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Arroyo
Flood
Control
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Post-it® Fax Note 7671	Date 8-1	# of pages ▶ 1
To BRAD BINGHAM	From LYNN MAZUR	
Co./Dept. HYDROLOGY	Co. AMAFCA	
Phone #	Phone #	
Fax #	Fax #	

File

August 1, 2005

Mr. John MacKenzie, P.E.
D. Mark Goodwin & Associates, P.A.
P.O. Box 90606
Albuquerque, NM 87199

Re: Arroyo Vista Subdivision Drainage Management Plan, ZAP A-10
Engineer's Stamp Dated July 25, 2005

Dear Mr. MacKenzie:

AMAFCA has reviewed the referenced report and Grading and Drainage Plan with respect to proposed improvements in the Calabacillas Arroyo. AMAFCA agreed to maintain the improvements per the Turnkey and Funding Agreement dated March 17, 2005. We also agreed to use the hydraulic analysis for the Calabacillas Arroyo improvements prepared by Mussetter Engineering, Inc., (MEI) March 2005.

AMAFCA does not approve the subdivision for Preliminary Plat. There appear to be some discrepancies between the proposed arroyo improvements on the Grading and Drainage Plan and the recommended improvements in the MEI report. More specifically, structures S5L, S6L and S7L were omitted. These structures must be included in the plan, or a new hydraulic analysis of the arroyo will be required. AMAFCA would also like to see the improvements listed per structure on the Infrastructure List. It would be helpful, also, to include an overall small-scale drawing of the subdivision adjacent to the arroyo with the arroyo improvements shown and labeled consistent with the MEI report.

If you have any questions, please call me at 884-2215.

Sincerely,
AMAFCA

Lynn M. Mazur

Lynn M. Mazur, P.E., C.F.M.
Development Review Engineer

Cc: Brad Bingham, City Hydrology

RAINBOW TRIBUTARY OF THE CALABACILLAS ARROYO

DRAINAGE MANAGEMENT PLAN

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RAINBOW TRIBUTARY OF THE CALABACILLAS ARROYO
DRAINAGE MANAGEMENT PLAN

March 2004

This Drainage Management Plan (DMP) is for the Rainbow Tributary of the Calabacillas Arroyo. The study area encompasses approximately 900 acres extending 2.4 miles north of Southern Boulevard and is located east of Rainbow Boulevard. The DMP location is shown on Figures 1 and 2. Details of development of the DMP and technical data are included in the separately bound Technical Appendix.

I. Objectives/Goals:

A. Correct/Resolve Existing Facility Deficiencies

1. Vancouver to Pecos Loop Channel Freeboard. This is a minor freeboard deficiency for existing flows with adequate bank-full capacity to convey the 100-year runoff rate of 540 cfs.
2. Pecos Loop Crossing Freeboard. The existing 100-year flow equals bank full capacity with the water surface at the property line. Increased upstream runoff will potentially flood private property at this crossing.
3. Rainbow Park Channel Stability. The existing natural channel erodes and meanders within the undeveloped portion of the park and does not currently endanger structures other than park sidewalk, paving, etc.
4. Basin 71A Storm Drain just west of the Rainbow culvert outfalls directly onto Southern Blvd. exceeding the local street capacity.

B. Remove existing developed properties and areas subject to development from FEMA flood hazard areas. See Approximate FEMA flood hazard limits on Figure 2.

1. Existing Floodplain – Inca Rd to Vancouver Rd. This is approximately 450' wide and encompasses approximately 27 properties.
2. Vancouver Rd to Southern Blvd – The FEMA floodplain is contained within the channel ROW.

C. Improve conveyance between Inca Road and Vancouver Road.

1. Reduce culvert sizes at Inca, Tulip and Idalia Rd. crossings.
2. Minimize potential conflicts with existing utilities. Two large diameter (16" and 20") gas lines cross the flow path at Idalia Rd.

D. Identify a Drainage Management Plan for the undeveloped area north (upstream) of Inca Road.

II. Criteria

The DMP is based on the following City/SSCAFCA criteria, constraints and assumptions.

A. Protect existing and downstream facilities.
   1. Include provision for eventual non-erosive conveyance of runoff.
   2. Avoid diversion of runoff without constructed downstream facilities.
   3. Consider probable development sequences and funding constraints.

B. Hydrology
   1. 100-year 24-hour return frequency design storm.
   2. Land use coefficients based on existing platting with full development and paved streets.
   3. Residential properties are assumed to discharge without detention ponding.
   4. SSCAFCA adopted AHYMO land use parameters.
   5. Bulking factor of 6%.

C. Stormwater Quality
   1. Include interception and treatment of the first 0.25" of runoff in detention facilities where runoff is conveyed through a detention basin.
   2. Incorporate debris removal in detention basins.

III. Alternates

An initial evaluation determined that the existing channel and crossing structures from Vancouver Rd. to Southern Blvd. were adequate for existing conditions, but inadequate to accept increased runoff from further development. This evaluation also determined that reduction of the peak runoff rate from the basin area upstream of Vancouver was preferable to re-constructing the existing channel between Vancouver Rd. and Southern Blvd. and re-constructing the crossing culverts at Pecos Loop and Southern Blvd.

Five alternates were defined and evaluated to accomplish the flow rate reduction using detention ponds upstream of Inca Rd. These alternates are illustrated and summarized on Figures 3 through 7 and Tables 2, 3 and 4. Technical data is defined in the separately bound Technical Appendix. Based on input from the City, it was determined that only the "Local" alternate (Figure 3) and the "Regional #1" Alternate (Figure 4) met City requirements. The Regional #2 and Regional #3 Alternates depend on controlling street runoff using water blocks at intersections. Due to the unknown sequence and time table for paving the

streets, the use of water blocks was discarded. The "No Pond" Alternate was discarded as too expensive and did not meet the DMP criteria.

The "Local" Alternate was selected based on lowest cost. The "Local" Alternate conceptual cost is approximately $2.6 million, about one-half the cost of the Regional #1 Alternate. The local pond outfall rates are significantly less than the "no pond" discharge resulting in reduced conveyance costs.

The "Local" Alternate utilizes four local public ponds upstream of Inca Rd. to limit the discharge into the lower portion of the basin. This is the proposed plan as summarized on Table 1 and on Figure 3. Table 1 identifies the project objectives and criteria as listed above, with the associated DMP element proposed to meet that objective/criteria.

Street paving is recommended for non-erosive conveyance of runoff but is not included in the overall drainage system project. The drainage system will function without stable non-erosive street conveyance but the streets will erode with the associated continuing maintenance.

IV. Drainage Management Plan

The proposed Drainage Management Plan is as follows:

A. Adoption of DMP by the Governing Bodies of Rio Rancho and SSCAFCA.

B. Establish guidelines and implement a "Temporary New Development Runoff Restriction Zone" for all property draining to the Pecos Loop crossing. This is required due to the existing capacity deficiency at the Pecos Loop crossing. Also,the Southern Blvd. crossing culvert is at design capacity. The "Temporary New Development Runoff Restriction Zone" will be required until a portion of the Rainbow Dam system is constructed and operational to restrict the flow rate to the existing system capacity.
A limit of one-half cfs per acre (0.5 cfs/ac) peak discharge rate is proposed for all new development in this zone, including street areas. With this limitation in place, the 100 year peak discharge at Pecos Loop is approximately 380 cfs, equal to the crossing capacity with design freeboard.

C. Eliminate the FEMA floodplain on private property, Inca Road to Vancouver Road.
   1. Acquire ROW – 1.4 acres+/-
   2. Construct Inca to Vancouver conveyance swale and 42", 54" and 60" storm drain - $442,000 (note; See Appendix 'G' for cost data) The combination swale and storm drain geometry should be investigated at the time of implementation to define the optimum system.

3. Prepare and obtain approval of CLOMR/LOMR documents to remove FEMA flood hazard area.

D. Implement Rainbow Dam system in phases, as funds allow and as development occurs. Limit future discharges to downstream facility capacity. Start at the downstream end and incorporate multiple use and stormwater quality considerations. $2,204,000 Total

1. Inca Pond P-40 – 2.8 acres, 6.9 AF
2. Inca Rd to Sandia Blvd. - 30" storm drain.
3. Sandia Pond P-33 – 5.7 acres, 15.3 AF
4. Sandia to 5th Ave - 18" and 30" storm drain.
5. 5th Ave Pond P-20 – 4.4 acres, 17.0 AF
6. 5th Ave to 9th Ave - 18" and 30" storm drain
7. 9th Ave Pond P-10 – 4.8 acres, 10.7 AF
8. Acquire 1 acre ROW and construct swale 9th Ave to 10th Ave w/ Northern Blvd. crossing.

E. Implement Improvements downstream of Vancouver Rd. $255,000.

1. Construct channel freeboard upgrade, Vancouver Road to Pecos Loop to correct existing deficiency and to match downstream facility capacity.
2. Construct Park/Landscape channel below Pecos Loop (in conjunction with Rainbow Park development).
3. Construct Basin R71A outfall diversion from Southern Blvd. to Rainbow Tributary.

F. As development occurs, pave streets to provide non-erosive conveyance. These costs are not included. Phase to match development.

TABLE 1
RAINBOW TRIBUTARY DMP FACILITY SUMMARY

OBJECTIVE/GOAL		PROPOSED DMP ELEMENT	
A.	Existing Conditions Deficiencies		
A1 & A2	Pecos Loop Crossing inadequate, Inadequate channel freeboard, Vancouver to Pecos Loop	1.	Temporary limit all new development upstream of Pecos Loop to 0.5 cfs/acre. (Until Rainbow Dam System operational) Priority–High. Required prior to any additional development upstream of Pecos Loop
		2.	Upgrade channel and crossing freeboard. Priority– Medium.
		3.	Rainbow Dam system to reduce future flows to upgraded capacity. (Phase to match development pace) Priority–High.
A3.	Rainbow Park Channel Unstable		When park develops, stabilize with low flow channel and reinforced turf overbank flow. Priority-Low/Future.
A4.	Basin 71A Outfalls directly onto Southern.		Storm drain from existing outfall to Rainbow Channel. Priority–Low/Future.
B1 & B2	FEMA Floodplain – Inca Road to Vancouver Road	1.	50' ROW, storm drain and conveyance swale. Priority–High.
		2.	Rainbow Dam System – reduces future flows to SD/swale capacity. Priority–High.
C1 & C2	Minimize culvert sizes, Inca to Vancouver Roads	1.	Rainbow Dam system reduces future flow to SD/swale capacity. Priority–High.
D.	System for managing watershed upstream of Inca Road.	1.	Four local pond "Rainbow Dam System" mitigates the downstream effect of increased runoff due to upstream development. Priority – High.
		2.	Storm drain conveyance for "clean water" pond outfall flows between ponds. Priority – High.
		3.	Local surface conveyance in streets – future paving to provide non-erosive conveyance. Not part of drainage system. Priority-Low/Future
		4.	ROW, shallow swale conveyance and crossing of Northern Blvd. between 9th Ave and 10th Ave. Priority-Low/Future

Note: See Section I for listing of Objectives and Goals

TABLE 2
CONCEPTUAL COST ESTIMATE SUMMARY
RAINBOW TRIBUTARY DMP

ALTERNATE	CONSTRUCTION COST	ROW / EASEMENT COST	ROW / EASEMENT ACRES	TOTAL
'LOCAL' ALTERNATE	$2,902,000.00	$582,000.00	19.4	$3,484,000.00
'REGIONAL 1' ALTERNATE	$4,598,000.00	$567,000.00	18.9	$5,165,000.00
'REGIONAL 2' ALTERNATE	$5,004,000.00	$567,000.00	18.9	$5,571,000.00
'REGIONAL 3' ALTERNATE	$3,997,000.00	$699,000.00	23.3	$4,696,000.00
'NO PONDS' ALTERNATE	$6,806,000.00	$120,000.00	4.0	$6,926,000.00

Note, see Techncial Appendix for detailed cost data.

TABLE 3
FLOW RATE SUMMARY (100 Yr/24 Hr Storm)
RAINBOW TRIBUTARY DRAINAGE MANAGEMENT PLAN

LOCATION	EXISTING CONDITIONS			- DEVELOPED CONDITIONS -									
				'LOCAL' FIGURE 3		'REGIONAL #1' FIGURE 4		'REGIONAL #2' FIGURE 5		'REGIONAL #3' FIGURE 6		'NO POND' FIGURE 7	
	EXISTING FLOW	EXISTING CAPACITY	EXISTING SYSTEM	FLOW	SYSTEM	FLOW	SYSTEM	FLOW	SYSTEM	FLOW	SYSTEM	FLOW	SYSTEM
10th Ave to Northern		NA	Overland	140 cfs	48" SD	140 cfs	48" SD	140 cfs	Swale	140 cfs	Swale	140 cfs	48" SD
5TH St below 5th Ave.		NA	Overland	5 cfs	18" SD	737 cfs	90" SD	524 cfs	54" SD	524 cfs	54" SD	737 cfs	90" SD
4th St below Sandia		NA	Overland	47 cfs	30" SD	1016 cfs	96" SD	574 cfs	60" SD	574 cfs	60" SD	1016 cfs	96" SD
Inca Rd. crossing		NA	Overland	72 cfs	42" SD	184 cfs	54" SD	165 cfs	54" SD	38 cfs	Swale & 24"	1465 cfs	30' BW Ch
Tulip Rd. crossing		39 cfs	3-18" CMP	148 cfs	54" SD	186 cfs	54" SD	165 cfs	54" SD	52 cfs	Swale & 24"	1595 cfs	30' BW Ch
Vancouver Rd. crossing	368 cfs	Overland	Overland	220 cfs	60 " SD	203 cfs	60 " SD	178 cfs	60 " SD	115 cfs	Swale & 24"	1595 cfs	30' BW Ch
Channel Reach 4	368 cfs	125 cfs	Grade Cont.	280 cfs	1' Upgrade	246 cfs	1' Upgrade	314 cfs	1' Upgrade	195 cfs	1' Upgrade	1700 cfs	30' BW Ch
Channel Reach 5	425 cfs	200 cfs	PCC Sides	290 cfs	1' Upgrade	300 cfs	1' Upgrade	323 cfs	1' Upgrade	261 cfs	1' Upgrade	1745 cfs	30' BW Ch
Pecos Lp crossing	425 cfs	380 cfs	4- 48" CMP	345 cfs	4- 48" CMP	352 cfs	4- 48" CMP	460 cfs	4- 48" CMP	319 cfs	4- 48" CMP	1745 cfs	30' BW CBC
Rainbow Park Channel	425 - 540 cfs	NA	natural	430 cfs	channel	437 cfs	channel	465 cfs	channel	405 cfs	channel	1855 cfs	30' BW Ch
Southern Blvd. crossing	540 cfs	540 cfs	4- 48" CMP	452 cfs	4- 48" CMP	455 cfs	4- 48" CMP	548 cfs	4- 48" CMP	428 cfs	4- 48" CMP	1875 cfs	30' BW CBC

Footnotes:
Capacity @ design freeboard.
2' freeboard at grade controls
Storm Drain (SD) sizes based on Mannings n value of 0.13
Paved street conveyance required for all alternates.

