x 29 = $92,800. to Maricopa County.

Add this amount to Alternate 1, 2, and 3

Alt. 1 This alternate consists of 5 separate systems with outfalls at 36th st., 40th st., 44th st., Tatum Blvd, and 56th st. The 36th st. system consists of RCP along Bell Rd. on both east and west side of 36th st. and 2-8'x6' RCBC along 36th st. from Bell Rd. to Indian Bend Wash, approximately 2.5 miles. The 40th st. system consists of RCP on west side of 40th st., RCP North of Bell Rd. along 40th st., 2-8'x6' RCBC West of 40th st. along Bell Rd, and 3-8'x6' RCBC from Bell Rd. to Indian Bend Wash along 40th st. The 44th st. system consists of 1-6'x6' RCBC West of 44th st. along Bell Rd., RCP east of 44th st. along Bell Rd., and 2-6'x6' RCBC from Bell Rd. to Indian Bend wash along 44th st. The Tatum Blvd. system consists of RCP West of Tatum along Bell, RCP North of Bell along Tatum, 2-8'x5' RCBC east of Tatum along Bell, and 2-10'x5' RCBC from Bell to Indian Bend wash along Tatum Blvd. The 56th st. system consists of RCP West of 56th st. along Bell Rd., RCP North of Bell Rd., RCP and RCBC east of 56th st. along Bell Rd., and 2-8'x5' RCBC from 56th st. to Indian Bend wash along 56th st. Where the off-site system along Bell Rd. is not continuous, on-site system consisting of sections of 18" RCP is used.

R.O.W requirements

No additional R/W for this alternate is required.

Greiner Engineering

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Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Rd. Project Drainage Study
Description Utilities Conflict
Area 8 Alt. 1
Calculated by R.H Date 11/14/86 Sheet No. 1
Checked by _____ Date _____ of 2

Utilities conflicts in Area 8, Alt. 1

Major utility line along Bell Rd; 48" water from 48' to 11's. of ℄ and from 32nd st. to 52nd st.

Storm Drain Systems of alternate 1 are in conflict with water and Sewer lines crossing Bell Rd. at various locations. The 36th st. System is in conflict with a 12" water line crossing Bell Rd. between 34th way and 34th st.; an 8" sewerline along 34th way, and a 12" waterline just east of 36th st. The Tatum Blvd. system is in conflict with 2-12" water line just west of 48th st. and a 10" sewerline along Tatum Blvd. for a distance of approximately 200' South of Bell Rd. The 56th St. System is in conflict with a 12" waterline crossing Bell Rd. at approximately 120' east of 58th way. Electric and gas lines don't seem to be in conflict with this alternate. ~~In addition to those already mentioned, the following storm drains would have to be plugged and abandoned or removed.~~

nd
2" water
12" sewer
rossing
Bell @
th st.

~~2-43"x27" CMPA crossing Bell Rd. near 40th st.~~
~~2-36"x22" CMPA Crossing Bell Rd. near 44th st.~~
~~2-36"x22" CMPA Crossing Bell Rd. near 45th place~~
~~36"x22" CMPA Crossing Bell Rd. near 47th st.~~
~~2-43"x27" CMPA Crossing Bell Rd. near 48th st.~~
~~2-36"x22" CMPA Crossing Bell Rd. near 49th Place.~~
~~2-36"x22" CMPA Crossing Bell Rd. near 51st place~~
29"x18" CMPA Crossing Bell Rd. near 52nd st.
~~29"x18" CMPA Crossing Bell Rd. near 56th st.~~
36"x22" CMPA Crossing Bell Rd. near 57th st.
29"x18" CMPA Crossing Bell Rd. near 60th place
36"x22" CMPA Crossing Bell Rd. near 61st Place
22"x36" CMPA Crossing Bell Rd. near 63rd st.

Greiner Engineering

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Job: Bell Road Project Drainage Study
Description: Cost & Quantities
Area B. Alternate 1
Calculated by: RB Date: 11-13-86 Sheet No. 1
Checked by: TMO Date: 11/14/86 of

36TH. ST. SYSTEM.

36" RCP
L = 1375'

Unit Cost 69
Total Cost 94875

72" RCP
L = 1600'

Unit Cost 150.
Total Cost 240000

2-8'x6' RCB
L = 14,000'

Unit Cost 432
Total Cost 6048000.

Total Cost of system = $6,382,875.

40TH. ST. SYSTEM.

48" RCP
L = 900'

Unit Cost 98
Total Cost 88200

72" RCP
L = 1320'

Unit Cost 150.
Total Cost 198000

2-8'x6' RCB
L = 850'

Unit Cost 432
Total Cost 367200

3-8'x6' RCB
L = 15300

Unit Cost 625
Total Cost 9562500

18" RCP (on-site)
L = 1000'

Unit Cost 29
Total Cost 29000

Total Cost of system $10,244,900. ✓

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Cost & Quantities

Calculated by: RB Date: 11-13-86 Sheet No. 3
Checked by: YMO Date: 11/14/86 of

44TH. ST. SYSTEM.

1-6x6 RCB L=250'	Unit Cost	198.
	Total Cost	49500
54" RCP L=1080	Unit Cost	124.
	Total Cost	133920
36" RCP L=1030	Unit Cost	69.
	Total Cost	71070
2-6'x6' RCB L=16500	Unit Cost	326.
	Total Cost	5379000
18" RCP L=900'	Unit Cost	29
	Total Cost	26100

Total Cost of System. $5,659,590

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Quantities & Cost

Calculated by: RB Date: 11-13-86 Sheet No. 4
Checked by: TWO Date: 11/14/86 of

48TH ST. SYSTEM

36" RCP L=520'	Unit Cost	69.
	Total Cost	~~363480~~ × $35,880
48" RCP L=1320	Unit Cost	98.
	Total Cost	129360. ✓
2-8'x5' RCB L=2180	Unit Cost	409
	Total Cost	891620. ✓
2-10'x5' RCB L=18400	Unit Cost	546
	Total Cost	10,046,400 ✓
18" RCP L=1800'	Unit cost	29
	Total Cost	52200

Total Cost of system: $~~11483060~~ × 11,155,460

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study.
Description: Cost & Quantities

Calculated by: RB Date: 11-13-86 Sheet No. 5
Checked by: TMO Date: 11/14/86 of

56TH. ST. SYSTEM.

36" RCP L=570'	Unit Cost	69.
	Total Cost	39330.
66" RCP L=1410'	Unit Cost	145.
	Total Cost	204450
2-6'x5' RCB L=825	Unit Cost	306
	Total Cost	252450
60" RCP L=1320'	Unit Cost	140.
	Total Cost	184800
1-8'x5' RCB L=830'	Unit Cost	222.
	Total Cost	184260
60" RCP L=1320'	Unit Cost	140.
	Total Cost	184800
72" RCP L=1280'	Unit Cost	150.
	Total Cost	192000
72" RCP L=810'	Unit Cost	150.
	Total Cost	121500
48" RCP L=850'	Unit Cost	98.
	Total Cost	83300
2-8'x5' RCB L=24700	Unit Cost	409.
	Total Cost	10102300
18" RCP L=~~1600~~ 3200	Unit Cost	29
	Total Cost	63800 ✓

Total Cost of system. ~~11,612,990.~~ ✓

add 3200 L.F. 18" RCP (on-site) Unit Cost 29.
Total Cost = 92800 $11,705,790

12-2-86 RDB.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study.
Description: Summary of Cost
Area 8 Alternate 1
Calculated by: RB Date: 11-13-86 Sheet No. 1
Checked by: YMO Date: 11/14/86 of

Location	Structure	Quantity	Unit Cost	Total Cost.
west of 36ST along Bell	36" RCP	1375 L.F.	69.	94875.
east of 36ST along Bell	72" RCP	1600 LF	150.	240000
36ST. OUTFall line	2-8'x6' RCB	14000 LF	432.	6048000
west of 40st along Bell	48" RCP	900 LF	98.	88200
N. of Bell along 40st.	72" RCP	1320 LF	150.	198000
east of 40ST along Bell.	2-8'x6' RCB	850 LF	432	367200
40ST OUTFALL	3-8'x6' RCB	15300 LF	625	9562500
west of 44ST along Bell	1-6x6 RCB	250 LF	198	49500
east of 44ST along Bell.	54" RCP	1080 LF	124	133920
east of 44ST along Bell.	36" RCP	1030 LF	69	71070
44ST OUTFALL	2-6'x6' RCB	16500 LF	326.	5379000
west of 48ST. along Bell.	36" RCP	520 LF	69	~~363480~~ 35,880
N. of Bell along 48ST.	48" RCP	1320 LF	98	129360
East of 48ST along Bell.	2-8'x5' RCB	2180 LF	409	891620
48ST Outfall line.	2-10'x5' RCB	18400 LF	546	10,046,400

Greiner Engineering

Greiner Engineering Sciences, Inc.

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Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Summary of Cost. Area 8 Alt. 1
Calculated by: RB Date: 11-13-86 Sheet No. 2
Checked by: TMO Date: 11/14/86 of

west of 56ST along Bell.	36" RCP	570'	69	~~39300~~ 39,330
west of 56ST along Bell.	66" RCP	1410'	145.	204450
east of 56ST along Bell	2-6'x5' RCB	825	306.	252450
N. of Bell along 57ST.	60" RCP	1320	140.	184800
east of 56ST along Bell	1-8'x5' RCB	830.	222.	184260
N. of Bell along 58th Way	60" RCP	1320	140	184800
east of 56ST along Bell.	72" RCP	1280	150	192000
east of 56ST along Bell.	72" RCP	810	150	121500
east of 56ST along Bell.	48" RCP	850	98.	83300
56ST Outfall line	2-8'x5' RCB	24700	409.	10,102,300.
on-site east of 40st	18" RCP	1000	29	29000 ✓
	18" RCP	900	29	26100 ✓
	18" RCP	1800	29	52200 ✓
	18" RCP	2200	29	63800 ✓

Total Cost of Alternate 1. = $ ~~45,383,385~~ ~~45,055,815~~ ✓

on-site 18" RCP 3200 @29.00 = 92800

45,148,615

12-2-86 RB.

Greiner Engineering

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Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Area 8 Alt 1
Cost by jurisdiction
Calculated by: RB Date: 11-13-86 Sheet No. 1
Checked by: TWO Date: 11/14/86 of

Cost of Alternate 1 by jurisdiction.

Maricopa Co. $12,933,375. + 92,800. = $13,026,175

City of Phoenix $32,122,410.

Alt 2 This alternate consists of 5 separate systems with outfalls at 36th st., 40th st., 44th st., Tatum Blvd, and 52nd st. The 36th st. system consists of RCP along Bell Rd. on east and west side of 36th st. and 2-8'x6' RCBC along 36th st. from Bell Rd. to Indian Bend Wash; approximately 2.5 miles. The 40th st. system consists of a 900' RCP to the west along Bell Rd. and 800' of earthen channel with a bottom width of 25' and depth of 3' with side slopes of 4:1. The outfall for this system consists of 2-8'x5' RCBC from Bell Rd to Indian Bend Wash; approximately 2.9 miles. The 44th st. system consists of 950' of earthen channel with a bottom width of 2', depth of 1.5' with 4:1 side slopes, just west of Tatum Blvd. which connect to 1050' of earthen channel with bottom width of 2' and depth of 2.9', with 4:1 side slopes. The outfall for this system consists of 2-8'x4' RCBC from Bell Rd. to Indian Bend Wash; approximately 3.1 miles. The Tatum Blvd system consists of 520' RCP along Bell Rd. and west of Tatum, 1320' of RCP along Tatum and north of Bell Rd. The outfall consists of 3-8'x5' RCBC from Bell Rd. to Indian Bend wash; approximately 3.9 miles. The 52nd st. system consists of approximately 1.5 miles of earthen channel of varying width and depth along Bell Rd. The outfall for this system consists of 3-8'x5' RCBC along 52nd st. from Bell Rd. to Indian Bend wash; approximately 3.9 miles. On-site drainage is to be handled by the off-site drainage system along Bell Rd. Where the off-site system along Bell Rd. is not continuous, an on-site system consisting of sections of 18" RCP is used.