TABLE 4
POND SUMMARY
RAINBOW TRIBUTARY DRAINAGE MANAGEMENT PLAN
(100 Yr/24Hr Storm)

'LOCAL' POND ALTERNATE							
Location	SWQ Area	Inflow	Outflow	Total Volume	SWQ Volume	Total Footprint	SWQ Footprint
Pond P10	124 acres	349 cfs	5 cfs	10.7 AF	2.6 AF	3.3 Ac	1.5 Ac
Pond P20	181 acres	409 cfs	5 cfs	17.0 AF	3.8 AF	6.3 Ac	2.2 Ac
Pond P33	189 acres	448 cfs	47 cfs	15.3 AF	4.0 AF	5.7 Ac	2.3 Ac
Pond P40	120 acres	310 cfs	72 cfs	6.9 AF	2.5 AF	2.8 Ac	1.4 Ac

'REGIONAL #1' POND ALTERNATE							
	SWQ Area	Total Inflow	Outflow	Total Volume	SWQ Volume	Total Footprint	SWQ Footprint
P40 Dam	614 Acres	1465 cfs	184 cfs	42 AF	12.8 AF	16.2 Ac	7.4 Ac

'REGIONAL #2' POND ALTERNATE							
	SWQ Area	Total Inflow	Outflow	Total Volume	SWQ Volume	Total Footprint	SWQ Footprint
P40 Dam	577 Acres	1156 cfs	165 cfs	38 AF	12.0 AF	16.0 Ac	7.0 Ac

'REGIONAL #3' POND ALTERNATE							
		-DEVELOPED CONDITIONS-(ULTIMATE)					
	SWQ Area	Total Inflow	Outflow	Total Volume	SWQ Volume	Total Footprint	SWQ Footprint
P40 Dam	614 Acres	1245 cfs	5 cfs	57 AF	12.8 AF	22 Ac.	7.4 Ac

SWQ - Storm Water Quality
SWQ Area - The upstream area not captured by an upstream SWQ facility.
SWQ Volume - The volume equal to 0.25" of runoff from the SWQ area.

APPENDIX 'D'
DRAINAGE PLAN DEVELOPMENT

RAINBOW TRIBUTARY
OF THE CALABACILLAS ARROYO

DRAINAGE MANAGEMENT PLAN

I. INTRODUCTION

This appendix summarizes the development of the Drainage Management Plan (DMP) for the Rainbow Tributary of the Calabacillas Arroyo in Rio Rancho, New Mexico. This study was performed for the City of Rio Rancho, New Mexico and the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA) by ASCG Incorporated *of New Mexico.*

This Appendix accompanies the Drainage Management Plan published as a separate document. Figures are in the DMP document.

A. OBJECTIVES

The DMP is to identify a system of conveyance and flood control facilities within this basin that will mitigate existing drainage deficiencies and serve as a basis for future development.

The primary goals of the DMP are:

- Remove existing developed properties and areas subject to development from FEMA flood hazard zones.
  - Existing Floodplain – Inca Rd to Vancouver Rd.

- Correct Existing Deficiencies.
  - Vancouver to Pecos Loop Channel Freeboard
  - Pecos Loop Crossing Freeboard

- Rainbow Park Channel Stability

- Basin 71A Storm Drain outfall onto Southern Blvd.

- Improve conveyance between Inca Road and Vancouver Road.
  - Reduce culvert sizes at Inca, Tulip and Idalia Rd. crossings consistent with minimizing potential conflicts with existing utilities.

- Identify a basin management plan upstream of Inca Road.

B. CRITERIA, CONSTRAINTS AND ASSUMPTIONS

The criteria, constraints and assumptions developed for this DMP, in conjunction with the City and SSCAFCA, include the following:

1. Hydrology:
   a. Methodology – AHYMO_97
   b. Design Storm - 100 year 24 hour event.
   c. Developed conditions land uses – In accordance with existing platting, SSCAFCA AHYMO land use parameters and current City requirements. Full build out with paved streets/roads.
   d. Residential properties are assumed to discharge without detention.

2. Roadways/Streets:
   a. 100-year storm - street flow within public ROW.
   b. 10 year - flow depth times velocity less than 6.5.
   c. 10 year - one lane open for arterials and collectors.
   d. Non-erosive flow. The study recognizes that street paving is ultimately required to meet this goal. However, the drainage system improvements must be able to function without paved streets.

3. Arterial, collector and other major streets within the study limits include Southern Boulevard, Tulip/Idalia/Inca Corridor (one or more of these), Sandia Boulevard, and Northern Boulevard.

4. Stormwater Quality Enhancement (SWQ):
   a. Intercept and treat first 0.25" of runoff.
   b. Incorporate NPDES Phase II Permit requirements.

5. Multiple-Use:
   a. Consider multi-use planning for detention facilities.
   b. Consider trail extensions along channels.

II. EXISTING DRAINAGE SYSTEM

A. OVERVIEW

The study area encompasses approximately 900 acres north of Southern Boulevard and east of Rainbow Boulevard and is shown on Figure E-1.

The area extends approximately 2.4 miles north of Southern Blvd. The Rainbow Tributary drains to the Calabacillas Arroyo, which drains to the Rio Grande south of the

Bernalillo/Sandoval County line. The lower third of the study area, from Vancouver Road to Southern Boulevard, is essentially fully developed with development pressure on the middle and northern portions. The entire drainage basin is subdivided with individual owners of lots, and therefore potential random development.

The arroyo south of Southern Boulevard is unimproved with the exception of primitive graded streets and the area is currently mostly undeveloped. Between Southern Boulevard and Vancouver Road, the conveyance is a manmade channel with some slope stabilization. Between Vancouver Road and Tulip Road, one 18" CMP culvert conveys flow. Three 18" CMP culverts sized to convey existing conditions cross under Tulip Road. North of Tulip Rd, the area is essentially undeveloped with primitive graded streets and the arroyo conveyance is a natural swale without a clearly defined channel.

B. DESCRIPTION

The existing Rainbow Tributary system, drainage sub-basins and approximate mapped floodplain limits are shown graphically on Figure 2. The existing system between the headwaters of the drainage basin to Southern Boulevard consists of six distinct reaches:

1. Reach 1 – Headwaters north of Northern Boulevard to Inca Road, approximately 9000 feet. This reach is undeveloped with overland flows. The area between Inca Road and Northern Boulevard was previously platted with long blocks (2000' – 3000') running north/south, the general flow direction, at a slope of approximately 1%.

2. Reach 2 – Inca Road to Tulip Road, approximately 800 ft. This reach is undeveloped. The flow path is poorly defined overland flow with a small incised arroyo. Inca Road and Idalia Road are dirt roads cutting across this flow path. Adjacent to the Idalia ROW are two large (16" & 20") natural gas pipelines. A third pipeline is currently out of service. Reach 2 is the upper limit of the existing mapped FEMA Floodplain.

3. Reach 3 – Tulip Rd to Vancouver Road, approximately 350 feet. Tulip Road was recently paved. The crossing consists of 3 – 18" CMP culverts with end sections. Downstream, a single 18" CMP culvert extends to just above Vancouver Road and discharges onto the street. The development between Tulip Road and Vancouver Road is approximately 50% built out with multi-family duplexes and apartments.

4. Reach 4 – Vancouver Road to start of concrete channel, approximately 1500 feet. At Vancouver Road, a concrete rundown collects flows at this low point in the roadway and directs it south into an earthen channel. The channel bottom is approximately 30 feet wide with 3:1 side slopes and is approximately 5 feet deep. Concrete grade control structures with a height of 3 feet are spaced at

approximately 100 feet. The grade control structures at the upper end have some local erosion. The areas adjacent to this reach are fully developed residential.

5. Reach 5 – From concrete slope protection to Pecos Loop, approximately 600 feet. This portion has concrete lined 2:1 side slopes, an earthen bottom width of 30 feet, and the concrete lining is 3 feet high. Concrete grade control structures in the bottom are spaced at approximately 100 feet within this reach. The culvert crossing at Pecos Loop is 4–48" corrugated metal pipes (CMP) with a concrete headwall and apron, all in good condition. Rundowns on both sides of Pecos Loop direct street flow into the channel upstream and downstream of the crossing. The areas adjacent to this reach are fully developed residential.

6. Reach 6 - Pecos Loop to Southern Boulevard, approximately 1200 feet. This reach is through an undeveloped portion of the Rainbow Park. The conveyance is a natural earthen channel with varying widths ranging from 2 feet to 10 feet and depths ranging from 6 inches to 3 inches, partially choked with vegetation. Over-bank flow areas are available in the undeveloped park area for conveyance in large storms. With the exception of Rainbow Park, the areas adjacent to this reach are fully developed residential. Rainbow Park includes paved parking and activity areas as well as a large grassed playing field. The culvert crossing at Southern Boulevard consists of 4 - 48" corrugated metal pipe (CMP) culverts with concrete headwall and concrete apron, with minimal siltation. The exposed concrete is deteriorated in some areas. The drainage from the residential area to the west (Basin R71A, Figure 2) drains directly onto Southern Boulevard via 3- 18" pipes. This may be a potential location of local flooding of Southern Boulevard in a major storm event.

B. FLOODPLAIN

The channel system from Inca Road to Southern Boulevard is within the 100 year floodplain as shown on the FEMA Flood Insurance Rate Map (FIRM) No. 35043C0900 dated July 16, 1996. The approximate floodplain limits are shown on Figure 2. As shown, the floodplain limit between Vancouver Road and Inca Road is approximately 450' wide, encompassing approximately 27 individual platted properties. Between Vancouver Road and Southern Boulevard, the 100 year flood hazard is contained within the channel right-of-way. The area north of Inca road was not included in the study identifying the flood hazard areas and is not mapped. This does not imply that flood hazard areas are absent from this area. Base flood elevations are not provided for these reaches on the FIRM map.

The flood hazard limits on the FIRM are from a Letter of Map Revision (LOMR) prepared for the City and accepted by FEMA (RD#1). The LOMR study also identifies existing channel and crossing culvert capacities utilized in this DMP.

This area should be re-assessed and the floodplain mapping revised as the DMP improvements are implemented. As programmed, one of the initial DMP efforts is to

purchase ROW and construct conveyance facilities between Inca and Vancouver to allow submittal of a CLOMR/LOMR to remove this floodplain area.

C. ESTIMATED EXISTING SYSTEM CAPACITY

The existing system capacities were estimated from available data consisting of the 1994 LOMR (RD#1), Rainbow Park Construction plans (RD#2) and field observations. The purpose of this estimate is to establish guidelines for evaluating possible alternate concepts, establishing potential bottlenecks within the system and identifying priorities. Estimated existing capacities and existing 100 year flow rates are summarized on Table IV-1. As indicated, existing flows exceed the design capacity of the existing facilities. The design capacity, as used here, includes adequate freeboard. The flows do not exceed the "bank full" capacity and the facilities can convey the existing 100 year runoff within the ROW. The deficiency is a freeboard deficiency, and therefore is not considered as critical as an "out-of-bank" deficiency.

Note that at Pecos Loop, the crossing capacity at "bank full" is approximately equal to the existing flow rate. Increased flow, from upstream development or other changes, will exceed the "bank full" capacity at Pecos Loop, potentially flooding private property.

IV. ALTERNATE EVALUATION

Three basic concepts and five alternates were identified based on the data in the LOMR (RD#1) and existing facilities. Four alternates are based on the concept of providing upstream detention to restrict flows at the Pecos Loop crossing to the existing capacity of 380 cfs. The other alternate is to provide increased conveyance capacity without any detention ("let-it-rip"). A short description and summary of results for each alternate follows. Tables IV-1 and IV-2 summarize flow rates and pond characteristics for the Alternates. Figures 3 through 7 and Tables IV-3 through IV-7 illustrate and summarize the alternates.

1. 'LOCAL' ALTERNATE (TABLE IV-3 AND FIGURE 3)

Four small (7 to 17 acre-foot) local public detention ponds would be provided within the drainage basin to restrict the flow at the Pecos Loop crossing to 380 cfs. Storm drains are provided to convey pond outfalls and where required to limit street flow to the estimated paved street capacity of 120 cfs. This alternate reduces the amount of storm drain required. Each pond could be laid out suitable for multiple uses including recreation and park uses. Also, each pond would incorporate stormwater quality Best Management Practices (BMPs) to trap floatables and capture and treat the first flush runoff.

2. 'REGIONAL #1' ALTERNATE (TABLE IV-4 AND FIGURE 4)

A single regional detention dam would be provided in the vicinity of Inca Road between 3rd and 5th Streets to restrict the flow at the Pecos Loop crossing to 380 cfs. Storm drains are provided at pond outfalls and where required to limit street flow to 120 cfs.

The dam would be laid out to accommodate multiple uses and would incorporate stormwater quality BMPs.

3. 'REGIONAL #2' ALTERNATE (TABLE IV-5 AND FIGURE 5)

The Regional #1 alternate collects the runoff in a trunk storm drain line for conveyance to the pond, limiting the street flows to 120 cfs. The 'Regional #2 and #3 alternates direct as much flow as feasible down streets allowing smaller storm drain pipe sizes. Paved streets and/or stabilized roadside ditches are used to convey the runoff along the roadway. Water blocks are incorporated to contain the runoff in 3rd St., 4th St. and 6th St. in these streets reducing the flow in the trunk line system. Alternate street sections are required to increase the conveyance capacity in the street. One possible alternate street section consists of depressing the street and using modified cross sections to increase capacity. One example is a 26' crowned paved street with valley gutters and stabilized shoulders. It is estimated that approximately 300 cfs could be conveyed and satisfy City street flow safety criteria. The regional pond is essentially unchanged from the Regional #1 Alternate.

4. 'REGIONAL #3' ALTERNATE (TABLE IV-6 AND FIGURE 6)

'Regional #1' and 'Regional #2' alternates discharge from the dam at a rate of approximately 184 cfs. This rate utilizes the existing capacity of the Pecos Loop crossing, but requires a large storm drain and/or swale to convey the flow from the dam at Inca Rd to the existing channel at Vancouver. Regional #3 reduces the pond discharge to 5 cfs, minimizing the size of the storm drain required downstream. The pond will detain a larger volume and thus will be larger than the 'Regional #1' and 'Regional #2' Alternates. Two sub-alternates were evaluated, 3a and 3b. Alternate 3a allows the flow in 3rd St. (Basin R41) to bypass the dam and results in increased flow between Inca and Vancouver and was discarded. Alternate 3b routes all of the runoff north of Inca Road as well as the runoff between Inca Road and Idalia Road east of the dam through the dam. Alternate 3b is shown on the Tables and Figures.

5. 'NO-POND' ALTERNATE (TABLE IV-7 AND FIGURE 7)

No detention is provided in the system upstream of Southern Boulevard. Essentially all structures, including the Pecos Loop and the Southern Boulevard crossing, will require upgrade or re-construction.

6. RATIONALE

The four detention pond alternates, 'Local', 'Regional #1', 'Regional #2' and 'Regional 3#' were selected based on the capacity of the existing Pecos Loop crossing with the idea that upstream detention will be less costly than replacing the crossing structures at Pecos Loop and Southern Boulevard and associated channel upgrades between the structures. The capacity of the existing crossing structures north of Vancouver Road is so small that it is ineffective and will eventually require replacement just to accommodate local flows. Upgrade of the grade controls and channel side lining between Vancouver and Pecos Loop is relatively inexpensive and allows full use of the Pecos Loop crossing structure.

The 'No-Pond' alternate minimizes the ROW required for drainage facilities and has minimum impact on the existing platted lots. This alternate will require upgrade of all the existing facilities within the system and will provide a baseline comparison for evaluation of the effectiveness of upstream detention.

B. HYDROLOGY

The hydrology model was developed using AHYMO_97 (RD#3). The hydrology basin map is Figure 2. The basin map in this DMP has the same overall basin boundary as the LOMR, although smaller sub-basins are used in the DMP. Land use runoff coefficients for full development based on existing platting were estimated from adopted SSCAFCA land use parameters. Mapping was provided by the city, consisting of electronic aerial photography dated 1998 and topography with 10' contours. Drainage divides and basin boundaries for existing development were based on field review. Drainage divides and basin boundaries in the undeveloped area north of tulip road were based on existing platted streets and existing contours. The hydrology was compared to previous hydrology from the LOMR (RD#1) to confirm reasonableness. Details of the hydrology, including basin area, land use, time of concentration, flow routing information and printouts of the AHYMO input and summary files is included in Appendix C.

The results of the hydrology analysis for the alternates are summarized in the Tables IV-1 and Table IV-2.