R.O.W. requirement - Additional R.O.W. for this alternate consists of a total of 11.94 acres at a total cost of $1,373,800, using the following criteria for land acquisition:

Agricultural	$40,000 /ac
Residential	$75,000 /ac
Industrial	$100,000 /ac
Commercial	$175,000 /ac

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Utilities Conflicts
Area 8, Alt. 2 + 3
Calculated by: R.H Date: 11/14/86 Sheet No. 2
Checked by: _____ Date: _____ of 2

Utilities Conflicts in Area 8, Alt. 2+3

Same utilities conflicts covered in alternate 1 apply to alternate 2+3 with the following exception:

The 56th st. system of alternate 1 has been replaced by the 52nd st. system. Therefore the only conflict of utilities along the outfalls seems to be along the 48th st. outfall as mentioned in alt. 1.

Alternate 2

Pipes for 36TH St. System.

L = 1375'
36" RCP

Unit Cost = 69/L.F.
Total Cost = $94875

? L = 1500'
42" RCP

Unit Cost = 83/L.F.
Total Cost = $124500.

RCB's for 36TH ST. System.

L = 13400'
2-8X6 RCB

Unit Cost = 432/L.F.
Total Cost = 5,788,800.

Total Cost for 36TH. ST. System. $6008175.

Earthen Channels for 40th St. Outfall.

L=800'
B=2.5'
D=3'
Z=4

Cross Section Area = 43.5 ft²

Volume = $\frac{43.5 \times 800}{27}$ = 1289 yd³

Unit Cost = 2.50/yd³
Total Cost = $3223.

Pipes for 40th St. Outfall

L=900'
54" RCP

Unit Cost = $124/L.F.
Total Cost = $111600.

L=1000' (on-site)
18" RCP

Unit Cost = 29/L.F.
Total Cost = $29,000.

RCB's for 40th St. Outfall

L=15300'
3-8'x5' RCB

Unit Cost = $ ~~589~~ 614
Total cost = ~~6,257,700~~ 9,394,200

Total Cost for 40TH ST. System = $ ~~6,401,523~~ $ 9,538,000.

Earthen Channels for 44ST System.

L=1050'
B=2
D=2.9
Z=4

Cross Section Area. = 39.44ft²
Volume = $39.44 \times \frac{1050}{27} = 1534 yd^3$

Unit Cost = 2.50/cu.yd.
Total Cost = $3835.

L=950'
B=2
D=1.5
Z=4

Cross Section Area = 12 ft²
Volume = $12 \times \frac{950}{27} = 422 yd^3$

Unit Cost = 2.50
Total Cost = $1056.

RCB's for 44ST. system.

L=16500'
2-8'x4' RCB

Unit Cost = 381/L.F.
Total Cost = $6,286,500

Pipes for 44.ST. system.

On-site

L=900'
18" RCP

Unit Cost = 29/L.F.
Total Cost = $26100

Total Cost for 44ST. system. $6,317491

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Pipes for 48ST. System.

L=520'
36" RCP
Unit Cost = 69/L.F.
Total Cost = 35880

L=2000'
18" RCP
on-site
Unit Cost = 29/L.F.
Total Cost = $58000.

L=1320'
48" RCP
Unit Cost = 98.
Total Cost = 129360

RCB's for 48ST. System

2-8'x4' RCB
L=18400'
Unit Cost = 381/L.F.
Total Cost = 7010400.

Total Cost for 48ST System $ 7233640

(10) Pipes for 52nd St. system.

L=2200'
18" RCP
L=3200'
18" RCP

Unit cost = 29/LF
Total Cost = $63800.
$92800

Earthen channels for 52nd St. system.

(1) L=360
B=2
D=4
Z=4

Cross section Area = $72 ft^2$
Volume = $72 \times \frac{360}{27} = 960 yd^3$
Unit cost = 2.50
Total Cost = $2400.

(2) L=800'
B=30
D=3
Z=4

Cross Section Area = $126 ft^2$
Volume = $126 \times \frac{800}{27} = 3733 yd^3$
Unit Cost = 2.50
Total Cost = $9333.

(3) L= 570
B=27
D=3
Z=4

Cross Section Area = $117 ft^2$
Volume = $117 \times \frac{570}{27} = 2470 yd^3$
Unit Cost = 2.50
Total Cost = $6175.

(4) L=1900
B=14
D=35
Z=4

Cross Section Area = $98 ft^2$
Volume = $98 \times \frac{1900}{27} = 6896 yd^3$
Unit Cost = 2.50
Total Cost = $17,241

⑤ L = 275
B = 13
D = 3.5
Z = 4

Cross Section Area = 94.5 ft²
Volume = $94.5 \times \frac{275}{27} = 963 yd^3$ ✓

Unit Cost = 2.50
Total Cost = $2406.

⑥ L = 830'
B = 2
D = 4
Z = 4

Cross Section Area = 72 ft²
Volume = $72 \times \frac{830}{27} = 2213 yd^3$ ✓

Unit Cost = 2.50
Total Cost = $5533.

⑦ L = 1280
B = 2
D = 3
Z = 4

Cross section Area = 42 ft²
Volume = $42 \times \frac{1280}{27} = 1991 yd^3$ ✓

Unit Cost = 2.50
Total Cost = $4978.

⑧ L = 810
B = 2
D = 2.7
Z = 4

Cross Section Area = 34.6 ft²
Volume = $34.6 \times \frac{810}{27} = 1038 yd^3$ ✓

Unit Cost = 2.50
Total Cost = $2595.

⑨ L = 850
B = 2
D = 2.1
Z = 4

Cross Section Area = 21.84
Volume = $21.84 \times \frac{850}{27} = 688 yd^3$ ✓

Unit Cost = 2.50
Total Cost = $1720.

Greiner Engineering

Greiner Engineering Sciences, Inc.
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Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Quantities & Cost Estimate
52nd St. System
Calculated by: RB Date: 11-12-86 Sheet No. 7
Checked by: (m) Date: 11-13 of 7

13177881

(11) RCB's for 52nd St. system.

3-8'x5' RCB
L=20700

Unit Cost = 631
Total Cost = 13,061,700

Pipe along 57th St. North of Bell

1320 L.F.
60" RCP

Unit Cost = 140
Total Cost = 184800

Pipe along 58th Way North of Bell

1320 L.F.
60" RCP

Unit Cost 140
Total Cost 184800

12-2-86 (RB)

Total Cost for 52ST. System $ 13547481.
+92800 = 13,640,281

Total Cost for Alt. 2 $ ~~39267350~~. X
~~39,508,310~~
$ 39,601,110.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Summary for Alternate 2
Drainage Area 8
Calculated by: RB Date: 11-17-86 Sheet No. 1
Checked by: TMO Date: 11/14/86 of 2

Location	Structure	Quantity	Unit Cost	Total Cost
W. of 36st. along Bell.	1-36" RCP	1375 L.F.	$ 69. /L.F.	$ 94875.
E. of 36th.st. along Bell	1-42" RCP	1500 L.F.	83.	124500.
36ST. OUTFALL Line.	2-8x6 RCB	13400 L.F.	432.	5,788,800.
East of 40st. along Bell.	earth channel	800 L.F. 1289 yd³	2.50 /c.y.	3223.
West of 40st. along Bell	54" RCP	900'	124.	111,600.
west of 40st. along Bell	18" RCP (on-site)	1000'	29.	29000.
40 ST. OUTFALL LINE	2-8'x5' RCB	15300'	409.	6,257,700.
west of 44st. along Bell.	18" RCP (on-site)	900'	29.	26,100.
east of 44st. along Bell.	→ earth channel	1050' 1534 yd³	2.50	3835.
east of 44st along Bell (east of above)	earth channel	950' 422 yd³	2.50	1056.
44ST. OUTFALL Line	2-8'x4' RCB	16500 L.F.	381.	6,286,500.
N. of Bell along Tatum	48" RCP	1320 LF	98	129360
West of 48st. along Bell.	36" RCP	520 L.F.	69.	35,880
east of 48st. along Bell.	18" RCP	2000 L.F.	29.	58,000
48st outfall line	2-8'x4' RCB	18400 L.F.	381.	7,010,400

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Road Project Drainage Study

Description Summary for Alternate 2

Calculated by RB Date 11-12-86 Sheet No. 2

Checked by MWO Date 11/14/86 of 2

Location	Structure	Quantity	Unit Cost	Total Cost
West of 52nd St. along Bell.	earth channel	(360') 960 yd³	2.50	2400.
east of 52nd St. along Bell.	earth channel	(800') 3733 yd³	2.50	9333.
east of 52nd st along Bell.	earth channel	(570') 2470 yd³	2.50	6175.
east of 52nd st. along Bell.	earth channel	(1900') 6896 yd³	2.50	17241.
east of 52nd st. along Bell.	earth channel	(275') 963 yd³	2.50	2406.
east of 52nd st. along Bell.	earth channel	(830') 2213 yd³	2.50	5533.
east of 52nd st. along Bell.	earth channel	(1280') 1991 yd³	2.50	4978.
east of 52nd st. along Bell.	earth channel	(810') 1038 yd³	2.50	2595.
east of 52nd st. along Bell.	earth channel	(850') 688 yd³	2.50	1720.
east of 52nd st. along Bell (on-site)	18" RCP	2200 L.F.	29.	63800.
52nd St outfall line	3-8'x5' RCB	20,700 LF	631.	13,061,700 X ~~13,177,881.~~
N. of Bell along 57st	60" RCP	1320 LF	140.	184800
N. of Bell along 58th Way	60" RCP	1320 LF	140	184800
On-site @ east end of project	18" RCP	3200 LF	29	92800

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Culverts under driveway cross-streets for Alt. 2 & 3.
Calculated by: RB Date: 11-14-86 Sheet No. 1
Checked by: _____ Date: _____ of _____

44TH ST. system.

36" RCP L=50' — Unit Cost 69, Total Cost 3450

36" RCP L=50' — Unit Cost 69, Total Cost 3450

Total 6900.

C.O.P. 0.00
M.Co. 6900.

52nd St. System.

2-10x5 RCB L=80' — Unit Cost 546., Total Cost 43680

2-10x5 RCB L=50' — Unit Cost 546, Total Cost 27300

2-8x4 RCB L=50' — Unit Cost 381, Total Cost 19050

2-8x4 RCB L=50' — Unit Cost 381, Total Cost 19050

2-8x4 RCB L=80' — Unit Cost 381, Total Cost 30480

✓ 2-8x4 RCB L=80' — Unit Cost 381, Total Cost 30480

✓ 2-6x5 RCB L=60' — Unit Cost 306, Total Cost 18360

✓ 1-8x4 RCB L=80' — Unit Cost 208, Total Cost 16640

✓ 1-8x4 RCB L=100' — Unit Cost 208, Total Cost [illegible]

Total. 225840.

C.O.P. 86280.
M.Co. 139560.

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study.
Description:

Calculated by: RB Date: 11-12-86 Sheet No. 1
Checked by: JMO Date: 11/14/86 of 1

Summary of Alternate 2 by Jurisdiction.

City of Phoenix (All outfall lines within C.O.P.

$38,533,468.
+ R/W 144375.
38,677,843

36st → 5,788,800
40st → 6,257,700
44st → 6,286,500
48st → 7,010,400
52st → 13,061,700.

Maricopa County.

1,080,842
+ R/W 1122925
$2097767
18" RCP On-Site 92800
$2,190,567

12-2-86 RB

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job [illegible]
Description R/W costs
Calculated by RB Date [illegible]-86 Sheet No. 1
Checked by [illegible] Date 11/14/86 of 2

AH-~~3~~2

R/W reqmts for open channels

C

L = 800'
TW = 51
Buffer = 16
Area = $\frac{(51+16)(800)}{43560}$ = $\boxed{1.23\text{ ac.}}$ $215,250

L = 570 (C)
TW = 51
Buffer = 16
Area = $\frac{(51+16)(570)}{43560}$ = $\boxed{0.88\text{ ac}}$ $154,000

10% C
90% R

L = 1050
TW = 25.2
Buffer = 16
Area = $\frac{(25+16)(1050)}{43560}$ $\boxed{0.99\text{ ac}}$ $113850

L = 1900 (10% R 90% C)
TW = 42
Buffer = 16
Area = $\frac{(42+16)(1900)}{43560}$ $\boxed{2.53\text{ ac}}$ $417450

R

L = 950
TW = 14
Buffer = 16
Area = $\frac{(14+16)(950)}{43560}$ = $\boxed{0.65\text{ ac.}}$ $48750

L = 275 (R) PHX
TW = 41
Buffer = 16
Area = $\frac{(41+16)(275)}{43560}$ = $\boxed{0.36\text{ ac.}}$ $27,000

R

L = 360
TW = 34
Buffer = 16
Area = $\frac{(34+16)(360)}{43560}$ $\boxed{0.41\text{ ac}}$ $30750

L = 830 (R) PHX
TW = 34
Buffer = 16
Area = $\frac{(34+16)830}{43560}$ $\boxed{0.95\text{ ac}}$ $71250

R

L = 800
TW = 54
Buffer = 16
Area = $\frac{(54+16)(800)}{43560}$ $\boxed{1.29\text{ ac.}}$ $96750

L = 1280 (R) 50% PHX " Co.
TW = 26
Buffer = 16
Area = $\frac{(26+16)(1280)}{43560}$ = $\boxed{1.23\text{ ac}}$ $92250

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job [illegible]
Description R/W costs

Calculated by RB Date 11-14-86 Sheet No. 2
Checked by [illegible] Date 11/14/86 of 2

L=810
TW=23.6
Buffer=16

(K)

$$\text{Area} = \frac{(24+16)(810)}{43560} = \boxed{0.74\text{ac}}$$

(55,500)

L=850
TW=18.8
Buffer=16

(P)

$$\text{Area} = \frac{(19+16)(850)}{43560} = \boxed{0.68\text{ac.}}$$

(51,000)

Total land acquisition = $1,373,800

Area 8 East

Alternate 1

Alternate 1 consist of 2 separate systems; The 48th st. System and The 52nd st. System. The 48th system consists of stormdrains north of Bell and west of Tatum with the outfall along 48th st. extending from Bell Rd. to Indian Bend Wash. The 52nd Street system consists of stormdrains north of Bell and east and west of 52nd Street with the outfall along 52nd Street to Indian Bend Wash. The 10-year discharge to 48th System would be 245 cfs and the discharge to 52nd Street would be 455 cfs. Storm drain sizes vary from 36-inch pipe to 2-6'x5' box culverts.

Alternate 2

Alternate 2 is indentical to alternate 1 with the exception of a 30 ac-ft detention basin southwest of Tatum which reduces the discharge to Indian Bend Wash to 39 cfs. Consequently reducing the outfall structure from an 8'x4' box culvert to a 36-inch pipe.

Alternate 3

This alternate recommends the same outfalls as alternate 1 and 2 for discharging flows to Indian Bend wash. The 48th street system is identical to that of alternate 1. The 52nd street system consists of a series of open channels along Bell Rd., east and west of 52nd street. The discharge to the 52nd st. System would be 408 cfs. but the outfall structure size remains the same as alternates 1 and 2. open channels would be from 1.5 to 3.6 feet deep and range from 14 to 31 feet in top width.

Area 8 West

Alternate 1.

Alternate 1 consists of a series of storm drains with outfalls at 36th Street and 40th Street.

The 36th Street system picks up flows from the north side of Bell Road and carries it to Indian Bend Wash. The outfall is 1-8x5 RCB. The peak 10-year discharge is 322 cfs.

The 40th Street system picks up flows from PV High School on the west, a storm drain that extends 1/2 mile north along 40th Street, and a storm drain that extends east to just west of Tatum Blvd. The peak 10-year discharge for this system is 742 cfs. This outfall is 2-10x5 RCB and discharges to Indian Bend Wash along 40th St.

Alternate 2

Alternate 2 consists of the same system layout as Alternate 1 except a 10 a.f. detention area is located in Paradise Valley Park which reduces the size of the 36th Street outfall to a 42" RCP. The peak discharge for the 36th St. System is 52 cfs.

The 40th Street system is identical to Alternate 1 and the peak discharge is 742 cfs outletting along 40th Street to Indian Bend Wash.

Alternate 3

Alternate 3 consists of a series of open channels and storm drains outletting along 36TH Street and 40TH Street to Indian Bend Wash.

The 36TH Street system is the same configuration as Alternate 1. The outfall is 1-8X5 RCB and outlets to Indian Bend Wash. The peak discharge is 322cfs.

The 40TH Street System consists of an open channel running along 40th Street north of Bell, a series of open channels east of 40th Street on the north side of Bell and a storm drain west of 40th Street on the north side of Bell. The outfall is 2-10X5 RCB along 40th Street outletting to Indian Bend Wash. The peak discharge is 743 cfs.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study

Description: Cost Summary for Drainage Area 8 - East and West

Calculated by: R.H. Date: 12/2/86 Sheet No. 1

Checked by: RB Date: 12/3/86 of 4

Cost Summary

Drainage Area 8

East and West.

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Drainage Area 8 East and West.
Alt. 1

off-site	on-site	land arguisition
$ 24,434,690	$ 226,800	—

City of Phx.	Maricopa County
$ 22,215,600	$ 2,445,890

Total

$ 24,661,490

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Rd. Project Drainage Study
Description Cost Estimates
DA 8, Q10, Alt. 2
Calculated by R.H Date 12/3/86 Sheet No.
Checked by Date of

Drainage Area 8 East and West

Alt. 2

off-site	on-site	land acquisition
$ 20,199,500	$ 226,800	$ 1,225,000

city of Phx.	Maricopa County
$ 19,165,100	$ 2,486,200

Total

$ 21,651,300

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Cost Estimates
DA 8, Q10, Alt. 3
Calculated by: R.H Date: 12/4/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

Drainage Area 8 East and West

Alt. 3

Off-Site	On-site	land acquisition
$21,328,700	$226,800	$792,000

City of Phx.	Maricopa County
$20,467,600	$1,879,900

Total

$22,347,500

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Alt. 1

Off-Site
$ 11,864,400

land-acquisition
$ 0.0

on-site
$ 226,800

Total cost = $12,091,200

City of Phx.
$ 10,824,900
(89.5% of total cost)

Maricopa County
$ 1,266,300
(10.5% of total cost)

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Alternate 1 Summary of Cost Estimates, DA 8E

Location	structure (Item)	Quantity	Unit Cost	Total Cost
Bell Rd. to I.B.W. along Tatum	1-8'x4' RCBC	? 18,400 L.F. o.k.	$ 208	$ 3,827,000
west of Tatum along Bell	1-24" RCP	520 L.F.	39	20,000
north of Bell Rd. along Tatum	1-36" RCP	1320 L.F.	69	91,000
Bell Rd. to I.B.W. along 52nd St.	2-6'x5' RCBC	? 20,700 L.F. o.k.	307	6,354,900
West of 52nd St. along Bell	1-66" RCP	360 L.F.	145	52,000
East of 52nd st. along Bell Rd.	1-10'x5' RCBC	800 L.F.	284	230,000
West of 56th st. along Bell Rd.	1-8'x5' RCBC	570 L.F.	222	130,000
across 56th st. along Bell Rd.	1-8'x5' RCBC	1960 L.F.	222	435,000
East of 56th st. along Bell Rd.	1-6'x5' RCBC	275 L.F.	180	49,500
north of Bell Rd. along 57th st.	1-48" RCP	1320 L.F.	98	130,000
East of 56th st. along Bell Rd.	1-72" RCP	830 L.F.	150	125,000
north of Bell Rd. along 58th way.	1-48" RCP	1320 L.F.	98	130,000
East of 56th st. along Bell Rd.	1-54" RCP	1280 L.F.	124	160,000
East of 56th st. along Bell Rd.	1-42" RCP	810 L.F.	83	70,000
East of 56th st. along Bell Rd.	1-36" RCP	850 L.F.	69	60,000
on-site Drainage East and West of 52nd st.	18" RCP	7560 L.F.	30	226,800
		Total		$ 13,091,200

Alt. 1

48th St. System

1 - 8'x4' RCBC	off-site	$ 3,827,000
24" RCP	off-site	20,000
36" RCP	off-site	91,000
18" RCP	on-site	68,400
	Total	$ 4,006,400

52nd St. System

2-6'x5' RCBC	off-site	$ 6,354,900
66" RCP	off-site	52,000
1-10'x5' RCBC	off-site	230,000
1-8'x5' RCBC	off-site	130,000
1-8'x5' RCBC	off-site	435,000
1-6'x5' RCBC	off-site	49,500
48" RCP	off-site	130,000
72" RCP	off-site	125,000
48" RCP	off-site	130,000
54" RCP	off-site	160,000
42" RCP	off-site	70,000
36" RCP	off-site	60,000
18" RCP	on-site	158,400
	Total cost	$8,084,800

City of Phx. $ 10,824,900

Maricopa County $ 1,266,300

Cost to various municipalities

City of Phoenix

1-8'x4' RCBC	$ 3,827,000
2-6'x5' RCBC	6,354,900
54" RCP	97,500
48" RCP	260,000
72" RCP	125,000
1-6'x5' RCBC	49,500
1-8'x5' RCBC	111,000
Total	10,824,900

Maricopa County

24" RCP	$ 20,000
36" RCP	151,000
18" RCP	226,800
66" RCP	52,000
1-10'x5' RCBC	230,000
1-8'x5' RCBC	454,000
54" RCP	62,500
42" RCP	70,000
Total	1,266,300

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Alternate 1 Q10

Calculated by: RB Date: 11-26-86 Sheet No. 1
Checked by: RH Date: 12/3/86 of

Quantity Summary Area 8 west
Alternate 1

Structure	Quantity	Unit Cost	Total Cost
✓ 1-8x5 RCB	13400 L.F.	222.	2974800.
✓ 1-36" RCP	1500 L.F.	69.	103500
✓ 1-36" RCP	900 L.F.	69.	62100
✓ 1-48" RCP	2640 LF.	98.	258720
✓ 2-10'x5' RCB	15300 L.F.	546.	8353800
✓ 2-6'x6' RCB	850 L.F.	326.	277100
✓ 1-6x6 RCB	1850 L.F.	198.	366300
1-48" RCP	1050 LF	98.	102900
1-36" RCP	1030 LF.	69.	71070.

No new R/W requirements. $12,570,290.

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Road Project Drainage Study.
Description Cost summary by jurisdiction.

Calculated by RB Date 12-1-86 Sheet No. 1
Checked by RH Date 12/3/86 of 3

Area 8 West

Alternate 1

City of Phoenix.

900 L.F. 36" RCP @ $62,100

1-8x5 RCB (13400 LF) @ $2,974,800.

2-10x5 RCB (15300 L.F.) @ $8,353,800

11,390,700.

Alternate 1

Maricopa County

1500 L.F. 36" RCP @ $103500.
2640 LF 48" RCP @ $258720
850 L.F. 2-6x6 RCB @ $277100
1850 LF. 1-6x6 RCB @ $366300
1050 LF 48" RCP @ $102900.
1030 LF 36" RCP @ $71070.
1,179,590.