C. CONVEYANCE

The soils in the Rainbow Tributary area are fine sands and are very erodible. As a consequence, runoff in concentrated flow paths will erode at small flow rates and volumes. For example, it is estimated that an earthen 'V' ditch along a typical north-south road in the area north of Inca Road can convey the 100 year event runoff from approximately ½ to 1 acre without eroding. (threshold of erosion - erosive vel = 1.5 fps, slope = 1.1%, Q = 0.5 cfs)

The system as proposed will function with unstable (erosive) conveyance. The erosion will increase local and regional maintenance costs. Also, the potential for street flow to enter onto private property and to "cut across" lots. Facility sizes shown are conceptual. Detailed design is required prior to implementation.

1. REACH 1 – ABOVE INCA ROAD

In this undeveloped area, the runoff from private properties flows onto the north-south roadways that intercept the flow and direct it southward as concentrated flow (See Figure 2). Flow rates in these roadways ranges up to 120 cfs to 300 cfs, depending on the Alternate. The platted roadway right-of-way is 50 feet. The City does not normally pave residential streets unless the property owners provide and/or participate in the funding, such as assessment districts, improvement districts, etc.

Several options for providing stable conveyance for these flows were investigated (See details in Appendix D.) These conveyance options, at the typical street slope in this reach of 1.1%, are summarized as follows:

a. Standard. Normal 32' asphalt street with 8" C&G
   1) Capacity – 120 cfs
   2) Cost - $100/ft.

b. High Capacity Design. Normal crown 26' paved street, 2' valley gutters and 10' stabilized shoulders.
   1) Capacity – 300 cfs
   2) Cost - $133/ft.

c. Unpaved Road/Paved Ditch. Unpaved 26' street with single paved ditch on uphill side. Crossing culverts range from 18" culverts to 2- 58"x36" CMPA arch culverts.
   1) Capacity w/ 18" culvert – 9 cfs
   2) Capacity w/ single 58"x36" CMPA – 60 cfs
   3) Capacity w/ 2 – 58"x36" CMPA – 120 cfs
   4) Cost - $110/ft.
   5) Capacity w/ precast CBC conforming to ditch geometry – 300 cfs
   6) Cost w/ CBC - $130/ft.

d. Unpaved Road/Unpaved Ditch. Unpaved 26' street and earthen ditch. Use culverts to provide grade control with added energy dissipation and slope protection at the outlet.
   1) Capacity – Same as Unpaved Road/Paved Ditch option.
   2) Cost - $111/ft. (Note, energy dissipater costs and pipe erosion control costs essentially offset ditch paving cost).

e. Combo. Paved street with paved ditch and culverts. Flow exceeding the ditch/culvert capacity flows in the street.
   1) Combined ditch & street capacity – 300 cfs
   2) Cost $160/ft

A section with inverted crown and stabilized shoulders was considered but deleted due to City safety concerns.

Based on these options, the DMP proposes to utilize paved streets as the baseline conveyance. Standard paved streets will be used for areas with flows less than 120 cfs and the high capacity section for flows greater than 120 cfs. While roadside ditches allow unpaved streets conforming to current City practice, the paving required and the size of the ditches and culverts to convey the flow reduces the prudence of this option. Note, detailed design is required prior to implementation.

2. REACHES 2 & 3 – INCA ROAD TO VANCOUVER ROAD (FLOODPLAIN REDUCTION)

The conveyance between Inca Rd. and Vancouver Rd. is intended to provide stable conveyance for existing and future flows and to remove the existing 100 year flood hazard zone. The existing flow rate in this reach is 368 cfs. With proposed upstream detention, the flow rate can be controlled and may decrease for future developed conditions. A low flow outfall from upstream detention is required.

Four options were identified addressing the conveyance in this reach.

a. Option 1. – 50' ROW, lined rectangular channel (3.5'x38'), surface flow across streets, 24" SD. Cost - $607,000 + one acre ROW.
b. Option 2. – 100' ROW, lined trapezoidal channel (3'x60'bottom), 24" SD. Cost - $756,000 + 2 acres ROW.
c. Option 3. – 100' ROW, earthen swale (5'x50'bottom) at "stable" slope (0.001) with 24" SD. Grade control and energy dissipation provided at roadway crossings. Cost - $360,000 + 2 acres ROW.
d. Option 4. – 50' ROW, 78" storm drain w/ earthen swale. Cost - $636,000 + 1 acre ROW.

Option 3 is the proposed option and is used in evaluating overall system alternates. This option meets the criteria, is less costly and provides the ROW for a corridor connection between Inca Road, the site of a proposed detention basin and multiple use facility, to the existing channel at Vancouver Road.

3. REACHES 4 & 5 – VANCOUVER ROAD TO PECOS LOOP

The existing channel is improved but existing 100 year flows exceed the design capacity (See data in Section III). Upgrades to increase the freeboard to meet design standards consist of adding to the top of the existing grade control headwalls and channel side lining. This is relatively simple and inexpensive and other options were not considered.

4. REACH 6 – PECOS LOOP TO SOUTHERN BLVD.

Currently this reach is a natural earthen swale/ditch flowing through an undeveloped section of Rainbow Park. A "park" section consisting of a shallow, lined low flow channel, with reinforced turf overbank flow areas, is proposed for future conditions. This type of channel (similar to the shallow channel at the Journal Center) will conform to the existing park grades. Due to the grades at the Pecos Loop crossing and at Southern Blvd, using underground storm drain for this reach is not practical.

D. ALTERNATE COSTS

Facility sizes, approximate location and other data for each alternate are shown on Figures 3, 4, 5, 6 and 7. Tables IV-1 through IV-7 summarize the major facilities required for each alternate.

Conceptual project costs and approximate right-of-way areas for implementing all of the facilities proposed in the DMP were estimated for each alternate, summarized as follows:

Tables IV-8 through IV-12 and summarized on Table IV-13.

E. PROPOSED ALTERNATE

The LOCAL Alternate is proposed based on cost. Alternates Regional #2 and Regional #3 were discarded based on the requirement for water blocks and paved streets. The Local Alternate is about $1.6 million less expensive than the Local Alternate. The overall Plan, based on this alternate, is described in the DMP.

All facilities require detailed analysis and design for implementation, including the combination of street capacity plus storm drain capacity.

TABLE IV-1
RAINBOW TRIBUTARY OF THE CALABACILLAS ARROYO
DRAINAGE MANAGEMENT PLAN
FLOW RATE SUMMARY
(100 YR/24HR STORM)

	EXISTING CONDITIONS			
LOCATION	EXISTING SYSTEM	EXISTING CAPACITY (1)	BANK FULL CAPACITY (2)	EXISTING FLOW
10th Ave to Northern	Overland	Overland		
5TH St below 5th Ave.	Overland	Overland		
5th St below Sandia	Overland	Overland		
Inca Rd. crossing	Overland	Overland		
Tulip Rd. crossing	3-18" CMP	39 cfs	39 cfs	
Vancouver Rd. crossing	Overland	Overland		368 cfs
Channel Reach 4	Grade Cont.	125 cfs (3)	850 cfs (4)	368 cfs
Channel Reach 5	PCC Sides	200 cfs	1,300 cfs	425 cfs
Pecos Lp crossing	4- 48" CMP	380 cfs	540 cfs (ROW)	425 cfs
Rainbow Park Channel	natural			425 - 540 cfs
Southern Blvd. crossing	4- 48" CMP	540 cfs	560 cfs	540 cfs

EXIST FROM HEWITT ZOLLARS STUDY FOR KATLEEN JACOBSON

	- DEVELOPED CONDITIONS - ALTERNATES									
	'LOCAL' FIGURE 3		'REGIONAL #1' FIGURE 4		'REGIONAL #2' FIGURE 5		'REGIONAL #3' FIGURE 6		'NO POND' FIGURE 7	
LOCATION	FLOW	SYSTEM (6)	FLOW	SYSTEM (6)	FLOW	SYSTEM (6)	FLOW	SYSTEM (6)	FLOW	SYSTEM (6)
10th Ave to Northern	140 cfs	1-48" SD	140 cfs	1-48" SD	140 cfs	Swale	140 cfs	Swale	140 cfs	1-48" SD
5TH St below 5th Ave.	5 cfs	1-18" SD	737 cfs	1- 90" SD	524 cfs	1- 54" SD	524 cfs	1- 54" SD	737 cfs	1- 90" SD
4th St below Sandia	47 cfs	1-30" SD	1016 cfs	1-96" SD	574 cfs	1-60" SD	574 cfs	1-60" SD	1016 cfs	1-96" SD
Inca Rd. crossing	72 cfs	1-42" SD	184 cfs	1-54" SD	165 cfs	1-54" SD	38 cfs	Swale & 24"	1465 cfs	30' BW Ch
Tulip Rd. crossing	148 cfs	1-54" SD	186 cfs	1-54" SD	165 cfs	1-54" SD	52 cfs	Swale & 24"	1595 cfs	30' BW Ch
Vancouver Rd. crossing	220 cfs	1-60 " SD	203 cfs	1-60 " SD	178 cfs	1-60 " SD	115 cfs	Swale & 24"	1595 cfs	30' BW Ch
Channel Reach 4	280 cfs	1' Upgrade	246 cfs	1' Upgrade	314 cfs	1' Upgrade	195 cfs	1' Upgrade	1700 cfs	30' BW Ch
Channel Reach 5	290 cfs	1' Upgrade	300 cfs	1' Upgrade	323 cfs	1' Upgrade	261 cfs	1' Upgrade	1745 cfs	30' BW Ch
Pecos Lp crossing	345 cfs	4- 48" CMP	352 cfs	4- 48" CMP	460 cfs	4- 48" CMP	319 cfs	4- 48" CMP	1745 cfs	30' BW CBC
Rainbow Park Channel	430 cfs	channel	437 cfs	channel	465 cfs	channel	405 cfs	channel	1855 cfs	30' BW Ch
Southern Blvd. crossing	452 cfs	4- 48" CMP	455 cfs	4- 48" CMP	548 cfs	4- 48" CMP	428 cfs	4- 48" CMP	1875 cfs	30' BW CBC

NOTES: (flows)
(1) Capacity @ design freeboard.
(2) Capacity at ROW or overtop of structure
(3) 2' freeboard at grade controls
(4) no freeboard at grade controls, 1' to 2' +/- freeboard to top of earthen channel
(5) Storm Drain (SD) sizes based on Mannings n value of 0.13
(6) Paved street conveyance required for all alternates.

TABLE IV-3
RAINBOW TRIBUTARY DMP FACILITY SUMMARY

'LOCAL' ALTERNATE

	FACILITY	LOCATION	FACILITY FLOW Q (cfs)	DETAINED VOLUME (AF)	ROW/ EASM'T (AC)
1	48" RCP SD	10th Ave to P10	140 cfs		1 Ac
2	Pond P10	Northern to 9th Ave.	In - 349, Out - 5	10.7 AF	3.3 Ac
3	18" RCP SD	6th St.; 9th Ave to 600' N of P20	5 cfs, P10 outfall		
4	30" RCP SD	6th St.; 600' N of P20 to P20	40 cfs		
5	30" RCP SD	5th Ave; 4th St. to 5th St.	45 cfs		
6	Pond P20	N. of 5th Ave	In - 409, Out - 5	17 AF	6.3 Ac
7	18" RCP SD	5th St; 5th Ave to 600' N of P33	5 cfs, P20 outfall		
8	30" RCP SD	5th St to P33	40 cfs		
9	Pond P33		In - 448, Out - 47	15.3 AF	5.7 Ac
10	30" RCP SD	4th St; P33 to P40	47 cfs, P33 outfall		
11	Pond P40	N. of 5th Ave; 5th St. to 6th St.	In - 310, Out - 72	6.9 AF	2.8 Ac
12	42" SD	Inca to Idalia	72 cfs		0.4 Ac
13	54" SD	Idalia to Tulip	148 cfs		0.4 Ac
14	60" SD	Tulip to Vancouver	220 cfs		0.5 Ac
15	1' Grade control extention	Vancouver to PCC lining	280 cfs		
16	1' PCC lining extension	PCC Lining to Pecos Loop	290 cfs		
		4-48" CMP Pecos Loop (existing)	345		
17	Landscape "Park" Channel	Pecos Loop to Southern Blvd.	430		
		4-48" CMP Southern (existing)	452 cfs		
18	30" SD	Basin 71A drain along Southern	41 cfs		
19	Standard Streets	32' AC, 8" C&G	Up to 120 cfs		

Note: Variations of storm drain capacity and stabilized surface swale can be investigated to reduce storm drain size if utility conflicts are a problem.

TABLE IV-4
RAINBOW TRIBUTARY DMP FACILITY SUMMARY
Date Dec. 2, 2002, Updated June 2003
'REGIONAL #1' ALTERNATE

	FACILITY DES	LOCATION	Q100 (cfs)	DETAINED VOLUME (AF)	ROW/ EASM'T (AC)
1	48" RCP SD	10th Ave to Northern	140		0.6 Ac
2	60" RCP SD	Northern to 9th Ave.	262		0.6 Ac
3	66" RCP SD	9th Ave to 5th Ave	350		
4	90" RCP SD	5th Ave to Sandia Blvd.	737		
5	96"RCP SD	In Sandia, 5th St to 4th St.	1016		
6			IN = 1465, Out = 184		
	P40	Sandia to Inca, 4th St to 3rd St.	cfs	42 AF	16.5 Ac
7	54" SD	Inca to Idalia	184 cfs		0.4 Ac
8	54" SD	Idalia to Tulip	186 cfs		0.5 Ac
9	60" SD	Tulip to Vancouver	203 cfs		0.5 Ac
10	1' Grade control extention	Vancouver to PCC lining	246		
11	1' PCC lining extension	PCC Lining to Pecos Loop	300		
12		4-48" CMP Pecos Loop (existing)	352		
13	Landscape "Park" Channel	Pecos Loop to Southern Blvd.	437		
14		4-48" CMP Southern (existing)	455		
15	30" SD	Basin 71A drain along Southern	41 cfs		
17	Standard Streets	32' AC, 8" C&G	1 to 120 cfs		

TABLE IV-5
RAINBOW TRIBUTARY DMP FACILITY SUMMARY
Date Dec. 2, 2002, Updated June 2003, Updated Feb 2004
REGIONAL #2' ALTERNATE

	FACILITY DES	LOCATION	Q100 (cfs) #	DETAINED VOLUME (AF)	ROW/ EASM'T (AC)
1	Swale	10th Ave to Northern	140		0.6 Ac
2	Swale	Northern to 9th Ave.	265		0.6 Ac
3a	42 " RCP SD	9th Ave to 5th Ave	385		
3b	48 " RCP SD		465		
4a	54" RCP SD	5th Ave to Sandia Blvd.	524		
4b	60" RCP SD		574		
5			IN = 1156, Out = 165		
	P40	Sandia to Inca, 5th St to 4th St.	cfs	38 AF	16.2 Ac
6	54" SD	Inca to Idalia	165		0.4 Ac
7	54" SD	Idalia to Tulip	178		0.5 Ac
8	60" SD	Tulip to Vancouver	242		0.5 Ac
9	Water Blocks		0 cfs		
10	1' Grade control extention	Vancouver to PCC lining	314		
11	1' PCC lining extension	PCC Lining to Pecos Loop	323		
12		4-48" CMP Pecos Loop (existing)	460		
13	Landscape "Park" Channel	Pecos Loop to Southern Blvd.	465		
14		4-48" CMP Southern (existing)	548		
15	30" SD	Basin 71A drain along Southern	41 cfs		
17	Standard Streets	32' AC, 8" C&G	1 to 120 cfs		