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Cost Estimates DA & E
Q_{10} - Alt. 2
Calculated by: R.H Date: 12/3/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

Off-Site	on-site	land acquisition
$9,451,500	$226,800	$1,225,000

City of Phx.	Maricopa county
$9,637,000	$1,266,300

Total Cost

$10,903,300

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Rd. Project Drainage Study
Description Cost Estimates
Alt. 2 DA & E
Calculated by R.H Date 12/3/86 Sheet No. ____
Checked by ____ Date ____ of ____

Alt. 2

48th st. System

36" RCP	$ 1,269,600
54" RCP	31,000
36" RCP	91,000
Det. basin	1,338,500
18" RCP	68,400
24" RCP	20,000

Total Cost $ 2,818,500

52nd st. System

2-6'x5' RCBC	$ 6,354,900
66" RCP	52,000
1-10'x5' RCBC	230,000
1-8'x5' RCBC	130,000
1-8'x5' RCBC	435,000
1-6'x5' RCBC	49,500
48" RCP	130,000
72" RCP	125,000
48" RCP	130,000
54" RCP	160,000
42" RCP	70,000
36" RCP	60,000
18" RCP	158,400

Total Cost $ 8,084,800

City of Phx. $ 9,637,000

Maricopa County $ 1,266,300

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Cost Estimates DA 8E
Alt. 2
Calculated by: R.H Date: 12/3/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

Cost to Various Municipalities

City of Phx.

2-6'x5' RCBC	$ 6,354,900
36" RCP	1,269,600
Det. basin	1,338,500
54" RCP	31,000
48" RCP	730,000
48" RCP	130,000
72" RCP	125,000
6'x5' RCBC	49,500
8'x5' RCBC	111,000
54" RCP	97,500
Total Cost	$ 9,637,000

Maricopa County

24" RCP	$ 20,000
36" RCP	151,000
18" RCP	226,800
66" RCP	52,000
10'x5' RCBC	230,000
8'x5' RCBC	454,000
54" RCP	62,500
42" RCP	70,000
Total Cost	$ 1,266,300

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Alternate ~~1~~ 2 Summary of Cost Estimates, DA 8E

Location	Structure (Item)	Quantity	Unit Cost	Total Cost
	1-36" RCP	? O.K.	$ 69	$ 1,269,600
Bell Rd. to I.B.W. along Tatum	~~1-8'x4' RCBC~~	18,400 L.F.	~~208~~	~~3,827,000~~
across Bell Rd. along Tatum	1-54" RCP	250	124	31,000
west of Tatum along Bell	1-24" RCP	520 L.F.	39	20,000
Det. Basin SW of Tatum	30 ac.ft.	175,000/ac. 2.50/C.Y.		1,225,000 113,500
north of Bell Rd. along Tatum	1-36" RCP	1320 L.F.	69	91,000
Bell Rd. to I.B.W. along 52nd St.	2-6'x5' RCBC	? O.K. 20,700 L.F.	307	6,359,900
West of 52nd St. along Bell	1-66" RCP	360 L.F.	145	52,000
East of 52nd St. along Bell Rd.	1-10'x5' RCBC	800 L.F.	284	230,000
West of 56th St. along Bell Rd.	1-8'x5' RCBC	570 L.F.	222	130,000
across 56th St. along Bell Rd.	1-8'x5' RCBC	1960 L.F.	222	435,000
East of 56th St. along Bell Rd.	1-6'x5' RCBC	275 L.F.	180	49,500
north of Bell Rd. along 57th St.	1-48" RCP	1320 L.F.	98	130,000
East of 56th St. along Bell Rd.	1-72" RCP	830 L.F.	150	125,000
north of Bell Rd. along 58th way.	1-48" RCP	1320 L.F.	98	130,000
East of 56th St. along Bell Rd.	1-54" RCP	1280 L.F.	124	160,000
East of 56th St. along Bell Rd.	1-42" RCP	810 L.F.	83	70,000
East of 56th St. along Bell Rd.	1-36" RCP	850 L.F.	69	60,000
On-site Drainage East and West of 52nd St.	18" RCP	7560 L.F.	30	226,800
		Total		$ 10,903,300

Greiner Engineering

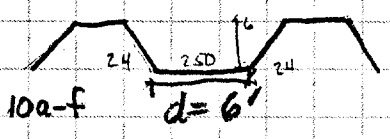
Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Alternate 2 - Qo

Calculated by: RB Date: 11-26-86 Sheet No. 2
Checked by: RH Date: 12/3/86 of

Quantity Summary ✓
Alternate 2. Area 8 West

Structure	Quantity	Unit Cost	Total Cost
✓ 1-42" RCP	13400 L.F.	83.	1112200.
✓ 1-36" RCP	1500 L.F.	69.	103500
✓ 1-48" RCP	2640 LF	98.	258720
✓ 1-36" RCP	900 L.F.	69.	62100
✓ 2-6X6 RCB	850 L.F.	326.	277100
✓ 2-10'X5' RCB	15300 LF.	546.	8353800
✓ 1-6X6 RCB	1850 LF	198.	366300
✓ 1-48" RCP	1050 LF	98.	102900
✓ 1-36" RCP	1030 LF	69.	71070
Retention Area (no add'l R/W costs) (City Park)	10 a-f (d=6') (16133 yd3) (70 a-f req'd)	2.50	40333.
			$10,748,023.



10x43560/27 = 16133 yd^3

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Road Project Drainage Study.
Description Cost Summary by jurisdiction

Calculated by RB Date 12-1-86 Sheet No. 2
Checked by RH Date 12/3/86 of 3

Area 8 West

Alternate 2

City of Phoenix

900 L.F. 36" RCP @ $ 62100.
13400 LF 42" RCP @ $ 1,112,200.
15300 LF 2-10x5 RCBC @ $ 8,353,800

$ 9,528,100.

Maricopa County

1500 LF 36" RCP @ 103500.
2640 LF 48" RCP @ 258720.
850 LF 2-6x6 RCB @ 277100.
1850 LF 1-6x6 RCB @ 366300.
1050 LF 48" RCP @ 102900.
1030 LF 36" RCP @ 71070.
Detention Area 40333.
$ 1,219,923

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Alt. 3

off-site
$ 10,580,700

land acquisition
$ 792,000

on-site
$ 226,800

Total Cost = $ 11,599,500

City of Phx.
$ 10,939,500
(94.3% of total cost)

Maricopa county
$ 660,000
(5.7% of total cost)

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Alt. 3

48th St. System

1-8'x4' RCBC	$ 3,827,000
24" RCP	20,000
36" RCP	91,000
18" RCP	68,400

Total cost $4,006,400

52nd St. System

2-6'x5'	$ 6,354,900
open Channel	819,800
48" RCP	260,000
18" RCP	158,400

Total cost $ 7,593,100

City of Phoenix $ 10,939,500

Maricopa County $ 660,000

Cost to Various municipalities

City of Phoenix

1-8'x4' RCBC	$ 3,827,000
2-6'x5' RCBC	6,354,900
48" RCP	260,000
open channel	497,600
Total	10,939,500

Maricopa County

24" RCP	$ 20,000
36" RCP	91,000
18" RCP	226,800
open channel	322,200
Total	660,000

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Alternate 2

Summary of Cost Estimates, DA 8E

Location	Structure (Item)	Quantity	Unit Cost	Total Cost
Bell Rd. to I.B.W. along Tatum	1-8'x4' RCBC	18,400 L.F.	$ 208	$ 3,827,000 ~~3,750,000~~
north of Bell along Tatum	1-36" RCP	1320 L.F.	69	91,000
West of Tatum along Bell	1-24" RCP	520 L.F.	39	20,000
Bell Rd. to I.B.W. along 52nd st.	2-6'x5' RCBC	20,700 L.F.	307	6,354,900 ~~6,140,000~~
West of 52nd St. along Bell Rd.	open channel {TW=25.2, L=360, D=2.9} 0.34 @ 75000	530 C.Y.	2.50	1300 25,500
East of 52nd st. along Bell Rd.	open channel {TW=30.8, L=800, D=3.6} 0.86 @ 75,000	1750 C.Y.	2.50	4,400 64,500
East of 52nd st. along Bell Rd.	open channel {TW=30.0, L=570, D=3.5} 0.60 ac @ 175000	1200 C.Y.	2.50	3,000 105,000
West of 56th St. along Bell Rd.	open channel {TW=29.2, L=1900, D=3.4} 1.97 ac @ 175000	3750 C.Y.	2.50	9,300 345,000
north of Bell along 57th St.	1-48" RCP	1320 L.F.	98	130,000
East of 56th St. along Bell	open channel {TW=28.4, L=275, D=3.3} 0.28 ac @ 75000	510 C.Y.	2.50	1300 21,000
north of Bell along 58th Way	1-48" RCP	1320 L.F.	98	130,000
East of 56th st. along Bell	open channel {TW=25.2, L=830, D=2.9} 0.79 ac @ 75000	1200 C.Y.	2.50	3,000 60,000
East of 56th st. along Bell	open channel {TW=20.4, L=1280, D=2.3} 1.07 ac @ 75000	1220 C.Y.	2.50	3,000 80,000
East of 56th st. along Bell	open channel {TW=18, L=810, D=2.0} 0.63 ac @ 75,000	600 C.Y.	2.50	1,500 47500
East of 56th st. along Bell	open channel {TW=14, L=850, D=1.5} 0.58 ac @ 75000	380 C.Y.	2.50	1000 43,500
On-site drainage east + west of 52nd st.	18" RCP	7560 L.F.	30	226,800
		Total Cost		$ 11,599,500

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Road Project Drainage Study
Description Alternate 3 - Q10

Calculated by RB Date 11-26-86 Sheet No. 4
Checked by RH Date 12/3/86 of

Quantity Summary
Alternate 3 Area 8 West

Structure	Quantity		Unit Cost	Total Cost
✓ 1-8X5RCB	13400 LF		222.	2974800
✓ 1-36" RCP	1500 LF		69.	103500
✓ 2-10'x5' RCB	15300 LF		546.	8353800 ~~8457300~~
✓ ① open channel	2640 LF (2933 yd³)		2.50	7333
✓ ② open channel	850 LF (3148 yd³)		2.50	7870
✓ ③ open channel	1850 LF (4045 yd³)		2.50	10113
④ open channel	1050 LF (924 yd³)		2.50	2310.
✓ ⑤ open channel	1030 LF (357 yd³)		2.50	893.
✓ ① R/W.	2.3 ac	50% R 50% C	75K 175K.	287500
✓ ② R/W	1.1 ac	100% C	175K	192500
✓ ③ R/W	2.0 ac	10% R 90% C	75K 175K	330000
✓ ④ R/W	0.9 ac	40% C 60% R	175K 75K	103500
✓ ⑤ R/W	0.7 ac	100% R	75K.	52500
↓(for driveways)↓				
50 LF 36" RCP			69	3450
50 LF 36" RCP			69	3450
50 LF 6x6 RCB			198	9900
50 LF 6x6 RCB			198	9900

Total 12,453,319

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project
Description: Drainage Study
Structures for driveways Att3
Calculated by: RB Date: 11-26-86 Sheet No. 5
Checked by: RH Date: 12/3/86 of 4

Area 8 West

Box Culverts for driveways and cross streets.
or
Pipe Culverts

50LF 36" RCP X 69. = 3450

50LF 36" RCP X 69. = 3450

D=259 50LF 6X6 RCB X 198. = 9900

D=259 50LF 6X6 RCB X 198. = 9900.

Total = $26700

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Alt 3 Q10
Cost summary by jurisdiction
Calculated by: RB Date: 12-1-86 Sheet No. 3
Checked by: _____ Date: _____ of 3

Area 8 West.

Alternate 3

City of Phoenix.

1500 LF 36" RCP @ 103500
13400 LF 1-8x5 RCB @ 2974800
15300 LF 2-10x5 RCB @ ~~8457300~~ 8,353,800
~~11,535,600~~ 11,432,100

Maricopa County

2640 L.F.	Open channel	$7333
850 L.F.	Open channel	$7870.
1850 L.F.	Open channel	$10113.
1050 LF	Open channel	$2310.
1030 L.F.	Open channel	$893
R/W		$966000
50 LF 36" RCP		$3450
50 LF 36" RCP		$3450
50 LF 6x6 RCB		$9900
50 LF 6x6 RCB		$9900
		$1,021,219

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Utility Conflicts.

Calculated by: RB Date: 12-2-86 Sheet No. 1
Checked by: RH Date: 12/3/86 of 1

Utility Conflicts - Drainage Area 8 West.

(1) 12" water line crossing Bell Rd. at 36th St.
(2) 8" sanitary sewer crossing Bell Rd. at 36th St.
(3) 12" water line crossing Bell Road at 450' east of 36th St.
(4) 12" water line crossing Bell Rd. at 38th St.
(5) 12" water line crossing Bell Rd. at 40th St.
(6) 12" sanitary sewer crossing Bell Rd. at 40th St.

Drainage area 8 West has a total of 6 utility conflicts. All 3 alternates are affected by these conflicts.

The 36th St. System is in conflict with the 12" water line at 36th St., the 8" sewer at 36th St., the 12" water line crossing Bell at 450' east of 36th St., and the 12" water line crossing Bell at 38th St.

The 40th St. system is in conflict with a 12" water line crossing Bell at 40th St., and the 12" sanitary sewer crossing Bell at 40th St.

Greiner Engineering

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Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Rd. Project Drainage Study
Description Utility conflicts

Calculated by RH Date 12/4/86 Sheet No. ____

Checked by ____ Date ____ of ____

Utility Conflicts – Drainage Area East

All three alternates are affected by the following utility conflicts:

(1) 2-12" water line crossing Bell Rd. at 48th st.
(2) 10" San. Sewer crossing Bell Rd. at 48th st.
(3) 8" San. Sewer crossing Bell Rd. at 56th st.
(4) 42" Water line crossing Bell Rd. at 56th st.
(5) 8" San. Sewer crossing Bell Rd. at 57th st.
(6) 8" San. Sewer crossing Bell Rd. at 58th way

The 48th st. System is in conflict with 2-12" waterline and a 10" San. Sewer at 48th st.

The 52nd st. System is in conflicts with 8" San. Sewer and a 42" Waterline at 56th st., 8" San. Sewer at 57th st., and 8" San. Sewer at 58th Way.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: 36st System
Q10 D.A. 8
Calculated by: RB Date: 12-2-86 Sheet No. 1
Checked by: _____ Date: _____ of 1

Alternate 1 36st System w/o detention

$3,078,300. subtract from Alt 1 to get Alt. 4

Alternate 2 36st system w/ detention.

$1,256,033. Subtract from Alt. subtract from Alt 2 for Alt. 5

Alt 3 only

Cost of detention pond

$40,300. excavation

no land cost.

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road Project Drainage Study
Description: Revisions to Quantities and Cost Estimate - Area 8 East
Calculated by: RDB Date: 5-6-87 Sheet No. ____
Checked by ____ Date ____ of ____

Facilities North of Bell Road - no change

Facilities Along Bell Road -

18" RCP	940 L.F.	@ $15/LF =	14,000.
30" RCP	830 LF	@ $55/LF =	46,000.
42" RCP	860 LF	@ $83/LF =	71,000.

Facilities South of Bell Road

42" RCP	11880 LF	@ $83/LF =	986,000.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road
Description: Quantities and Cost Estimate
Calculated by: RB Date: 3-23-87 Sheet No. 1 of 7
Checked by: _____ Date: _____

Drainage Area 8 - East Side.

					Jurisdiction
	110 LF	30" RCP	@ $55 =	6050.00	M.C.
	110 LF	~~24"~~ 30" RCP	@ ~~$35~~ 55 =	~~3850~~ 6050.00	M.C.
	110 LF	21" RCP	@ $23 =	2530.00	M.C.
52st	23500 LF	39" RCP	@ $76 =	1,786,000.00	C.O.P.
	1320 LF	30" RCP	@ $55 =	72600.00	M.C.
	2640 LF	30" RCP	@ $55 =	145200.00	M.C.
	1320 LF	30" RCP	@ $55 =	72600.00	M.C.
48st	18,200 LF	39" RCP	@ $76 =	1,383,200.00	C.O.P.
	1320 LF	39" RCP	@ $76	100320.00	M.C.
	500 LF	21" RCP	@ $23 =	11500.00	M.C.
	3960 LF	30" RCP	@ $55 =	217800.00	M.C.
	1320 LF	30" RCP	@ $55 =	72600.00	M.C.
5-5-87	940 LF	18" RCP	@ $15 =	14000	
	830 LF	30" RCP	@ $55 =	46000	
	860 LF	42" RCP	@ 83 =	71000	

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

-23-39

Job: Bell Road

Description: Quantities and cost estimate

Calculated by: RB Date: 3-23-87 Sheet No. 2 of 7

Checked by: _____ Date: _____

Drainage Area 8 - West Side

						Jurisdiction
44st.	16300 LF	48" RCP	@ $98	=	1597400.00	C.O.P.
	1320 LF	36" RCP	@ $69	=	91080.00	m.c.
	2640 LF	39" RCP	@ $76	=	200,640.00	m.c
	1320 LF	24" RCP	@ $39	=	51480.00	m.c
verify unit cost	2640 LF	21" RCP	@ $23	=	60720.00	m.c
40st	15300 LF	48" RCP	@ $98	=	1499400.00	C.O.P.
	1320 LF	39" RCP	@ $76	=	100320.00	m.c
	2640 LF	42" RCP	@ $83	=	219120.00	m.c
	1680 LF	33" RCP	@ $63	=	105840.00	m.c.
36st	13300 LF	48" RCP	@ $98	=	1303400.00	C.O.P.
verify unit cost	1320 LF	18" RCP	@ $15	=	21120.00	m.c.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Structures east of ADMS study limit.

Structure Location	Q	Size of exstg str.	Capacity	Recommended Size.
✓ DA 819	5	18x29 CMPA	8.7	leave exstg 18x29 CMPA
✓ DA 822	4	22x36 CMPA	15.8	leave exstg 18x29 CMPA
DA 821	20	—		use 30" RCP
Problem DA 823	21	22"x36" CMPA	15.8	use ~~24"~~ 30" RCP
DA 824	1	22x36 CMPA	15.8	leave exstg 22x36 CMPA
DA 825	2	18x29 CMPA	8.7	leave exstg 18x29 CMPA
DA 826	9	—		use 21" RCP.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road.
Description: check of adequacy of proposed ADMS structures
Calculated by: RB Date: 3-23-87 Sheet No. 4
Checked by: _____ Date: _____ of 7

Structure Location	Q.	Size as per ADMS.	Capacity (Based on Manning Eqn. Ass'd slope = .005 n = .012)		Recommended Size as Per Bell Road Study	
36th Street system						
S.D. along 36st S. of Bell	68	48"	110		48"	
40th Street system						
S.D. along 40st S. of Bell	76	48"	110		48"	
S.D. along Bell east of 40st.	51	33"	29	upsize ⇒	39"	*
S.D. along 40st N. of Bell	25	42"	77		42"	
S.D. along Grovers E. of 40st	28	30"	25	⇒ upsize	33"	*
44th Street system						
S.D. along 44th St. S. of Bell	83	42"	77	⇒ upsize	48"	*
SD along Bell east of 44st	39	24"	17	⇒ upsize	36"	*
SD along 44st N. of Bell	47	33"	29	⇒ upsize	39"	*
SD along Grovers east of 44th	18	24"	17		24"	
SD along 44th N. of Grovers	15	21"	16		21"	
Tatum System						
S.D. along Tatum S. of Bell	61	39"	63		39"	
SD along Bell east of Tatum	45	30"	25	⇒ upsize	39"	*
SD along Bell west of Tatum	10	no str. proposed.			21"	
SD along Tatum N. of Bell	12	30"	25		30"	
SD along Grovers east of Tatum	12	30"	25		30"	
52nd St. system						
S.D. along 52nd S. of Bell	43	36"	32	⇒ upsize	39"	*
S.D. along Bell e. of 52nd	7	30"	25		30"	
SD along 52nd N. of Bell	12	30"	25		30"	
SD along Grovers E. of 52nd	12	30"	25		30"	

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road
Description: Capacity of various sizes of RCP flowing full.
Calculated by: RB Date: 3-23-87. Sheet No. 5
Checked by: _____ Date: _____ of 7

$$\frac{1.49}{.012} A R^{2/3} \cdot .071 = 8.78 A R^{2/3}$$

Diameter	A	P	R	$AR^{2/3}$	Q
21"	2.405	5.498	0.437	~~1.796~~ 1.386	~~15.769~~ 12.17
24"	3.142	6.283	0.500	1.979	17.376
30"	4.909	7.854	0.625	2.890	25.374
33"	5.940	8.639	0.688	3.282	28.816
36"	7.069	9.425	0.750	3.686	32.363
39"	8.296	10.210	0.813	7.226	63.444
42"	9.621	10.996	0.875	8.801	77.273
48"	12.566	12.566	1.00	12.566	110.329

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Table ___

Estimated Costs

Drainage Area 8.

2-year frequency storm.

Facilities North of Bell Road.

Structure	Quantity	Unit Cost	Estimated Cost
33" RCP	1680 L.F.	63.	105840.
42" RCP	2640 L.F.	83	219120.
21" RCP	2640 LF.	23.	60720.
24" RCP	1320 L.F.	39.	51480.
39" RCP	2640 L.F.	76.	200640.
30" RCP	1320 L.F.	55.	72600.
30" RCP	3960 L.F.	55.	217800.
30" RCP	1320 LF	55.	72600.
30" RCP	2640 LF	55	145200.
			1146000. Maricopa County

Facilities Along Bell Road.

21" RCP	110 LF	23.	2530.
30" ~~24~~" RCP	110 LF	~~35~~ 55	~~3850~~ 6050.
30" RCP	110 LF	55.	6050.
30" RCP	1320 LF	55.	72600.
39" RCP	1320 LF	76.	100320.
21" RCP	500 LF	23.	11500.
36" RCP	1320 LF	69.	91080.
39" RCP	1320 LF	76.	100320.
18" RCP	1320 LF	15.	21120.
5-5-87 18" RCP	940 LF	15 = 14000	~~409370~~ 411570
30" RCP	830 LF	55 = 46000	Maricopa Co
42" RCP	860 LF	83 = 71000	543000.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Facilities South of Bell Road

48" RCP	13300 L.F.	98	1303400.
48" RCP	15300 L.F.	98	1499400.
48" RCP	16300 L.F.	98	1597400.
39" RCP	18200 L.F.	76	1383200.
39" RCP	23500 L.F.	76	1786000.
42" RCP	11880 LF	83	986040
			~~7569400.~~ 8555440

City of Phoenix.

Total Facility Cost = 9124770.

30% Appurtenances = 2737431.

Subtotal = 11,862201

20% Engr. + Admin. = 2372440.

Total = 14,235000

City of Phoenix improvements

Facility Cost ~~7,569,400.~~ 8555440
30% Appurt. 2,270,820
Subtotal. 9840220
20% Eng + Ad. 1968044

$11808000.

Maricopa County Improvements

Facility Cost 1,555,370.
30% Appurt. 466611.
Subtotal 2021981.
20% Eng + Ad. 404396.

$2426377.

E125061
RB 3-23-87.