Notes
- Total flow, street plus storm drain at lower end of facility reach

TABLE IV-6
RAINBOW TRIBUTARY DMP FACILITY SUMMARY
Date Dec. 18, 2002, Updated June 2003
'REGIONAL #3 ALTERNATE

	FACILITY DESCRIPTION	LOCATION	Q100 (cfs)# (Future)	DETAINED VOLUME (AF)	ROW/ EASM'T (AC)
1a	Swale	10th Ave to Northern	140		0.6 Ac
1b	Box Crossing	Northern Blvd.	200		
2	Swale	Northern to 9th Ave. 5th Street 9th Ave to Sandia Blvd. - Special Street Conveyance Design	262		0.6 Ac
3a	42" SD + street	9th Ave to 900' South	385		
3b	48" SD + street	to 5th Ave	464		
4a	54" SD + street	5th Ave to 1400' South	524		
4b	60" SD + street	to Sandia Blvd.	574		
	P40 - Rainbow Dam	Vicinity of Sandia to Inca, 5th St to 3rd St.	Qin = 1245 cfs, Qout = 5 cfs	57 AF	22 Ac.
5	48" SD 3rd to P40	3rd Street to Rainbow Dam (Basin R41)	98 cfs		
6	24" SD + Swale	Inca to Idalia	38 cfs		0.6 Ac
7	24" SD + Swale	Idalia to Tulip	52 cfs		0.7 Ac.
8	24" SD & Swale	Tulip to Vancouver	115 cfs		0.7 Ac
9	Water Blocks	5th Ave @ 3rd, 4th & 6th St.	0 cfs		
10	1' Grade control extention	Vancouver to PCC lining	195 cfs		
11	1' PCC lining extension	PCC Lining to Pecos Loop	261 cfs		
12		4-48" CMP Pecos Loop (existing)	319 cfs		
13	Landscape "Park" Channel	Pecos Loop to Southern Blvd.	405 cfs		
14		4-48" CMP Southern (existing)	428 cfs		
15	30" SD	Basin 71A drain along Southern	41 cfs		
16	High Flow Streets	High flow conveyance design of streets - 26'AC, Valley Gutter, Stabilized Shoulders	120 to 300 cfs		
17	Standard Streets	32' AC, 8" C&G	1 to 120 cfs		

Notes
- Total flow, street plus storm drain at lower end of facility reach

TABLE IV-7
RAINBOW TRIBUTARY DMP FACILITY SUMMARY
Date Dec. 2, 2002, Updated June 2003
'NO POND' ALTERNATE

	FACILITY DESC.	LOCATION	Q100 (cfs)	ROW/ EASM'T (AC)
1	48" RCP SD	10th Ave to Northern	140	1 Ac
2	60" RCP SD	Northern to 9th Ave.	262	
3	66" RCP SD	9th Ave to 5th Ave	350	
4	90" RCP SD	5th Ave to Sandia Blvd.	737	
5	96"RCP SD	In Sandia, 5th St to 4th St.	1016	
6	102" RCP SD	Sandia to Inca Rd.	1164	
7	102" RCP SD	Inca Rd, 4th St to 3rd St.	1265	
8	30' BW PCC Channel	Inca to Tulip	1465	2 Ac
9	30' BW PCC Channel	Tulip to Vancouver	1595	1 Ac
10	30' BW PCC Channel	Vancouver to Pecos Lp	1745	
11	30' BW Trap CBC	Pecos Lp CBC	1745	
12	30' BW PCC Channel	Pecos Lp to Southern	1855	
13	30' BW Trap CBC	Southern Blvd. CBC	1875	
15	30" SD	Basin 71A drain along Southern	41 cfs	
16	High Flow Streets	High flow conveyance design of streets - 26'AC, Valley Gutter, Stabilized Shoulders	120 to 300 cfs	
17	Standard Streets	32' AC, 8" C&G	1 to 120 cfs	

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NAME OF PROJECT/CALCULATION			SHEET NO. C-1 OF
Rainbow Trib			
COMPUTED BY: CD	CHECKED BY:	JOB/TASK NO. 20289	DATE: 11/12/02

IDENTIFY/ADDRESS THESE ELEMENTS	1.0 SUBJECT	2.0 PURPOSE	3.0 REFERENCES	4.0 ASSUMPTIONS	5.0 CRITERIA / REQUIREMENTS
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

Cost Estimates (to compare Alternates)

Use COA avg unit prices +/-

Assumptions:

Street capacity ~ 120 cfs R#1, 300 R#2 & #3

Pipe slope approx ~ natural grade (1.1% +/-)

Use ANYMO results for Q, V

RCP storm drain pipe n ~ 0.013

Flows follow platted street layout

Full flow circular pipes w/ Manning Eqn.

Use street w/ cutoff wall as generic emergency spillway

Assume ported tower w/ submerged port inlets for principal spillway

Convey low flow outlet between ponds in SD. due to grade.

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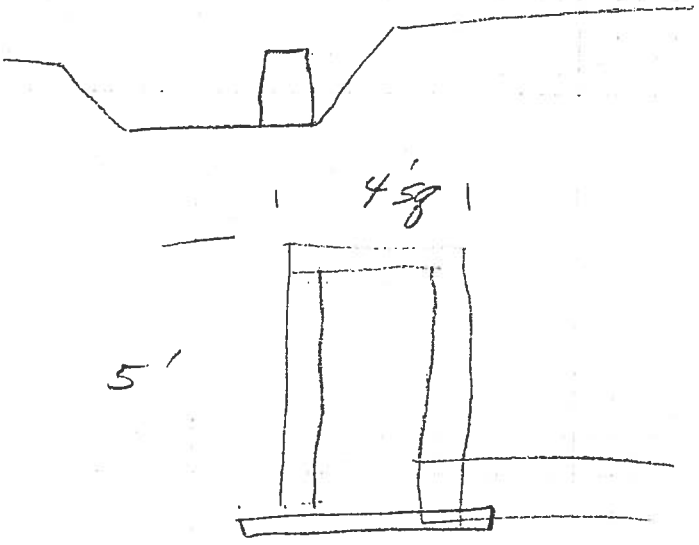
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

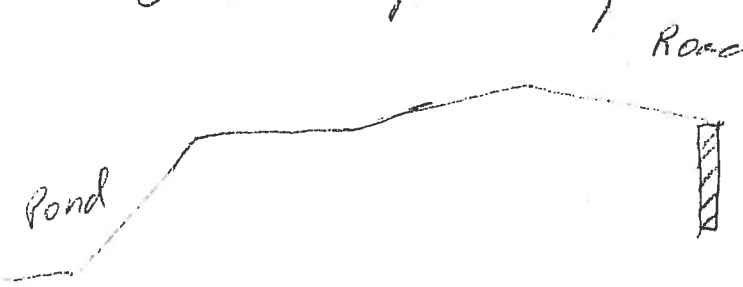
Cost Est. Data
Use COA unit prices +/-

Pond outlet.



~125 CF ~ 5 CY @ $400 ~ $2000
use $3K

Em. Spillway



5' x 1' cut
x 50' @ $150/CY
~$14K

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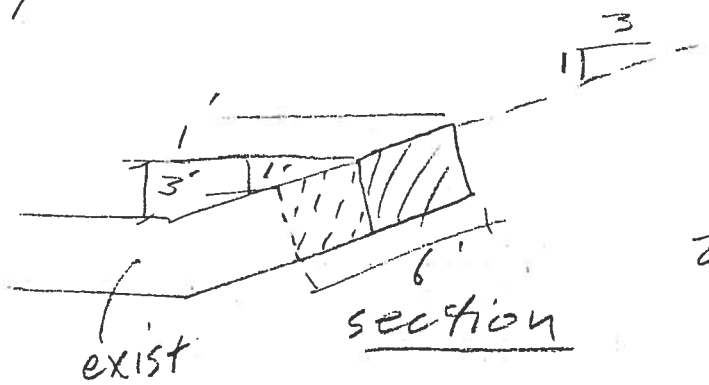
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	

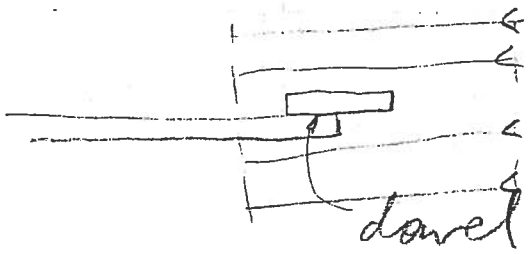
REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

1' grade control extension



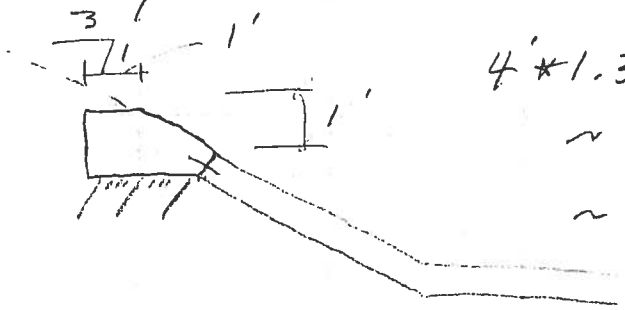
section

2*6'*1'*4'
@$400 ~ 700
+ dowels ~ 1500



Plan

1' lining extension



4'*1.3' - ½(1*3)
~ 3.7 cf/ft @$400
~ 55 + dowels
~ use $75/LF

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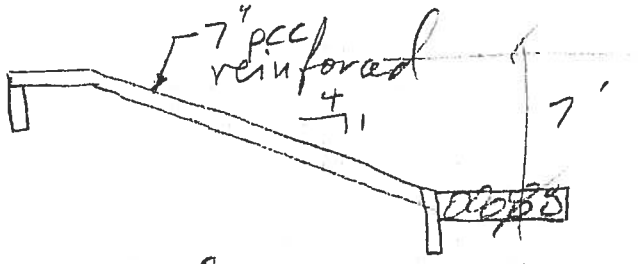
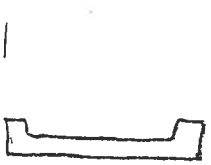
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

rundown

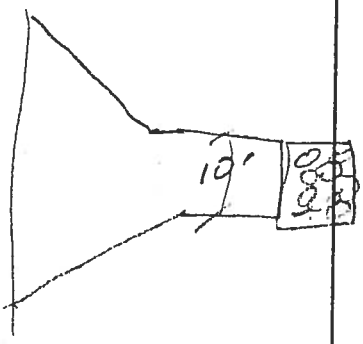




typical $q \sim 100$ cfs

rein $q = 3.0\, w h^{3/2}$

set h @ 8" $w = 60'$



~ 20 CY @ $200 ~ $4000

use $5000 for RR, etc.

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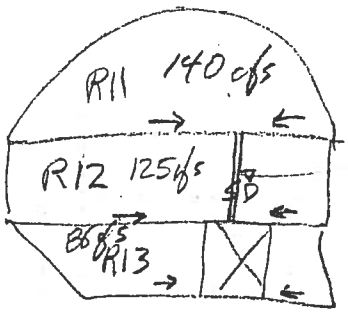
NAME OF PROJECT/CALCULATION			SHEET NO. C-5 OF
Rainbow DMP			
COMPUTED BY: CD	CHECKED BY:	JOB/TASK NO.	DATE: 11/12/02

IDENTIFY/ADDRESS THESE ELEMENTS: 1.0 SUBJECT | 2.0 PURPOSE | 3.0 REFERENCES | 4.0 ASSUMPTIONS | 5.0 CRITERIA / REQUIREMENTS | 6.0 SKETCHES | 7.0 CALCULATIONS | 8.0 CONCLUSIONS | 9.0 ATTACHMENTS

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

'LOCAL' ALT SD SIZES
(assuming street capacity $\leq$ 120 cfs)

into P10

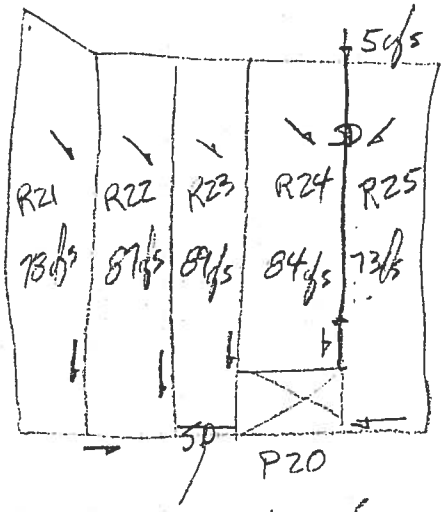


1000' SD @ 140 cfs
S_o ~ 1%
$Q = C\sqrt{S}$
C = 1400
~ 48" RCP
14 inlets @ 10 cfs ea.

ROW req'd. (50' wide lots)

1000' 48" RCP
14 inlets
2 rundowns
1.0 acre ROW for SD

into P20



600' 30" RCP
2000' 18" RCP
300' 24" RCP
8 inlets
2 rundowns

2000' 18" RCP pond outlet
300' 24" @ lower end for 30 cfs excess
3 inlets

600' SD @ 45 cfs 15 inlets @ 10 cfs/ea
S_o ~ 1.6 $Q = C\sqrt{S}$ C = 355 30" RCP

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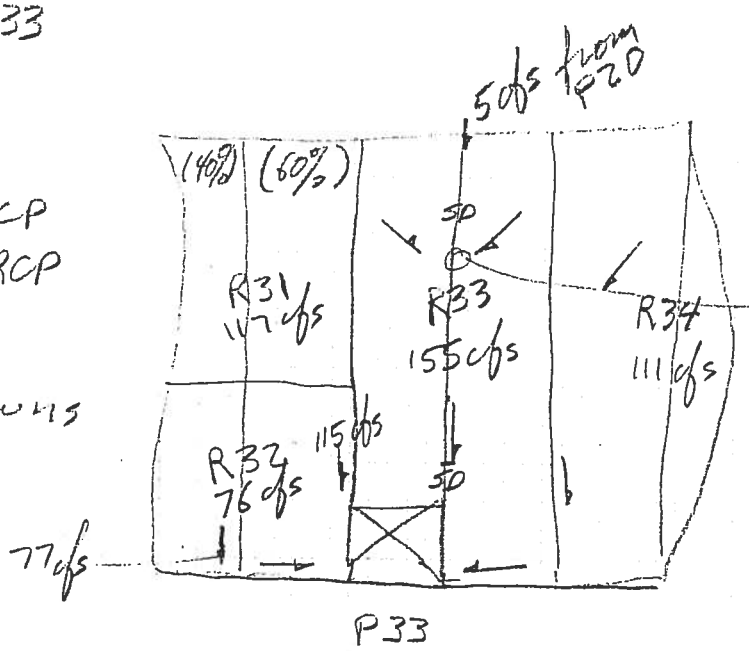
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

into P33

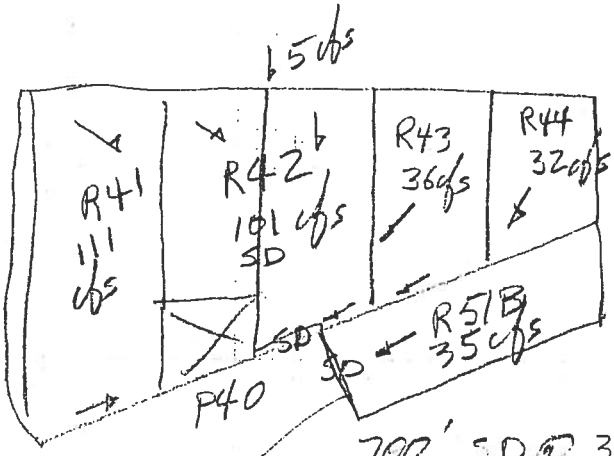
2000' 18" RCP
400' 24" RCP
4 inlets
2 rundowns



2000' 18" RCP outlet from P20
400' 24" RCP @ lowgrad
4 inlets

into P40

1400' 18" RCP
700' 30" RCP
3 rundowns
0.2 Ac ROW
4 inlets



1400' 18" RCP outlet from P33

700' SD @ 35 cfs
Q = CI5 S ~ 0.7% C ~ 418
30" RCP, 4 inlets

ROW
30' easmt
x 300'
~ 0.2 Ac.