TABLE _____

ESTIMATED COSTS

DRAINAGE AREA 8

2-YEAR FREQUENCY STORM

	Str. No.	STRUCTURE	Design flow (cfs)	QUANTITY	UNIT COST		ESTIMATED COST
Facilities North of Bell Road	1	33" RCP	28	1680 L.F.	63.		106000.
	2	42" RCP	25	2640 L.F.	83.		219000
	3	21" RCP	15	2640 L.F.	23.		61,000
	4	24" RCP	18	1320 L.F.	39.		51000
	5	39" RCP	47	2640 L.F.	76.		201000
	6	30" RCP	12	1320 L.F.	55		73000
	7	30" RCP	12	3960 L.F.	55.		218000.
	8	30" RCP	12	1320 L.F.	55		73000.
	9	30" RCP	12	2640 L.F.	55.		145000.
							1,147,000. Maricopa County.
Facilities Along Bell Road	10	21" RCP	9	110 L.F.	23.		3000
	11	30" RCP	21	110 L.F.	55.		6000.
	12	30" RCP	20	110 L.F.	55.		6000.
	13	30" RCP	7	1320 LF	55.		73000.
	14	39" RCP	45	1320 LF	76.		100000.
	15	21" RCP	10	500 LF	23.		12000.
	16	36" RCP	39	1320 LF	69.		91000.
	17	39" RCP	51	1320 LF	76.		100000.
rev 5-5-87	18	18" RCP		2260 LF	15.	34000	~~21000.~~
		30" RCP		830 LF	55	45700	~~412,000~~
		42" RCP		860 LF	83	71000	Maricopa County. ~~Tot~~ 541700
Facilities South of Bell Road	19	48" RCP	68	13300 L.F.	98.		1303000.
	20	48" RCP	76	15300 L.F.	98.		1499000.
	21	42" ~~48"~~ RCP	48	16300 L.F.	83 ~~98~~.	1,353,000	~~1597000~~.
	22	39" RCP	61	18200 L.F.	76.		1383000.
	23	39" RCP 36"	43	23500 L.F.	69 ~~76~~.	1,622,000	~~1786000~~.
							City of Phoenix
		42" RCP	41	11880 LF	83		~~7568000~~. 7160,000
						986040	Subtotal ~~9127000~~ ~~8,719,000~~
30% Appurtenances		~~2,738,000~~.		2911500			
Subtotal		~~11,862,500~~.		12,616,500			$ 9,705,000
20% Engineering and Administration		~~2,373,000~~.		2,523,300			
Sub-Total		~~14,236,000~~.					
		15,139,800					

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-6400

Description: DA-9 'SKUNK CREEK
E123051 [illegible]
Calculated By: R.H Date: 9/10/86 Sheet No. 1
Checked By: _____ Date: _____ of 28

Area 1

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: 5501

Area: 1.33 square miles

Upstream Elevation: 2010 Hydraulic Length: 102,00 feet

Downstream Elevation: 1510 Slope: 0.0490 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See Outer Loop Subarea 11L

Weighted CN= 86

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.05 L= 1.93 mi Lc 0.47 mi	L= _____ ft CN= _____
S= 259 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.54 hours	Adjust Lag:

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123051 5502

Calculated By: R.H Date: 9/10/86 Sheet No. 2 of 28

Checked By: Date:

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 5502

Area 0.53 square miles

Upstream Elevation 1975 Hydraulic Length 6800 feet

Downstream Elevation 1510 Slope 0.0684 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer loop subarea 11K

Weighted CN= 85

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= 0.05 L= 1.29 mi Lc 0.44 mi	L= ft CN=
S= 361 ft/mi	S= % Lag= hours
Lag= 0.31 hours	Adjust Lag:

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Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123051 J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 3
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS03

Area 1.18 square miles

Upstream Elevation 2380 Hydraulic Length 9700 feet

Downstream Elevation 1510 Slope 0.0897 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer Loop subarea 11J

Weighted CN= 87

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.05 L= 1.84 mi Lc 0.85 mi	L= ft CN=
S= 473 ft/mi	S= % Lag= hours
Lag= 0.44 hours	
	Adjust Lag:

Greiner Engineering
Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123 OEL J0201
Calculated by: R.H Date: 9/10/86 Sheet No. 4 of 28
Checked by: Date:

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS04

Area 0.93 square miles

Upstream Elevation 1865 Hydraulic Length 10100 feet

Downstream Elevation 1510 Slope 0.0351 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer Loop Subarea 11J

Weighted CN= 85

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.05 L= 1.91 mi Lc 0.85 mi	L= ft CN=
S= 185 ft/mi	S= % Lag= hours
Lag= 0.53 hours	Adjust Lag:

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123OEL J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 5
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS05

Area 0.38 square miles

Upstream Elevation 1840 Hydraulic Length 6900 feet

Downstream Elevation 1510 Slope 0.0478 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer Loop Subarea 11H

Weighted CN= 85

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.05 L= 1.31 mi Lc 0.55 mi	L= ft CN=
S= 252 ft/mi	S= % Lag= hours
Lag= 0.37 hours	
	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-6400

Job: [illegible]
Description: E123061 J0501
Calculated By: R.H Date: 9/9/86 Sheet No. 6
Checked By: _____ Date: _____ of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: S506

Area: 3.05 square miles

Upstream Elevation: 1515 Hydraulic Length: 16,800 feet

Downstream Elevation: 1415 Slope: 0.0060 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer Loop
11G

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= 0.035 L= 3.18 mi Lc 1.42 mi	L= _____ ft CN= _____
S= 32 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.77 hours	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123OEI J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 1
Checked by: _____ Date: _____ of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS07

Area 1.57 square miles

Upstream Elevation 1515 Hydraulic Length 11,800 feet

Downstream Elevation 1410 Slope 0.0089 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer Loop Subarea 11F

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.035 L= 2.37 mi Lc 1.61 mi	L= ____ ft CN= ____
S= 44 ft/mi	S= ____ % Lag= ____ hours
Lag= 0.68 hours	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123068 J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 8
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: SS08

Area: 1.02 square miles

Upstream Elevation: 1515 Hydraulic Length: 13,200 feet

Downstream Elevation: 1400 Slope: 0.0087 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	27%	COP	IND. PK.		B	88	
	26%	COP	A-1		B	88	See after Loop 11E
	24%	M.C.	RE-43		B	80	
	12%	M.C.	IND-2		B	88	
	2	COP	RE-43		B	80	
	2	M.C.	IND-1		B	88	
	1	COP	PSC		B	95	
	1	COP	C-2		B	92	
	2	COP	C-2		B	92	
	2	COP	C-1		B	92	
	1	COP	RE-43		B	80	

Weighted CN= 86

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\,(L\,Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\,(1000/CN - 9)^{0.7}/1900\,S^{1/2}$
N= 0.035 L= 2.61 mi Lc 1.44 mi	L= ft CN=
S= 44 ft/mi	S= % Lag= hours
Lag= 0.68 hours	

Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123051 J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 9
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: SS09

Area: 0.45 square miles

Upstream Elevation: 1445 Hydraulic Length: 6000 feet

Downstream Elevation: 1405 Slope: 0.0057 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	21	COP	A-1		B	88	
	7	COP	C-2			92	
	4	COP	C-3			92	See outerloop
	39	COP	A-1			88	IID
	18	COP	C-3			92	
	11	COP	C-2			92	

Weighted CN= 90

Large or Elongated Watersheds

$Lag = 24n\,(L\,Lca/S^{0.5})^{0.38}$

N= 0.025 L= 1.52 mi Lc 0.57 mi

S= 26 ft/mi

Lag= 0.31 hours

Small, Uniform Watersheds

$Lag = L^{0.8}\,(1000/CN - 9)^{0.7}/1900\,S^{1/2}$

L= ft CN=

S= % Lag= hours

Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]

Description: E123051 J0501

Calculated by: R.H Date: 9/10/86 Sheet No. 10

Checked by: _____ Date: _____ of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS10

Area 0.26 square miles

Upstream Elevation 1425 Hydraulic Length 4500 feet

Downstream Elevation 1400 Slope 0.0056 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	25	COP	IND.PK.		B	88	
	9	↓	C-3		↓	92	see outer loop subarea 11C
	32		R-5			87	
	28		C-3			92	
	6		IND.PK.			88	

Weighted CN= 89

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.026 L= 1.0 mi Lc 0.57 mi	L= _____ ft CN= _____
S= 25 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.27 hours	
	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123068 J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 11
Checked by: _____ Date: _____ of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: SS11

Area: 0.06 square miles

Upstream Elevation: _____ Hydraulic Length: 1480 feet

Downstream Elevation: _____ Slope: 0.0049 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	COP	IND.PK.		B	88	

See outerloop Subarea 11B

Weighted CN= 88

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n $(L\ Lca/S^{0.5})^{0.38}$	Lag = $L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.028 L= 0.28 mi Lc 0.13 mi	L= _____ ft CN= _____
S= 26 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.10 hours	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123068 J0501
Calculated By: R.H Date: 9/10/86 Sheet No. 12 of 28
Checked By: Date:

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS12

Area 2.33 square miles

Upstream Elevation 1435 Hydraulic Length 17,000 feet

Downstream Elevation 1340 Slope .0056 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

see outerloop subarea 11A

Weighted CN= 83

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.031 L= 3.5 mi Lc 1.08 mi	L= [illegible] ft CN=
S= 77 ft/mi	S= [illegible] % Lag= [illegible] hours
Lag= 0.66 hours	Adjust Lag:

reiner
ngineering

Greiner Engineering
Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123 OEL [illegible]

Calculated by: R.H Date: 9/10/86 Sheet No. 13

Checked by: _____ Date: _____ of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 5513

Area .17 square miles

Upstream Elevation 1360 Hydraulic Length 3440 feet

Downstream Elevation 1340 Slope 0.0058 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer Loop
Subarea 12

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.026 L= 0.65 mi Lc 0.30 mi	L= _____ ft CN= _____
S= 31 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.17 hours	
	Adjust Lag:

Greiner Engineering
Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123 OEL J0201
Calculated by: R.H Date: 9/10/86 Sheet No. 14
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS14

Area 0.56 square miles

Upstream Elevation 1400 Hydraulic Length 8800 feet

Downstream Elevation 1320 Slope 0.0091 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer Loop
Subarea 13

Weighted CN= 83

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.031 L= 1.67 mi Lc 0.83 mi	L= ft CN=
S= 48 ft/mi	S= % Lag= hours
Lag= 0.40 hours	
	Adjust Lag:

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123OEL J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 15
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS15A

Area 0.12 square miles

Upstream Elevation _____ Hydraulic Length _____ feet

Downstream Elevation _____ Slope _____ feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See Outer Loop subarea 14A

Weighted CN= 85

Kinematic

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= _____ L= _____ mi Lc _____ mi	L= _____ ft CN= _____
S= _____ ft/mi	S= _____ % Lag= _____ hours
Lag= _____ hours	

Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123051 J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 16 of 28
Checked by: Date:

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS15B

Area 0.14 square miles

Upstream Elevation _____ Hydraulic Length _____ feet

Downstream Elevation _____ Slope _____ feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

SEE OuterLoop Subarea 14B

Weighted CN= 93

Large or Elongated Watersheds	Small, Uniform Watersheds (Kinematic)
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= _____ L= _____ mi Lc _____ mi	L= _____ ft CN= _____
S= _____ ft/mi	S= _____ % Lag= _____ hours
Lag= _____ hours	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]

Description: E123OEI J0501

Calculated by: R.H. Date: 9/10/86 Sheet No. 17 of 28

Checked by: _____ Date: _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: SS15C

Area: 0.06 square miles

Upstream Elevation: _____ Hydraulic Length: _____ feet

Downstream Elevation: _____ Slope: _____ feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

SEE OUTER LOOP SUBAREA 14C

Weighted CN= 93

Large or Elongated Watersheds	Small, Uniform Watersheds (Kinematic)
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= _____ L= _____ mi Lc _____ mi	L= _____ ft CN= _____
S= _____ ft/mi	S= _____ % Lag= _____ hours
Lag= _____ hours	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123068 J0501
Calculated by: TMO Date: 9/10 Sheet No. 18
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: 5516

2959

Area: 0.83 square miles

Upstream Elevation: 1340 Hydraulic Length: 12,500 feet

Downstream Elevation: 1278 Slope: 0.0050 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	60	COP	RE-43		B	79	
	40	Glendale	R1-10		B	82	

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{\frac{1}{2}}$
N= 0.035 L= 2.37 mi Lc 0.98 mi	L= ft CN=
S= 26.2 ft/mi	S= % Lag= hours
Lag= 0.30 hours	

Adjust Lag:

Greiner Engineering
Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123 OEL J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 19
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS17

Area 2.73 square miles

Upstream Elevation 1520 Hydraulic Length 19,400 feet

Downstream Elevation 1340 Slope 0.0093 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

see outer loop
Subarea 15 B

Weighted CN= 86

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.035 L= 3.67 mi Lc 1.89 mi	L= ft CN=
S= 49 ft/mi	S= % Lag= hours
Lag= 0.84 hours	
	Adjust Lag:

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Description: E123 OES J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 20
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS18

Area 1.22 square miles

Upstream Elevation 1340 Hydraulic Length 10,800 feet

Downstream Elevation 1290 Slope 0.0046 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

See outer loop Subarea 15A

Weighted CN= 94

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n.(L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= 0.02 L= 2.39 mi Lc 1.02 mi	L= ft CN=
S= 24 ft/mi	S= % Lag= hours
Lag= 0.35 hours	
	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job [illegible]
Description
E123058 J0501
Calculated by [illegible] Date 9/10/86 Sheet No. 21
Checked by Date of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS19

Area 0.47 square miles

Upstream Elevation 1290 Hydraulic Length 5300 feet

Downstream Elevation 1266 Slope 0.0045 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.35 Impervious	.80	Glendale	R1-10		B	82	
.40 Impervious	20	Glendale	M-P		B	88	

Weighted CN= 83

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= L= mi Lc mi	L= 5300 ft CN= 83
S= ft/mi	S= 0.45 % Lag= ~~1.63~~ 1.27 hours
Lag= hours	Adjust Lag:
	.36% Imp.
	(.78)(1.63) = 1.27

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job [illegible]
Description
E123068 J0501
Calculated by TMO Date 9/10/86 Sheet No. 22
Checked by [illegible] Date of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 5S20

Area 0.93 square miles

Upstream Elevation 1274 Hydraulic Length 6000 feet

Downstream Elevation 1247 Slope 0.0036 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.93	100		C-2		B	92	

Weighted CN= 92

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= L= mi Lc mi	L= ~~7600~~ 6000 ft CN= 92
S= ft/mi	S= 0.36 % Lag= ~~0.97~~ (1.43) hours
Lag= hours	1.43(.68)=0.97

Adjust Lag:
90% imp. w/ CN=92; L.F. ≐ 0.68
(FROM FIG 9.5)

0.68(1.73) = 1.18 Hrs

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123068 J0501
Calculated by: R.H. Date: 9/10/86 Sheet No. 23
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: SS21

Area: 0.68 square miles

Upstream Elevation: 1256 Hydraulic Length: 6200 feet

Downstream Elevation: 1236 Slope: 0.0032 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

see attached sheet

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= L= mi Lc mi	L= 6200 ft CN= 82
S= ft/mi	S= 0.32 % Lag= 2.27 / 1.40 hours
Lag= hours	Adjust Lag:
	30% Improved channel 40% Impervious (0.83)(.73)(2.27) = 1.40 hrs

SHT 24 of 28

FROM: DIBBLE & ASSOC.
PHX, ARROWHEAD RANCH

EAST HALF, SECTION 25

AREA NO.	AREA (MI.2)	CN		Tc (HOUR)	1 HOUR 100 YEAR (C.F.S.)	24 HOUR 100 YEAR (C.F.S.)
10	0.068	88	5.984	0.167	191	105
11	0.020	76	1.520	0.262	23	21
12	0.028	86	2.408	0.167	71	41
13	0.049	88	4.312	0.167	138	76
14	0.044	83	3.652	0.167	94	60
15	0.016	71	1.136	0.167	15	15
16	0.082	85	6.97	0.167	197	118
17	0.014	61	0.854	0.167	6	8
18	0.011	84	0.924	0.167	25	15
19	0.044	84	3.694	0.167	100	62
20	0.013	76	0.988	0.167	17	14
21	0.041	84	3.444	0.167	93	58
22	0.060	79	4.740	0.167	96	73
23	0.051	77	3.927	0.167	73	58
24	0.049	76	3.724	0.167	66	54
25	0.087	82	7.134	0.167	176	116
	0.677		55.413			

55.413 ÷ 0.677 = 81.85

USE CN = 82

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: E123068 J0501
Calculated by: R.H Date: 9/10/86 Sheet No. 25
Checked by: Date: of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: SS22

Area: 0.40 square miles

Upstream Elevation: 1247 Hydraulic Length: 4300 feet

Downstream Elevation: 1217 Slope: 0.0070 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	75	Glendale	SR-17		B	81	
	13	Glendale	RAD		B	81	
	12	Glendale	SR-12		B	81	

Weighted CN= 81

KINEMATIC

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= ____ L= ____ mi Lc ____ mi	L= ____ ft CN= ____
S= ____ ft/mi	S= ____ % Lag= ____ hours
Lag= ____ hours	

Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS 23

Area 0.23 square miles

Upstream Elevation 1266 Hydraulic Length 3200 feet

Downstream Elevation 1230 Slope 0.0113 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	5	Glendale	R1-10		B	82	
	25	Glendale	R-4		B	86	
	70	Glendale	SR-17		B	81	

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{\frac{1}{2}}$
N= 0.02 L= 1.28 mi Lc 0.47 mi	L= ft CN=
S= 28.1 ft/mi	S= % Lag= hours
Lag= 0.21 hours	

Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]

Description: E123068 J0501

Calculated by: R.H Date: 9/10/86 Sheet No. 27

Checked by: _____ Date: _____ of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: SS24

Area: 0.11 square miles

Upstream Elevation: 1230 Hydraulic Length: 2700 feet

Downstream Elevation: 1218 Slope: 0.0044 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	Glendale	P.A.D.			82	

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.02 L= 0.61 mi Lc 0.42 mi	L= _____ ft CN= _____
S= 19.7 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.16 hours	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job [illegible]

Description E123061 J0501

Calculated by TMO Date 9/10/86 Sheet No. 28

Checked by _____ Date _____ of 28

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation SS25

Area 0.20 square miles

Upstream Elevation 1294 Hydraulic Length 6800 feet

Downstream Elevation 1257 Slope 0.0054 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100	Glendale	P.A.D.		B	82	

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.02 L= 1.29 mi Lc 0.91 mi	L= _____ ft CN= _____
S= 28.4 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.27 hours	
	Adjust Lag:

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD E123061
Description: MUSKINGUM ROUTING CALC'S & ASSUMPTIONS
Calculated by: TMO Date: 9/10/86 Sheet No. 1
Checked by: _____ Date: _____ of 1

SKUNK CREEK / SCATTER WASH

≡ASSUMED VELOCITIES OF 10 FT/SEC≡

COMMAND (KK CARD)		DISTANCE (FT)	NSTPS	AMSKK (HRS)	X		
R014	(PARTIAL IMPROVEMENT)	12,500	2	0.35	0.1		
R015		11,500	2	0.32	0.1		
R016		10,000	2	0.28	0.1		
R019	RK	4500	0.0030	0.027	TRAP	80	4
R020		2500	1	0.08	0.3		
R021		1560	1	0.04	0.3		
R022	(PARTIAL IMP)	3360	1	0.09	0.1		
R023		1560	1	0.04	0.0		
R024	RK	3200	0.0053	0.016	TRAP	40	0
R025		3200	1	0.09	0.0		
R026	RK 4680	0.0041	0.027	TRAP	20	4	
R027		700	1	0.02	0		

CAVE CREEK ≡ASSUMED v = 10 FT/SEC

COMMAND (KK CARD)	DISTANCE (FT)	NSTPS	AMSKK (HRS)	X
R001	FROM O.LOOP STUDY	4	0.40	0.2
R002	1000	1	0.03	0
R003	1000	1	0.03	0
R004	4600	2	0.13	0
R005	2300	1	0.06	0
R006	2000	1	0.06	0
R007	1600	1	0.05	0
R008	1600	1	0.05	0

FORMULA: $AMSKK = \frac{\text{REACH LENGTH IN FT}}{(10\ \text{FT/SEC})(3600\ \frac{\text{SEC}}{\text{HR}})}$, $\frac{1}{2(1-X)} \le \frac{AMSKK \cdot 60}{\underset{(10)}{NMIN} * \underset{(1 \text{ to } 4)}{NSTPS}} \le \frac{1}{2X}$

*(NOT ALWAYS WITHIN LIMITS)

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Job [illegible]

Description DA-10 CAVE CK WASH

E123061 J0501

Calculated by ~~[illegible]~~ MC Date _____ Sheet No. 1

Checked by _____ Date _____ of 8

EXISTING

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~7B~~ CC01

Area 2.26 square miles

Upstream Elevation 2045 Hydraulic Length 16,000 feet

Downstream Elevation 1510 Slope 0.0334 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
1.48				EX		80	from outer
0.78						98	loop study

Weighted CN= 86

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.05 L= 3.03 mi Lc 1.7 mi	L= _____ ft CN= _____
S= 176 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.84 hours	
	Adjust Lag:

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Job [illegible]

Description E123061 J0501

Calculated by MC Date _____ Sheet No. 2

Checked by _____ Date _____ of 8

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~7C~~ CO2

Area 1.86 square miles

Upstream Elevation 1690 Hydraulic Length 17,700 feet

Downstream Elevation 1515 Slope 0.0099 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
1.67				EX		80	from outer loop study
0.19						98	

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.035 L= 3.35 mi Lc 1.14 mi	L= 17,700 ft CN= 82
S= 52 ft/mi	S= 0.99 % Lag= 2.99 hours
Lag= 0.66 hours	Adjust Lag:

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Job [illegible]

Description E123061 J0501

Calculated by MC Date _____ Sheet No. 3

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~P7A~~ CC03

Area 1.45 square miles

Upstream Elevation 1515 Hydraulic Length 14,500 feet

Downstream Elevation 1430 Slope 0.0059 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
1.45	100			Ex		81	from outfalls study

Weighted CN= 79

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{\frac{1}{2}}$
N= 0.05 L= 2.75 mi Lc 1.86 mi	L= 14,500 ft CN= 81
S= 235 ft/mi	S= 0.59 % Lag= 3.39 hours
Lag= 0.79 hours	

Adjust Lag:

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Job: [illegible]
Description: E123068 J0501
Calculated by: MC/[illegible] Date: _____ Sheet No. 4
Checked by: _____ Date: _____ of 8

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~P7D~~ C94

Area: 0.64 square miles

Upstream Elevation: 1550 Hydraulic Length: 8200 feet

Downstream Elevation: 1436 Slope: 0.0139 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100			Ex.		84	from outerloop study

Weighted CN= 84

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.035 L= 1.55 mi Lc 1.08 mi	L= 8200 ft CN= 84
S= 73 ft/mi	S= 1.39 % Lag= 1.28 hours
Lag= 0.45 hours	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: RH Date: Sheet No. 5
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~P6003~~ CC05

Area .30 square miles

Upstream Elevation 1438 Hydraulic Length 6100 feet

Downstream Elevation 1400 Slope 0.0062 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
		City of Phx.					
	20%		R-2	Ex.	A	77	1540
	80%		R1-8		A	72	5760
							7300

Weighted CN= 73

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.03 L= 1.15 m; Lc 0.58m;	L= 6100 ft CN= 73
S= 32.9 ft/m;	S= 0.62 % Lag= hours
Lag= 0.32 hours	
	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