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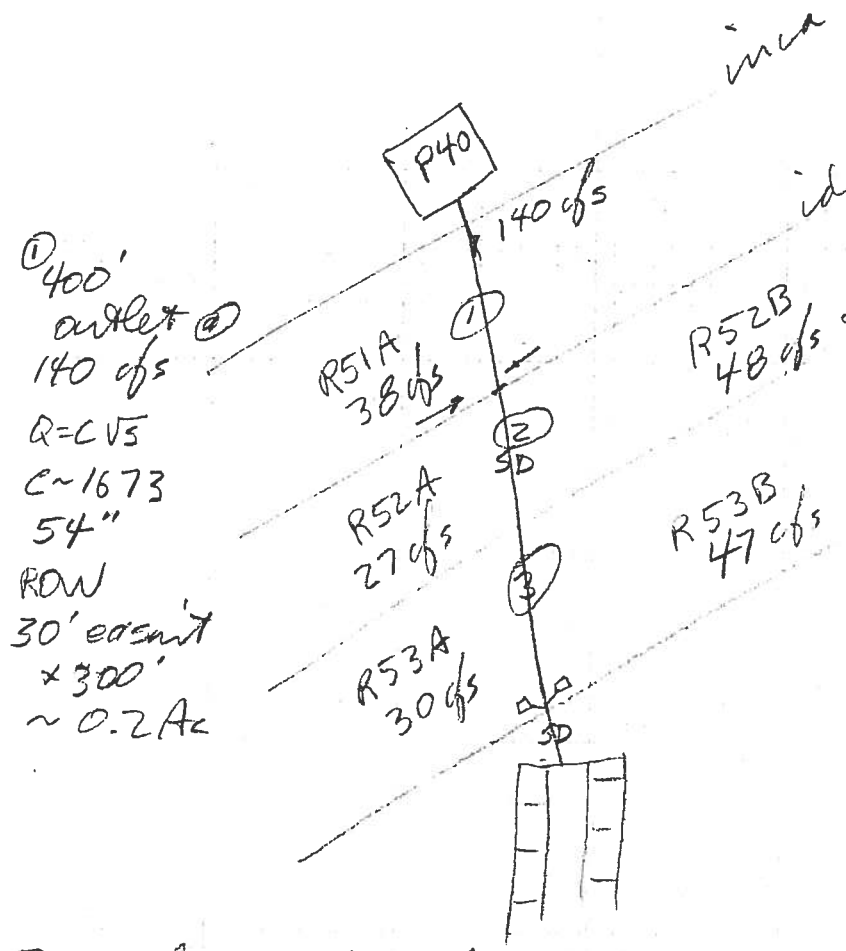
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	
REVISION #	SUPERSEDES CALC TITLE		CHECKED BY:	DATED	

into channel @ Vancouver

$S_o \sim 10'/1400' \sim 0.7\%$



① 400' outlet @ 140 cfs
$Q = CV5$
$C \sim 1673$
54"
ROW
30' easmt
x 300'
~ 0.2 Ac

② purchase 50' x 450' = 0.5 Ac lot w/ surface swale @ 35 cfs from idalia to Tulip
450' SD w/ 140 cfs 54"
use existing 3-18" CMP culverts

③ 50' drainage easmt w/ swale @ 113 cfs
50 * 300' = 0.35 Ac

400' 54" SD @ 140 cfs
excess flow across Vancouver as current.
1 - rundown
2 - inlets

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NAME OF PROJECT/CALCULATION			SHEET NO. C-8 OF
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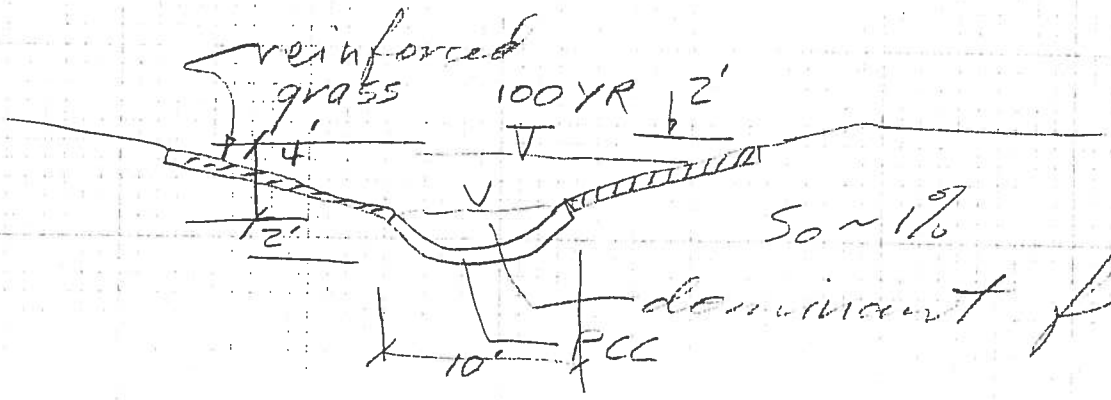
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

'Local' option,
"Park" Channel
Qty's
Landscape
Channel

Perc. Loop →
Southern
1300'



$S_o \sim 1\%$

dominant flow

$q \sim 46$ cfs

dominant $q_D \sim 0.2\, q_{100} \sim 9$ cfs

PCC ~ 13 KSF

grass w/ reinforcement
~ 43 KSF

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LEEDSHILL – HERKENHOFF, INC. ENGINEERS ARCHITECTS ALBUQUERQUE • SANTA FE COMPUTATIONS	NAME OF PROJECT/CALCULATION: Rainbow			SHEET NO. C-9 OF
	COMPUTED BY: CD	CHECKED BY:	JOB/TASK NO.	DATE:

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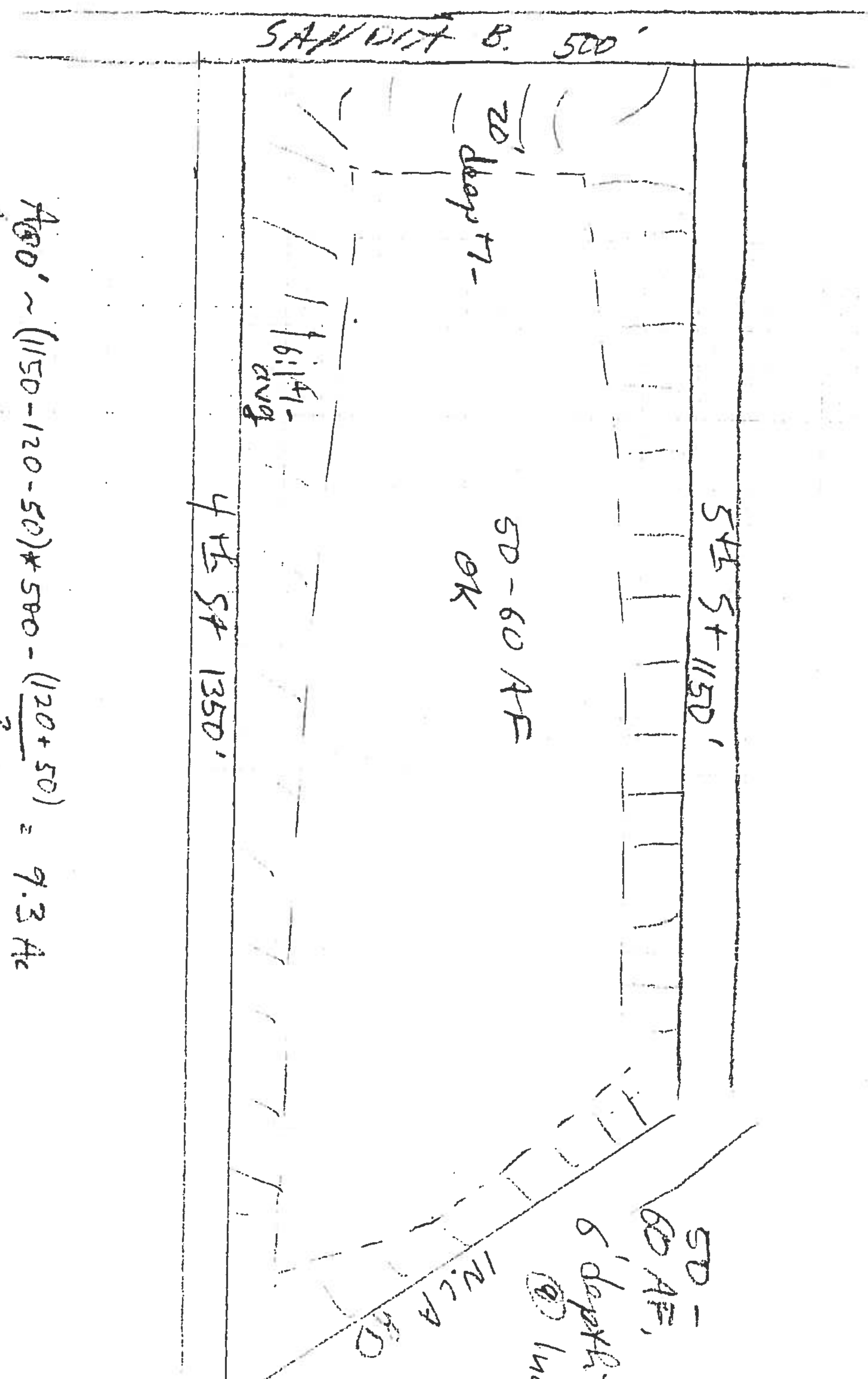
REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

Concept P40 @ 4th → 5th



A@0' ~ (1150-120-50)*500 - (120+50)/2 = 9.3 Ac

A@6' ~ (1150-84-0)*500 - (84+0)/2 = 11.2 Ac

A@top ~ 14.3 Ac

Vol ~ (A0+A6)/2 * 6 + (A6+Atop)/4 * 14 ~ 15 AF ~ 24.3 KCY

1" = 260' +/-

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LEEDSHILL – HERKENHOFF, INC.
ENGINEERS ARCHITECTS
ALBUQUERQUE • SANTA FE
COMPUTATIONS

NAME OF PROJECT/CALCULATION	SHEET NO. / OF	
Rainbow	C-10	
COMPUTED BY: CD	CHECKED BY:	JOB/TASK NO.

DATE:

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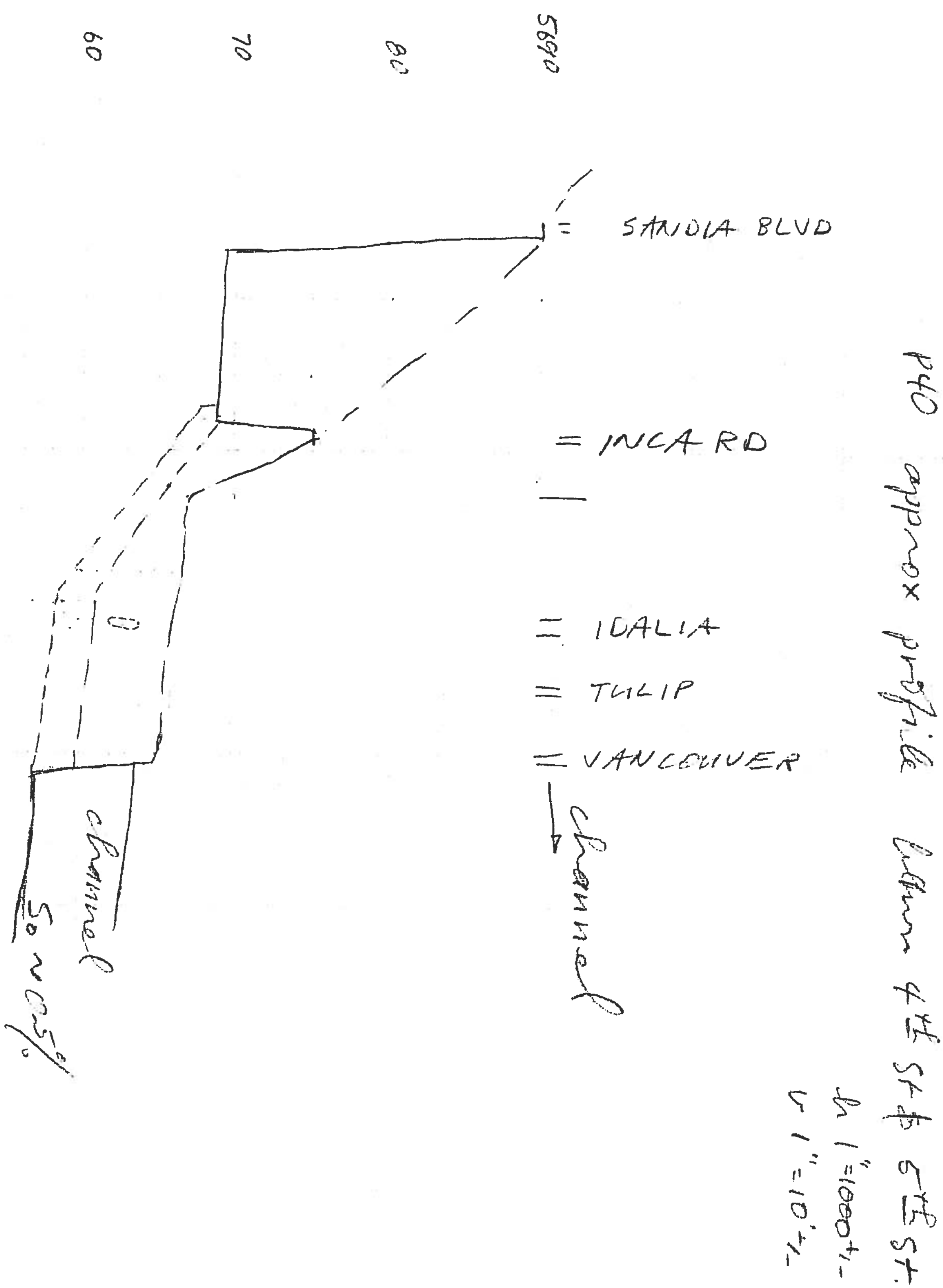
REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED



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LEEDSHILL – HERKENHOFF, INC. ENGINEERS ARCHITECTS ALBUQUERQUE • SANTA FE COMPUTATIONS	NAME OF PROJECT/CALCULATION Transmission			SHEET NO. C-11 OF
	COMPUTED BY: CD	CHECKED BY:	JOB/TASK NO.	DATE:

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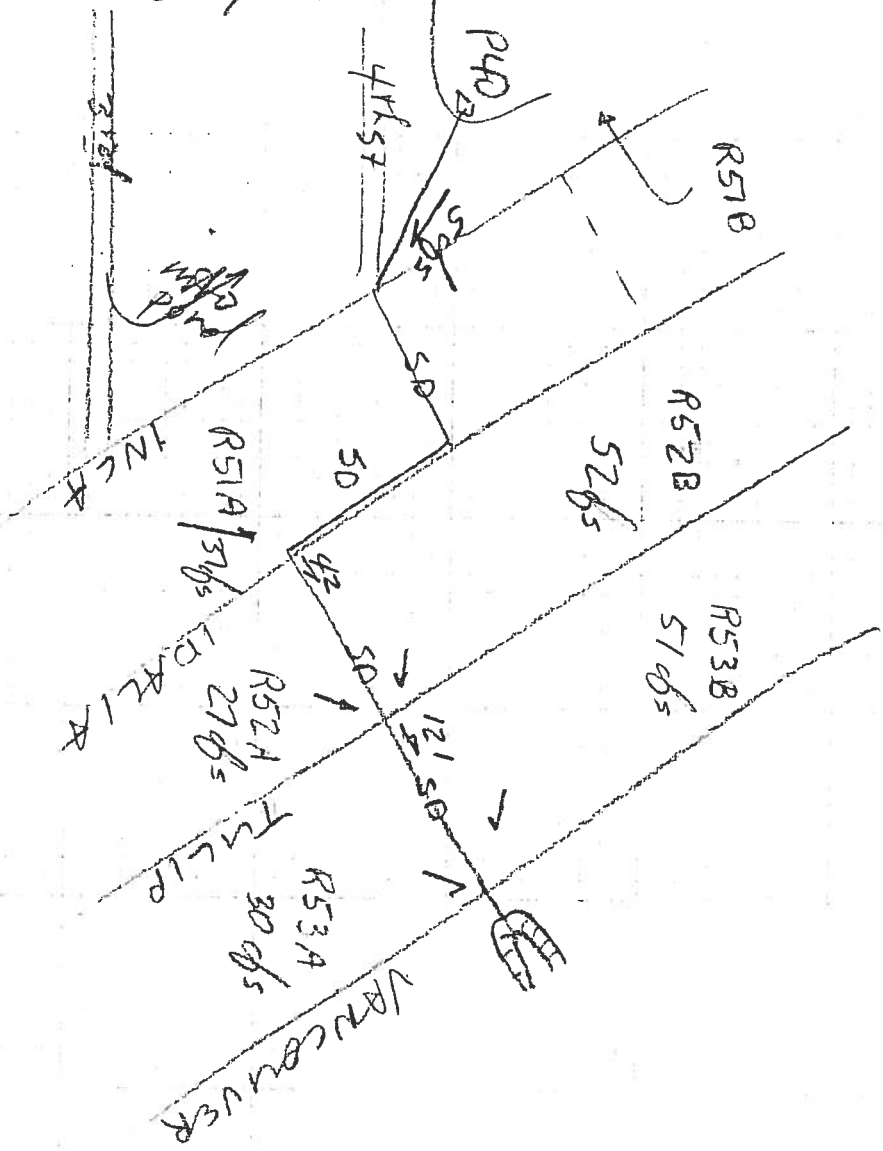
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS		9.0 ATTACHMENTS

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

Concept Sizing w/ 5 cfs P40



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COMPUTATIONS

NAME OF PROJECT/CALCULATION	SHEET NO.	OF
Kanuban / DMP	C12	

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CD			4/24/03

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REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

Street/Ditch Conveyance Summary

See Appendix 'D' for derivation

	Capacity	Cost	
AC Standard Crown, 32' C&G Street	120 cfs	$100/LF	⟸ Proposed Q<120
AC ~~Inverted Crown~~, Stabilized (CTB) Shoulders	300 cfs	$115/LF	
Combo - 'V' Ditch plus AC Road & 2-58"x36" CMPA culverts	300 cfs	$160/LF	
AC, Crown w/ Valley Gutter, Stabilized Shldr.	300 cfs	$133/LF	⟸ Proposed 120<Q<300
Dirt ditch, dirt street w/ 2-58"x36" @ driveways as drop structures/ energy diss.	120 cfs	$111/LF	
Paved ditch, dirt street w/ 2-58"x36" CMPA @ drives	120 cfs	$110/LF	
Paved ditch, dirt street w/ Precast CBC @ drives	300 cfs	$130/LF	

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NAME OF PROJECT/CALCULATION			SHEET NO. C13 OF
Rainbow LMP			
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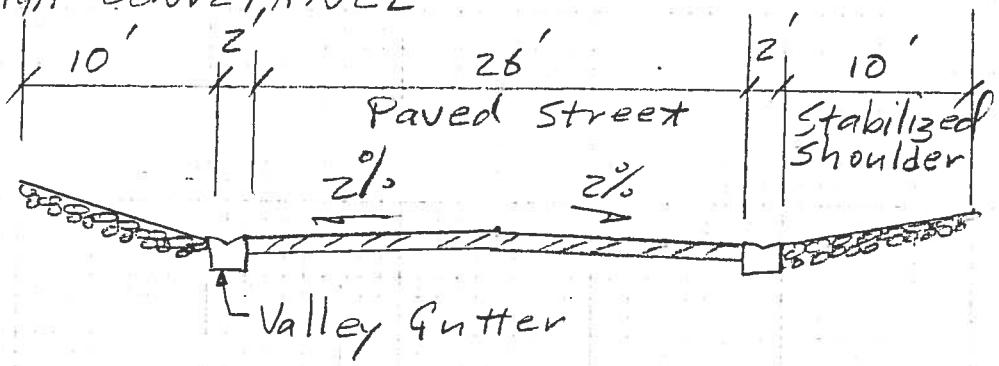
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS	9.0 ATTACHMENTS	

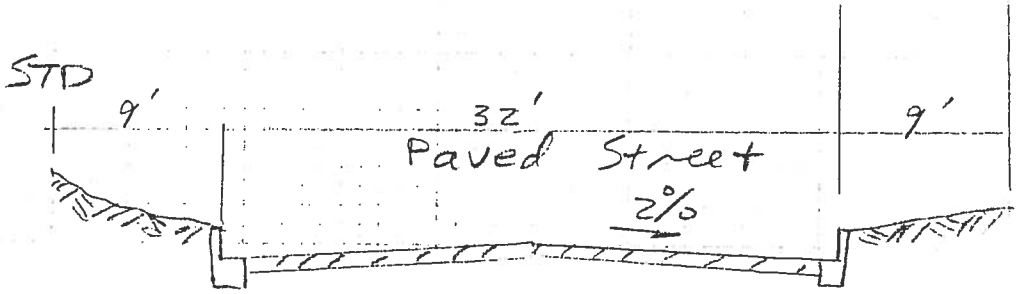
REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

Typical Street Conveyance Sections for north/south @ $S_o \geq 1.1\%$

HIGH CONVEYANCE



Flow Capacity ~ 300 cfs
Cost ~ $133/ft



Flow Capacity ~ 120 cfs
Cost ~ $100/ft

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CITY OF RIO RANCHO
RAINBOW TRIBUTARY DMP

SUMMARY OF TECHNICAL CRITERIA, ASSUMPTIONS & REQUIREMENTS

October 1, 2002

1. DESCRIPTION:
   The Rainbow Tributary of the Calabacillas Arroyo within Rio Rancho extends from the County line north to approximately 10th Ave. NE, a length of approximately 4.5 miles. Below Southern Blvd., the arroyo is natural. Between Southern Blvd. and Vancouver Rd., the land is currently mostly developed with a manmade channel. Between Vancouver and Tulip, one 18" CMP conveys flows. Three 18" CMP culverts cross under Tulip Rd. North of Tulip Rd, the area is undeveloped and the arroyo is natural without a clear channel. The DMP study limits extend from Southern Blvd. north to the drainage area boundary, an area of approximately 1.4 square miles.

2. OBJECTIVE:

   Develop a Plan for managing the drainage within the Rainbow Tributary of the Calabacillas Watershed. The Plan should identify ultimate facilities for fully developed conditions and an interim plan and schedule as development continues. Existing facilities have been developed from Southern Blvd north to Tulip Rd. North of Tulip Rd, the area is essentially undeveloped. The existing facilities are suspected to be undersized for fully developed conditions. It is anticipated that the study will focus on the area north of Vancouver Rd.

3. CRITERIA:

   a. Hydrology:
      i. Methodology – AHYMO_97
      ii. Design Storm - 100 year 24 hour or 100 year 6 hour storm event, whichever is the controlling event.
      iii. Developed conditions land uses – In accordance with existing platting and SSCAFCA AHYMO land use parameters. All properties allowed to discharge without detention as currently platted. Redeveloped properties will be required to detain.
   b. Roadways/Streets: In accordance with NMSHTD and Rio Rancho criteria, including:

i. 100-year storm street flow within public ROW.
ii. 10 year flow depth times velocity less than 6.5.
iii. 10 year one lane open for arterials and collectors.
iv. Crossing structures for arterials – 50 year at pipe soffit, 100 year at edge of shoulder.
v. Arterial and collector streets within the study limits include Southern Blvd, Tulip/Idalia/Inca Corridor (one or more of these), Sandia Blvd, and Northern Blvd.

c. Stormwater Quality Enhancement (SWQ): In accordance with Black Arroyo, Montoyas Arroyo and Venada Arroyo Watershed Management Plan standards.
   i. Intercept and treat first 0.25" of runoff.
   ii. Incorporate NPDES Phase II Permit requirements, if available.

d. Multi-Use:
   i. Incorporate planning for multiple uses of detention facilities, channel ROW and other drainage public property. Incorporate considerations for trail extensions along channels where appropriate. It is anticipated that maintenance access in the reach between Southern Blvd. and Vancouver Rd. will also function as a trail.
   ii. The lower reach of the Calabacillas (within Bernalillo Co.) is designated an "Open Space Arroyo". The Calabacillas is also being considered as an "open space habitat corridor".
   iii. The upper reach of the Rainbow Tributary (north of Tulip Rd.) is separated from the Calabacillas by existing development and the existing constructed channel between Southern Blvd. and Vancouver Rd.
   iv. Due to the upper reach location and separation from the Calabacillas Main Branch, "habitat corridor" considerations are not being incorporated into the DMP.

Prepared By: Clinton Dodge Date: 10/1/02
Clinton Dodge, PE
ASCG

Concurrence By: Robert C. Schulz Date: 11-5-02
Robert Schulz, PE
City of Rio Rancho

APPENDIX ~~F~~ I

CONCEPT EVALUATION SUMMARY

I. CONCEPTS LIMITING FLOW AT TULIP ROAD TO EXISTING TULIP ROAD CULVERT CAPACITY, UPGRADE CMP BETWEEN TULIP AND VANCOUVER ROAD

CAPACITY:

- Tulip Road – 3-18" CMP -39 cfs @ overtop of road. (Requires upgrade of 1-18" CMP between Tulip Road and Vancouver Road which has capacity of approximately 13 cfs.)

CONCEPT IA - LOCAL PUBLIC PONDS

- Restrict flow at Tulip Road to existing capacity.
- Ponds are located within drainage basin to minimize conveyance flow rates and minimize storm drain requirements by reducing runoff rate to allow street flow and overland flow.
- Ponds are combination flood detention and stormwater quality facilities. Outflow from the ponds is limited to 5 cfs.
- Street flow is utilized to convey runoff where 100 year peak is less than approximately 120 cfs. The street 100 year capacity with 8" curb and gutter or with 2' by 10' "vee" ditches is estimated to be approximately 60 cfs per side. Note that the ditch velocity exceeds 6 fps and will be erosive, eventually requiring stabilization. Storm drains are utilized to convey flows greater than 120 cfs.
- Flows are restricted to the existing capacity at the crossing of Tulip Road (Q100 = 39 cfs).
- Six ponds are proposed ranging from 4 AF to 15 AF. Total area for the ponds is estimated at approximately 20 acres. The ponds are located upstream from roadway crossings to utilize the street paving as emergency spillways.
- Approximately 1200 ft. of 48" storm drain and 600 ft. of 30" storm drain are required for areas where the street flow rate exceeds 120 cfs.

Concept 'IA' is not recommended as an alternate. The additional pond volume to meet the undersized Tulip Road crossing is not cost effective.

CONCEPT 'IB' – SINGLE REGIONAL INCA DETENTION DAM AT INCA ROAD

- The pond is a combination flood detention and stormwater quality facility located just north of Inca Road (or Idalia Road) Outflow from the pond is limited to 5 cfs.

- Street flow is utilized to convey runoff where 100 year peak is less than approximately 120 cfs. Storm drains are utilized to convey flows greater than 120 cfs.
- Flows are restricted to the existing capacity at the crossing of Tulip Road (Q100 = 39 cfs).
- Pond size is approximately 59 AF requiring approximately 18 acres.
- Flow rate at Tulip is marginal (39 to 44 cfs) due to runoff from basins between Inca and Idalia Road.
- Flow just below Vancouver is approximately 200 cfs.
- Flow into Regional Inca Pond is approximately 1650 cfs.
- Approximately. 4,600' of 54" SD, 8,100' of 48" SD and 6,000' of 36" SD are required for areas where the street flow rate exceeds 120 cfs.

Concept 'IB' is not recommended as an alternate. The additional pond volume to meet the undersized Tulip Road crossing is not cost effective.

CONCEPT 'IC' – DIVERT NORTH RAINBOW RUNOFF AT INCA TO CALABACILLAS ARROYO

- Developed flow at Inca or Idalia is approx. 1650 cfs. Divert this instorm drain to Calabacillas Arroyo, approx. 8,000'.
- Slope between 3rd Street NE and 1st Street NW controls the hydraulic grade line at approx. 0.3%.
- Approx. pipe size to convey the flow is 3 – 96" RCP or 2 – 10'x10' CBC.
- The cut through the hill between 1st and 2nd Street NE is approx. 27' to 30'.

Concept 'IC' is not recommended as an alternate due to excessive cost.

II. CONCEPTS WITH FLOW LIMITED BY CAPACITIES DOWNSTREAM OF VANCOUVER.

CAPACITY:

- Channel Reach 4 w/ 2' freeboard at existing grade control structures – 150+/- cfs.
- Channel Reach 5 w/ existing side lining w/ 2' freeboard – 200 cfs.
- Pecos Loop crossing (4-48" CMP), WS @ roadway – 380 cfs.
- Pecos Loop crossing, WS @ property line – 540 cfs.
- Southern Blvd crossing (4-48" CMP), WS @ roadway – 560 cfs.

CONCEPT 'IIA' – REDUCE FLOW TO EXISTING DOWNSTREAM CAPACITY OF 150-200 CFS.

- Developed flow generated between Inca Road and Vancouver Road is approximately 200 cfs. Therefore, detention to reduce the flow at Inca Road to approximately 5 cfs is required. Storm drain requirements are the same as the respective Concepts.
- Concept 'IA' w/o the Tulip Pond (Local Public Ponds) satisfies the criteria.
- Concept 'IB' (Regional Pond @ Inca) satisfies this criteria.

- Conveyance between Inca and Vancouver would be surface flow. This conveyance could also be in a storm drain.

Concept 'IIA' is not proposed as an alternate. The increase in channel capacity to provide additional freeboard required for concept 'IIB' is relatively inexpensive. Local flows and flows generated between Inca Road and Vancouver Road will exceed 200 cfs and may require a pond in this congested area.

CONCEPT 'IIB' – REDUCE FLOW TO CAPACITY AT PECOS LOOP CROSSING OF 380 cfs.

- This concept requires upstream ponds to reduce the flow to 380 cfs at Pecos Loop.
- Either the Local or Regional Pond Concept will meet the criteria. The ponds can discharge up to approximately 120-180 cfs at the Inca crossing. Storm drain requirements are the same as the respective Concepts.
- The reduction in detention volume is estimated to be approximately 10-15 AF. This would allow elimination of the Inca and Tulip Ponds in the Local Public Pond (CONCEPT IA) layout. This would allow reduction of the Regional Pond volume from 59 AF to 44-49 AF.
- Conveyance between Inca and Vancouver could be in a 54"-60" RCP storm drain.
- Channel upgrade to provide an approximately 10 inches of additional height on the grade control structures in Reach 4 and the channel wall lining in Reach 5 is required.

Concept 'IIB' is the basis for two of the proposed alternates. The flow control location for the system is 380 cfs at the Pecos Loop crossing. Channel freeboard upgrades on the order of 10+/- inches for the reach between Pecos Loop and Vancouver Road will be required but the Pecos Road crossing will not require upgrade. Upgrade and new construction of facilities upstream of Vancouver Road will be required.