Calculated by: RH Date: Sheet No. 6

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~Q600Z~~ CC6

Area: .12 square miles

Upstream Elevation: 1400 Hydraulic Length: 2000 feet

Downstream Elevation: 1388 Slope: 0.0060 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
		City of Phx.					
	65%		R1-6	Ex.	A	75	4875
	35%		R1-8		A	72	2520
							7395

Weighted CN= 74

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= L= m; Lc m;	L= 2000 ft CN= 74
S= ft/m;	S= 0.60 % Lag= 0.85 hours
Lag= hours	
	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

Calculated by: RH/JMO Date: _____ Sheet No. 7

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~Q600+~~ C07

Area: .08 square miles

Upstream Elevation: 1390 Hydraulic Length: 3900 feet

Downstream Elevation: 1367 Slope: 0.0059 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
		City of Phx.					
	5%		R-3A	Ex.	A	78	390
	10%		R1-6		A	75	750
	85%		R1-8		A	72	6120
							7260

Weighted CN= 73

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= 3900 ft CN= 73
S= _____ ft/m;	S= 0.59 % Lag= 1.51 hours
Lag= _____ hours	

Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY

Description: E123061 J0501

Calculated by: RH Date: Sheet No. 8

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~P6004~~ CC8

Area: .02 square miles

Upstream Elevation: 1380 Hydraulic Length: 2500 feet

Downstream Elevation: 1367 Slope: 0.0052 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100%		R1-8	Ex.	A	72	

Weighted CN= 72

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.03 L=0.47 mi Lc 0.24 mi	L= 2500 ft CN= 72
S= 27.7 ft/mi	S= 0.52 % Lag= hours
Lag= 0.17 hours	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: DA-10 CAVE CREEK WASH
E123061 J0501
Calculated by: R.H Date: 9/9/86 Sheet No. 1
Checked by: _____ Date: _____ of 8

Area 10

FUTURE

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation CC01

Area 2.26 square miles

Upstream Elevation 2045 Hydraulic Length 16,000 feet

Downstream Elevation 1510 Slope 0.0334 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	34		RE-43	UNDEV.	D	98	future
	66		RE-43	UNDEV.	B	80	future

Weighted CN= 86

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= .05 L= 3.03 mi Lc 1.7 mi	L= _____ ft CN= _____
S= 176 ft/mi	S= _____ % Lag= _____ hours
Lag= .84 hours	Adjust Lag:

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Job: [illegible]
Description: E123OEI J0501
Calculated By: R.H Date: 9/9/86 Sheet No. 2 of 8
Checked By: _____ Date: _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: CC02

Area: 1.86 square miles

Upstream Elevation: 1690 Hydraulic Length: 17,700 feet

Downstream Elevation: 1515 Slope: .0099 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	10		RE-43	UNDEV.	D	98	Future
	90		RE-43	UNDEV	B	80	

Weighted CN= 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= .035 L= 3.35 mi Lc 1.14 mi	L= _____ ft CN= _____
S= 52 ft/mi	S= _____ % Lag= _____ hours
Lag= .66 hours	

Adjust Lag:

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Job: [illegible]
Description: E123068 J0501
Calculated by: R.H. Date: 9/9/86 Sheet No. 3
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: CC03

Area: 1.45 square miles

Upstream Elevation: 1515 Hydraulic Length: 14,500 feet

Downstream Elevation: 1430 Slope: .0059 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	50		RE-43		B	79	Future
	10		RE-43		D	89	
0.44	30		IND.PK.		B	88	
0.14	10		IND.PK.		D	93	

Subarea = 0.58 mi² w/CN = 89

Weighted CN= 84

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\,(L\,Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\,(1000/CN - 9)^{0.7}/1900\,S^{1/2}$
N= .05 L= 2.75 mi Lc 1.86 mi	L= ____ ft CN= ____
S= 235 ft/mi	S= ____ % Lag= ____ hours
Lag= .79 hours	Adjust Lag:

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Job: [illegible]

Description: E123OEL J0501

Calculated by: R.H Date: 9/9/86 Sheet No. 4 of 8

Checked by: _____ Date: _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation CC04

Area 0.64 square miles

Upstream Elevation 1550 Hydraulic Length 8200 feet

Downstream Elevation 1436 Slope 0.0139 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	70		RE-43		B	79	future
	30		RE-43		D	95	

Weighted CN= 84

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= .035 L= 1.55 mi Lc 1.08 mi	L= _____ ft CN= _____
S= 73 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.45 hours	
	Adjust Lag:

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Job: [illegible]
Description: E123061 J0501
Calculated by: R.H. Date: 9/9/86 Sheet No. 5
Checked by: _____ Date: _____ of 8

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: CC05

Area: .30 square miles

Upstream Elevation: 1438 Hydraulic Length: 6100 feet

Downstream Elevation: 1400 Slope: .0062 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.06	20		R-2		A	77	
0.24	80		R1-8		A	72	

Weighted CN= 73

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= 0.03 L= 1.15 mi Lc 0.58 mi	L= ____ ft CN= ____
S= 32.9 ft/mi	S= ____ % Lag= ____ hours
Lag= 0.32 hours	Adjust Lag:

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Job: [illegible]
Description: E123051 J0501
Calculated By: R.H Date: 9/9/86 Sheet No. 6 of 8
Checked By: _____ Date: _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation CC06

Area .12 square miles

Upstream Elevation 1400 Hydraulic Length 2000 feet

Downstream Elevation 1380 Slope .0060 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
(0.65)(.50)+(0.35)(50)	65		R1-6		A	75	future
.50	35		R1-8		A	72	

Weighted CN= 74

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ mi Lc _____ mi	L= 2000 ft CN= 74
S= _____ ft/mi	S= 0.60 % Lag= 0.85 ~~0.425~~ hours
Lag= _____ hours	Adjust Lag:
	(.50)(.85) = 0.~~425~~ .43

Greiner Engineering

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Phoenix: 602 275-5400

Job: [illegible]
Description: E123061 J0501
Calculated by: R.H Date: 9/9/86 Sheet No. 7 of 8
Checked by: _____ Date: _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: CC07

Area: .25 square miles

Upstream Elevation: 1390 Hydraulic Length: 3900 feet

Downstream Elevation: 1367 Slope: .0059 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
(.85)(.50)+(.10)(.50)	85		RI-8	DEV.	A	72	future
+(.05)(.65) = .51	10		RI-6	DEV.	A	75	
0.02	5		R-3A	DEV.	A	72	

Weighted CN= 73

Large or Elongated Watersheds

$Lag = 24n\,(L\,Lca/S^{0.5})^{0.38}$

N= _____ L= _____ mi Lc _____ mi

S= _____ ft/mi

Lag= _____ hours

Small, Uniform Watersheds

$Lag = L^{0.8}\,(1000/CN - 9)^{0.7}/1900\,S^{\frac{1}{2}}$

L= 3900 ft CN= 73

S= 0.59 % Lag= ~~0.77~~ 1.51 hours

Adjust Lag:

(.51)(1.51) = .77

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Job: [illegible]

Description: E123OEL J0501

Calculated by: R.H Date: 9/9/86 Sheet No. 8

Checked by: _____ Date: _____ of 8

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation CC08

Area .02 square miles

Upstream Elevation 1380 Hydraulic Length 2500 feet

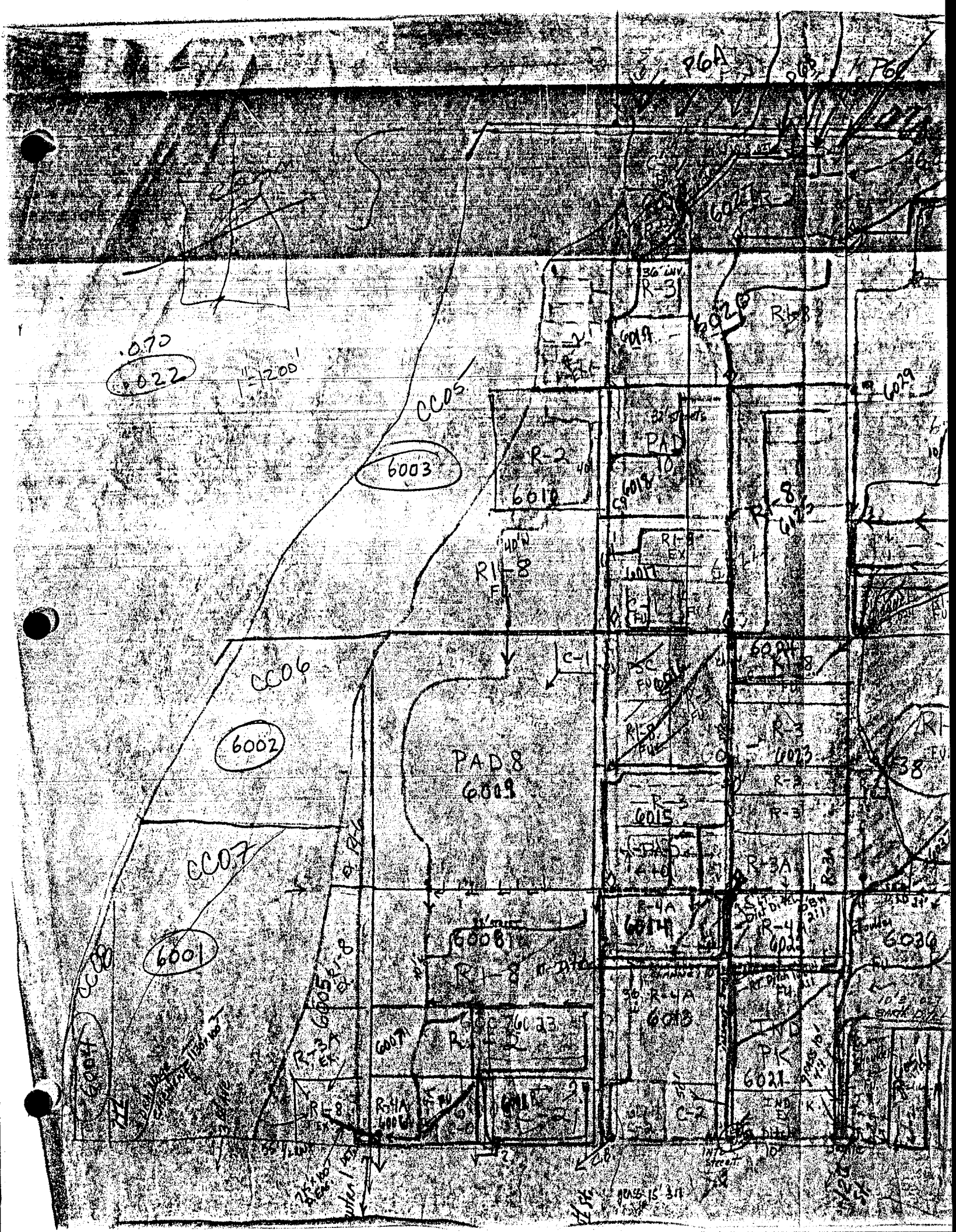
Downstream Elevation 1367 Slope .0052 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
	100		R1-8		A	72	

Weighted CN= 72

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.03 L= 0.47 mi Lc 0.24 mi	L= _____ ft CN= _____
S= 27.7 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.17 hours	
	Adjust Lag:


.070
.022
1"=1200'
CC05
6003
R-2
6010
PAD
10
6018
R1-8
6019
6029
R-3
6023
R-3
6015
R-3A
R-4A
6014
R-4A
6023
R-4A
6013
6030
PAD 8
6009
CC06
6002
CC07
6001
6008
R1-8
6005
R-3
6007
6004
IND
PK
6021
C-2
R-3
R-3A
R-4A
R-4A
R-3
R-3
R-3