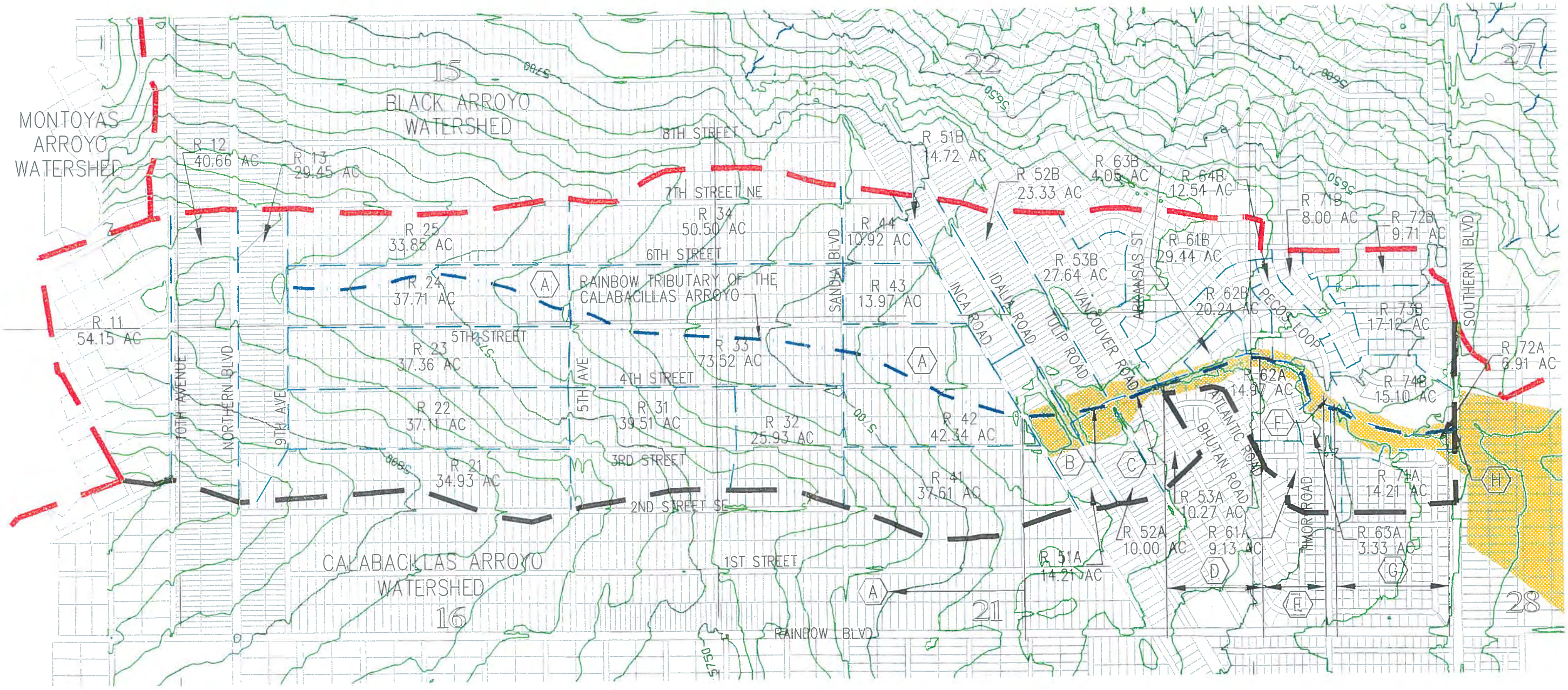
III. CONCEPT WITH NO FLOW LIMITATION; UPGRADE OF CHANNELS, CROSSING STRUCTURES AND GRADE CONTROLS, INCLUDING SOUTHERN BOULEVARD

CONCEPT 'III' – NO PONDS WITHIN SYSTEM ("LET-IT-RIP")

- Conditions north of Inca would be the same as Concept IB. Approx. 4,600' of 54" SD, 8,100' of 48" SD and 6,000' of 36" SD are required for areas where the street capacity exceeds 120 cfs.
- Flow at Inca approx. 1650 cfs.
- Flow at Vancouver at head of existing channel approx. 1850 cfs.
- Stable conveyance Inca to Vancouver - Concrete channel with 30' bottom width, 2:1 side slopes with trapezoidal CBC at Inca Rd, Tulip Road and Vancouver Road Crossing at Idalia Road could be abandoned.
- Pipeline crossing at Idalia Road may create a vertical alignment conflict.

- Upgrade of entire channel and crossing system south of Vancouver Road required. Concrete channel with 30' bottom width and trapezoidal CBC at Pecos Loop and Southern Boulevard crossings.

Concept 'III' is included as a baseline alternate to evaluate the impact of replacement of the existing channel and crossing structures between Vancouver Road and Southern Boulevard Essentially all existing structures and facilities within the reaches of this study will be required.



LEGEND

- 22 — SECTION NUMBERS
- SECTION LINES
- WATERSHED BOUNDARY
- RAINBOW TRIBUTARY STUDY BOUNDARY
- R 21 — BASIN NUMBERS
- BASIN BOUNDARIES
- LOT LINES
- FLOW ARROW
- STORM DRAINS
- CHANNELS/ARROYOS
- DETENTION PONDS/DAMS W/INTEGRATED SWQ
- APPROXIMATE FIRM 100 YEAR FLOOD HAZARD

EXISTING FACILITIES KEYED NOTES

- A REACH 1 – OVERLAND FLOW – POORLY DEFINED FLOW PATH
- B REACH 2 – OVERLAND FLOW
- C REACH 3 – TULIP ROAD CROSSING, 3 – 18" CMP
  TULIP TO VANCOUVER CONVEYANCE, 1 – 18" CMP
  VANCOUVER ROAD CROSSING – NO CULVERT,
  CONCRETE RUNDOWN TO CHANNEL
- D REACH 4 – EARTHEN CHANNEL WITH GRADE CONTROL STRUCTURES
- E REACH 5 – EARTHEN BOTTOM CONCRETE SIDE SLOPE CHANNEL
  WITH GRADE CONTROL STRUCTURES
- F PECOS LOOP CROSSING, 4 – 48" CMP
- G REACH 6 – EARTHEN CHANNEL
- H SOUTHERN BOULEVARD CROSSING, 4 – 48" CMP

NORTH ASCG INCORPORATED

0 500' 1000'

1" = 1000'

CITY OF RIO RANCHO

RAINBOW TRIBUTARY
DRAINAGE MANAGEMENT PLAN

STUDY AREA & DRAINAGE BASIN MAP

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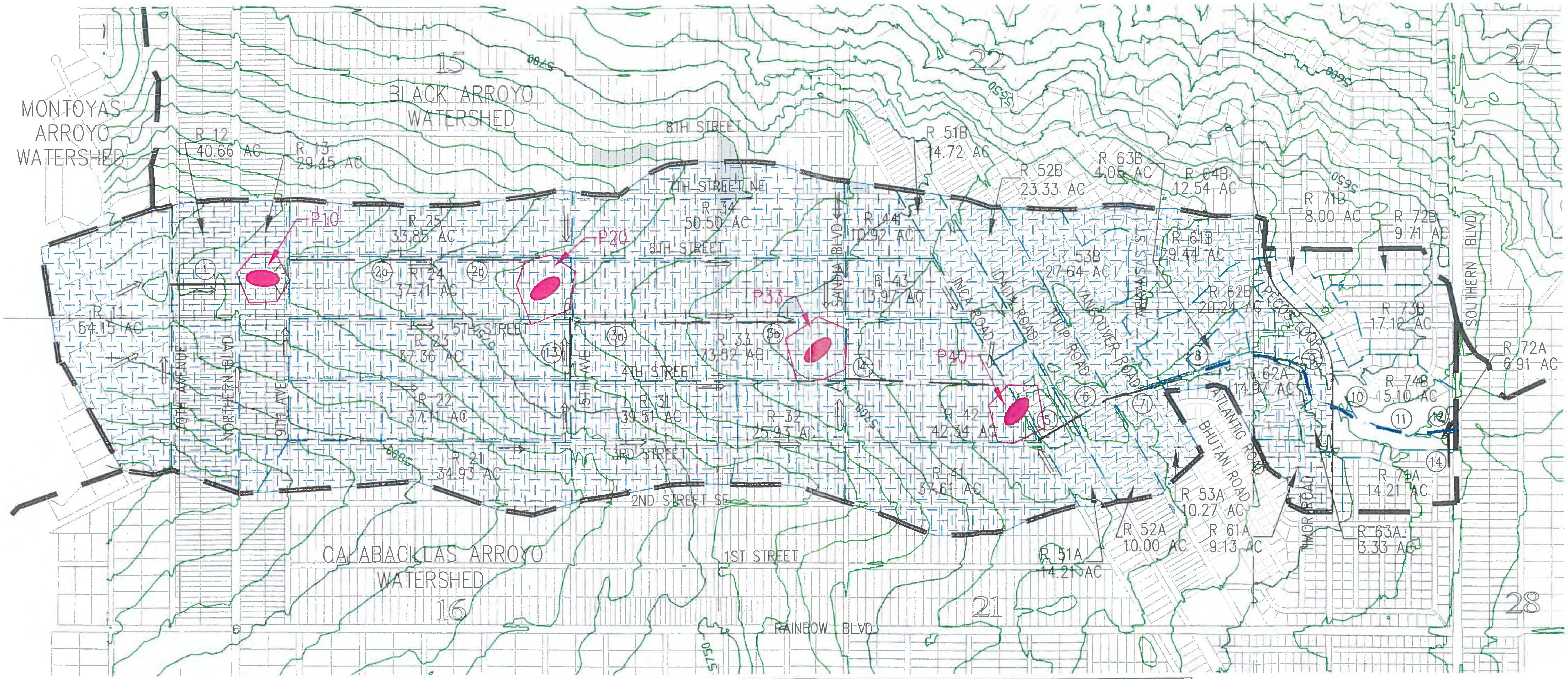
ALBUQUERQUE, NEW MEXICO 87113-1372
PHONE 505.247.0294 · FAX 505.242.4845

FIGURE 2



LEGEND

Symbol	Description
22	SECTION NUMBERS
	SECTION LINES
	WATERSHED BOUNDARY
	RAINBOW TRIBUTARY STUDY BOUNDARY
R 21	BASIN NUMBERS
	BASIN BOUNDARIES
	LOT LINES
	FLOW ARROW
	STORM DRAINS
	CHANNELS/ARROYOS
	DETENTION PONDS/DAMS W/INTEGRATED SWQ
	TEMPORARY RUNOFF RESTRICTION TO 0.5 CFS/AC

CONVEYANCE					
	FACILITY FLOW-CFS	FACILITY	ROW-AC	L-FT	INLETS
1	140	48" SD	0.3	600	6
2a	5-10	18" SD	-	1700	-
2b	40	30" SD	-	600	4
3a	5	18" SD	-	1700	-
3b	40	30" SD	-	600	4
4	47	30" SD	-	1100	-
5	72	42" SD	0.4	500	4
6	148	54" SD	0.4	500	8
7	220	60" SD	0.5	500	-
8	280	(*)	-	-	-
9	290	(*)	-	-	-
10	345	4-48"CMP	-	-	-
11	430	(*)	-	-	-
12	452	4-48" CMP	-	-	-
13	40	1-30" SD	-	700	4
14	40	1-30" SD	-	400	-

PONDS					
	INFLOW Q CFS	OUTFLOW Q CFS	TOTAL VOL AC FT	SWQ VOL AC FT	TOTAL AREA (AC)
P10	349	5	10.7	2.6	4.8
P20	409	5	17.0	3.8	4.4
P33	448	47	15.3	4.0	5.7
P40	310	72	6.9	2.5	2.8

(*) 8 - EXTEND GRADE CONTROLS 1' VERTICAL
(*) 9 - EXTEND SIDE WALL LINING 1' VERTICAL
(*) 11 - PARK LANDSCAPE CHANNEL

NORTH

0 500' 1000'
1" = 1000'

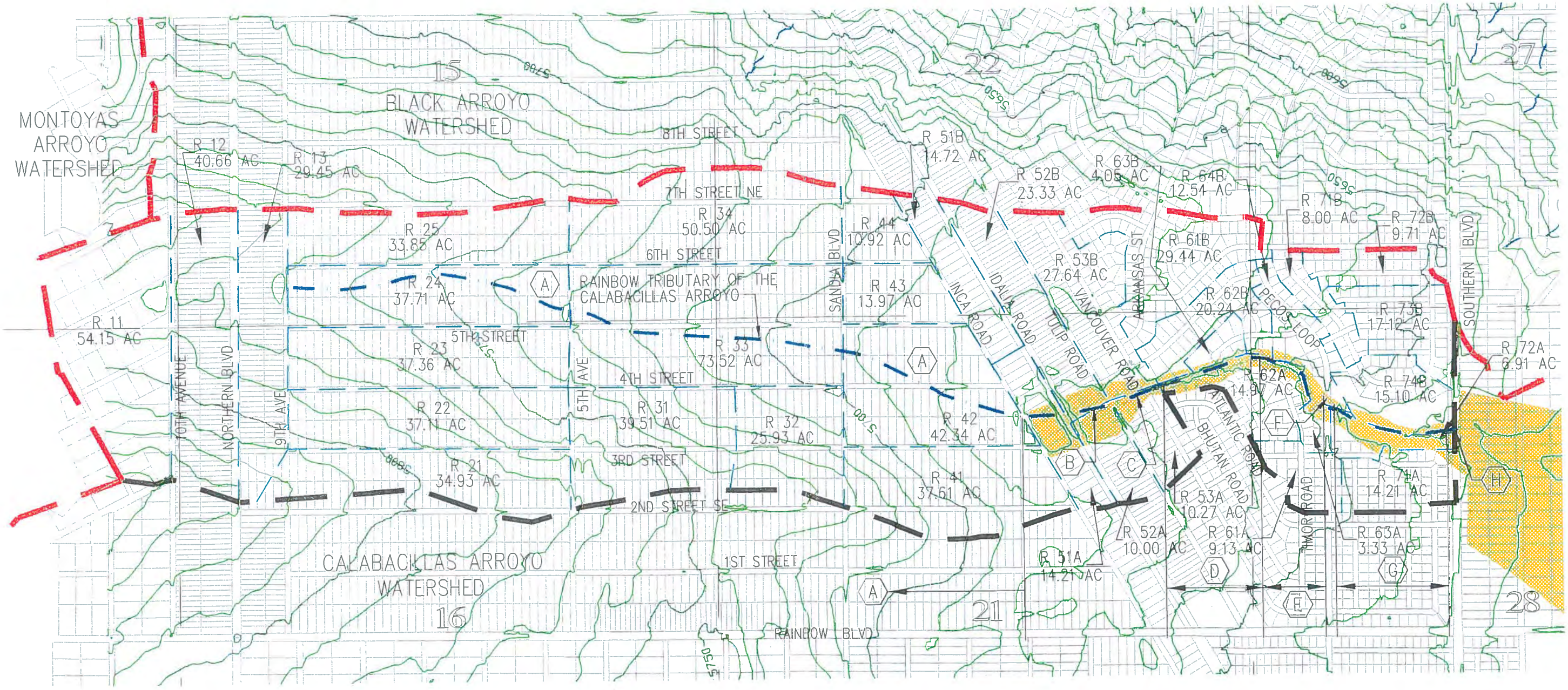
CITY OF RIO RANCHO

RAINBOW TRIBUTARY DRAINAGE MANAGEMENT PLAN

'LOCAL' ALTERNATE & PROPOSED DRAINAGE PLAN

ASCG INCORPORATED

FIGURE 3



LEGEND

- 22 — SECTION NUMBERS
- SECTION LINES
- WATERSHED BOUNDARY
- RAINBOW TRIBUTARY STUDY BOUNDARY
- R 21 — BASIN NUMBERS
- BASIN BOUNDARIES
- LOT LINES
- FLOW ARROW
- STORM DRAINS
- CHANNELS/ARROYOS
- DETENTION PONDS/DAMS W/INTEGRATED SWQ
- APPROXIMATE FIRM 100 YEAR FLOOD HAZARD

EXISTING FACILITIES KEYED NOTES

- A REACH 1 – OVERLAND FLOW – POORLY DEFINED FLOW PATH
- B REACH 2 – OVERLAND FLOW
- C REACH 3 – TULIP ROAD CROSSING, 3 – 18" CMP
  TULIP TO VANCOUVER CONVEYANCE, 1 – 18" CMP
  VANCOUVER ROAD CROSSING – NO CULVERT,
  CONCRETE RUNDOWN TO CHANNEL
- D REACH 4 – EARTHEN CHANNEL WITH GRADE CONTROL STRUCTURES
- E REACH 5 – EARTHEN BOTTOM CONCRETE SIDE SLOPE CHANNEL
  WITH GRADE CONTROL STRUCTURES
- F PECOS LOOP CROSSING, 4 – 48" CMP
- G REACH 6 – EARTHEN CHANNEL
- H SOUTHERN BOULEVARD CROSSING, 4 – 48" CMP

NORTH ASCG INCORPORATED

0 500' 1000'

1" = 1000'

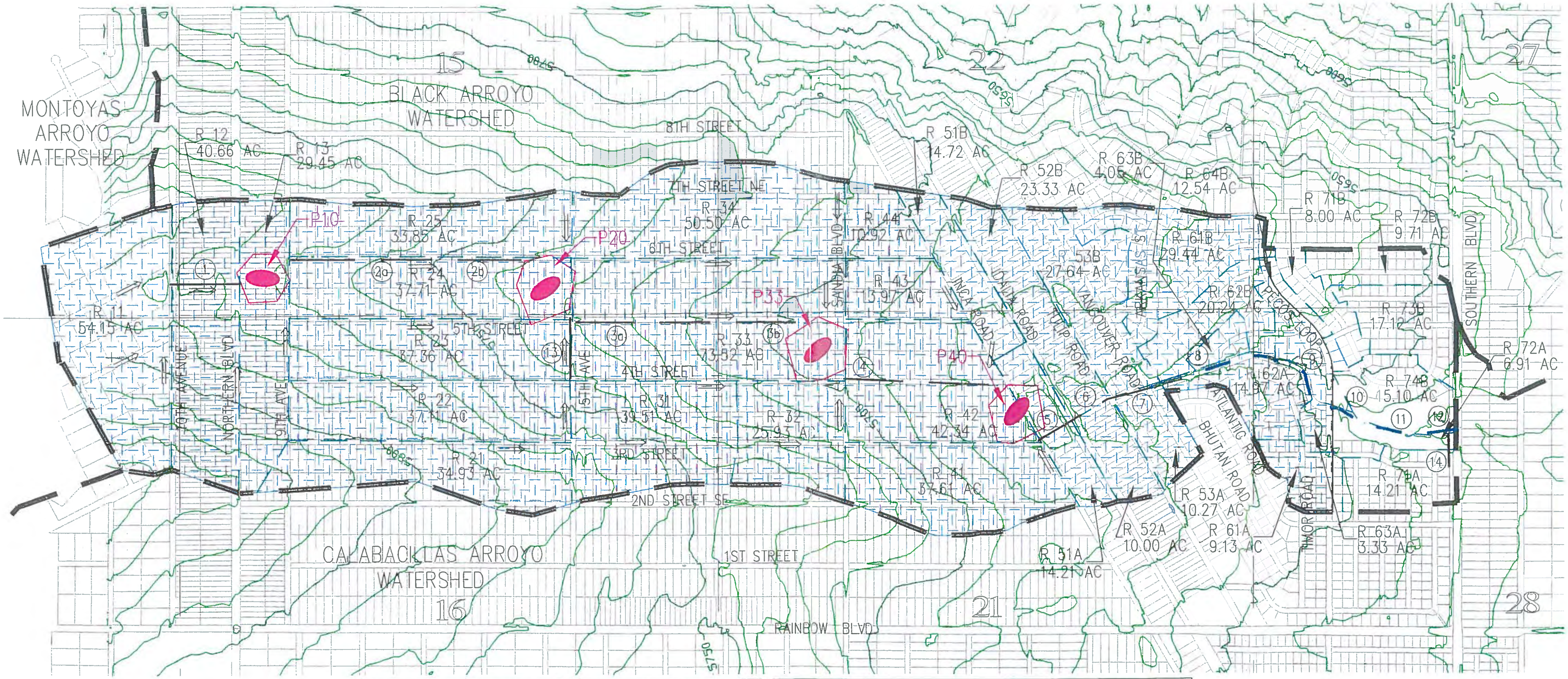
CITY OF RIO RANCHO

RAINBOW TRIBUTARY
DRAINAGE MANAGEMENT PLAN

STUDY AREA & DRAINAGE BASIN MAP

ASCG INCORPORATED
CIVIL/SITE · ARCHITECTS · SURVEYORS · PLANNERS
8501 AMERICAS PARKWAY NE, SUITE 400
ALBUQUERQUE, NEW MEXICO 87113-1372
PHONE 505.247.0294 · FAX 505.242.4845

FIGURE 2



LEGEND

22	SECTION NUMBERS
	SECTION LINES
	WATERSHED BOUNDARY
	RAINBOW TRIBUTARY STUDY BOUNDARY
R 21	BASIN NUMBERS
	BASIN BOUNDARIES
	LOT LINES
	FLOW ARROW
	STORM DRAINS
	CHANNELS/ARROYOS
	DETENTION PONDS/DAMS W/INTEGRATED SWQ
	TEMPORARY RUNOFF RESTRICTION TO 0.5 CFS/AC

CONVEYANCE

	FACILITY FLOW-CFS	FACILITY	ROW-AC	L-FT	INLETS
1	140	48" SD	0.3	600	6
2a	5-10	18" SD	–	1700	–
2b	40	30" SD	–	600	4
3a	5	18" SD	–	1700	–
3b	40	30" SD	–	600	4
4	47	30" SD	–	1100	–
5	72	42" SD	0.4	500	4
6	148	54" SD	0.4	500	8
7	220	60" SD	0.5	500	–
8	280	(*)	–	–	–
9	290	(*)	–	–	–
10	345	4-48"CMP	–	–	–
11	430	(*)	–	–	–
12	452	4-48" CMP	–	–	–
13	40	1-30" SD	–	700	4
14	40	1-30" SD	–	400	–

PONDS

	INFLOW Q CFS	OUTFLOW Q CFS	TOTAL VOL AC FT	SWQ VOL AC FT	TOTAL AREA (AC)
P10	349	5	10.7	2.6	4.8
P20	409	5	17.0	3.8	4.4
P33	448	47	15.3	4.0	5.7
P40	310	72	6.9	2.5	2.8

(*) 8 - EXTEND GRADE CONTROLS 1' VERTICAL
(*) 9 - EXTEND SIDE WALL LINING 1' VERTICAL
(*) 11 - PARK LANDSCAPE CHANNEL

NORTH

0 500' 1000'

1" = 1000'

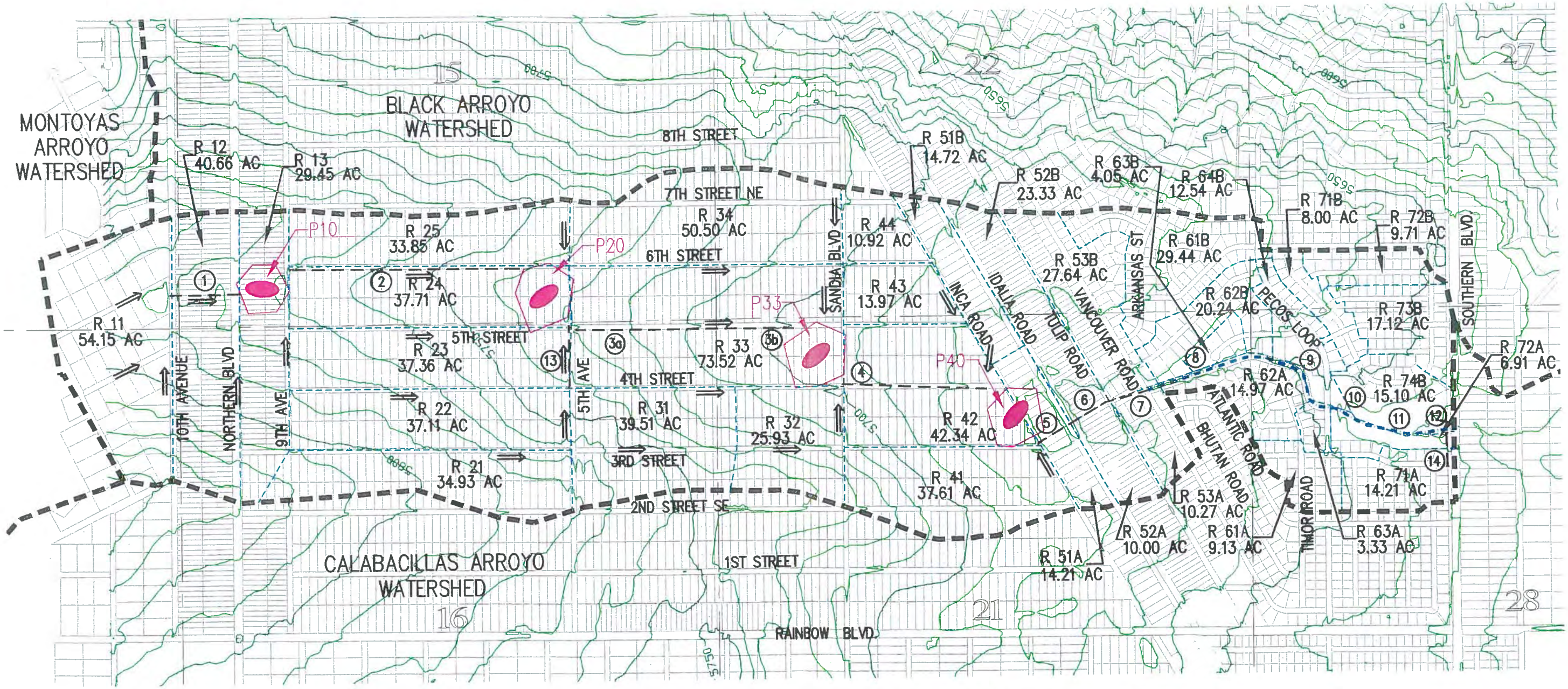
CITY OF RIO RANCHO

RAINBOW TRIBUTARY DRAINAGE MANAGEMENT PLAN

'LOCAL' ALTERNATE & PROPOSED DRAINAGE PLAN

ASCG INCORPORATED

FIGURE 3



LEGEND

22	SECTION NUMBERS
	SECTION LINES
	WATERSHED BOUNDARY
	RAINBOW TRIBUTARY STUDY BOUNDARY
R 21	BASIN NUMBERS
	BASIN BOUNDARIES
	LOT LINES
⟹	FLOW ARROW
	STORM DRAINS
	CHANNELS/ARROYOS
	DETENTION PONDS/DAMS W/INTEGRATED SWQ

CONVEYANCE

	FACILITY FLOW-CFS	FACILITY	ROW-AC	L-FT	INLETS
1	140	48" SD	0.3	600	6
2	5-10	18"SD	–	2900	–
3a	5	18" SD	–	2000	–
3b	25	24"SD	–	335	4
4	47	30" SD	–	1100	–
5	72	42" SD	0.4	500	4
6	148	54" SD	0.4	500	8
7	220	60" SD	0.5	500	–
8	280	(*)	–	–	–
9	312	(*)	–	–	–
10	372	4-48"CMP	–	–	–
11	462	(*)	–	–	–
12	484	4-48" CMP	–	–	–
13	40	1-30" SD	–	700	4
14	40	1-30" SD	–	400	–

PONDS

	INFLOW Q CFS	OUTFLOW Q CFS	TOTAL VOL AC FT	SWQ VOL AC FT	TOTAL AREA (AC)
P10	349	5	10.7	2.6	4.8
P20	409	5	17.0	3.8	4.4
P33	497	47	15.3	4.0	5.7
P40	310	72	6.9	2.5	2.8

(*) 8 – EXTEND GRADE CONTROLS 1' VERTICAL
(*) 9 – EXTEND SIDE WALL LINING 1' VERTICAL
(*) 11 – PARK LANDSCAPE CHANNEL

NORTH

0 500' 1000'

1" = 1000'

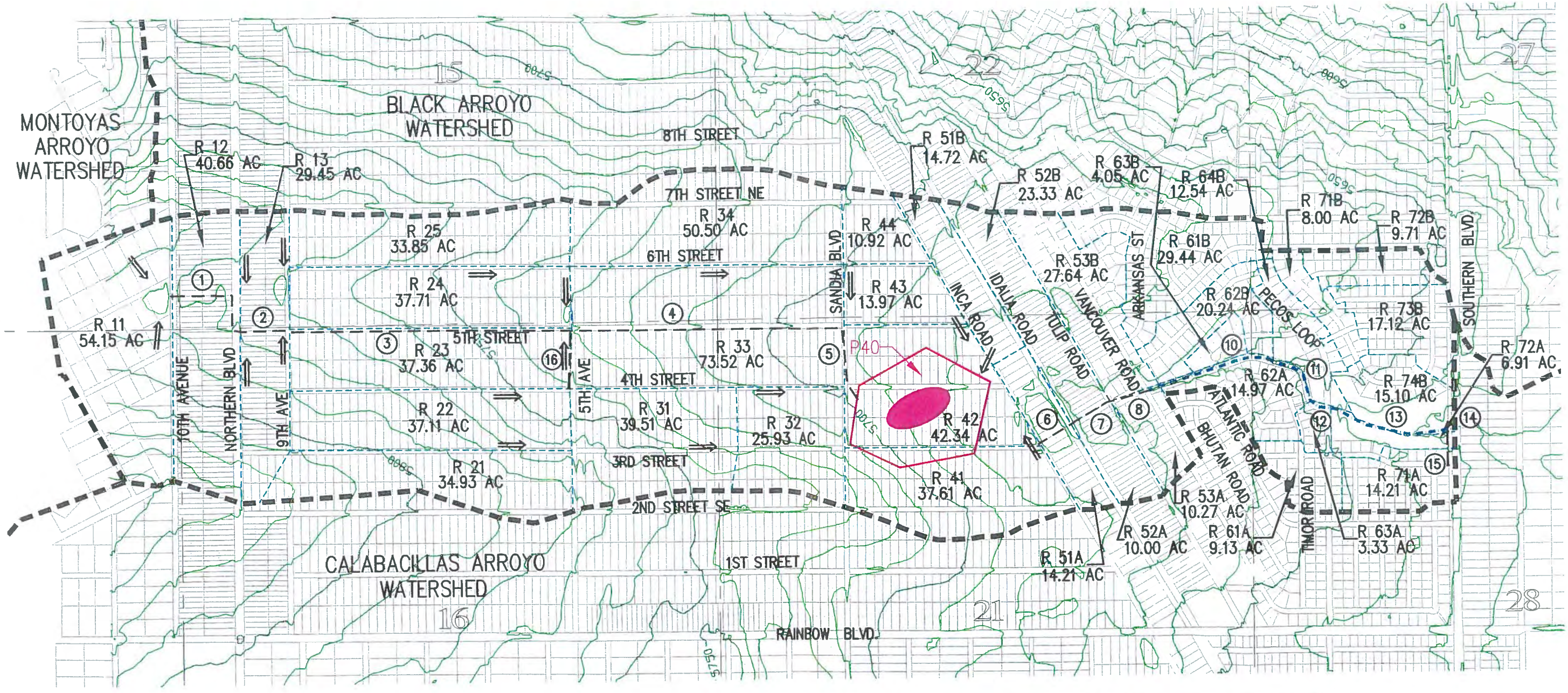
CITY OF RIO RANCHO

RAINBOW TRIBUTARY DRAINAGE MANAGEMENT PLAN

'LOCAL' ALTERNATE

ASCG INCORPORATED

FIGURE 3



LEGEND

22	SECTION NUMBERS
	SECTION LINES
	WATERSHED BOUNDARY
	RAINBOW TRIBUTARY STUDY BOUNDARY
R 21	BASIN NUMBERS
	BASIN BOUNDARIES
	LOT LINES
⇒	FLOW ARROW
	STORM DRAINS
	CHANNELS/ARROYOS
	DETENTION PONDS/DAMS W/INTEGRATED SWQ

CONVEYANCE					
	FACILITY FLOW-CFS	FACILITY		FACILITY FLOW-CFS	FACILITY
1	141	48" SD	10	246	EXTEND GRADE CONTROL 1'
2	262	60"SD	11	300	EXTEND SLOPE PAVING 1'
3	350	66" SD	12	352	30-48" CMP
4	737	90"SD	13	437	PARK LANDSCAPE CHANNEL
5	1016	96" SD	14	455	3-48" CMP
6	184	54" SD + SWALE	15	41	30" SD
7	186	54" SD + SWALE	16	40	30" SD
8	203	60" SD + SWALE			

NOTE: STREET FLOW LIMITED TO 120 CFS.

PONDS					
	INFLOW Q CFS	OUTFLOW Q CFS	TOTAL VOL AC FT	SWQ VOL AC FT	TOTAL AREA (AC)
P40	1465	183	42	12.8	16.2

NORTH

0 500' 1000'

1" = 1000'

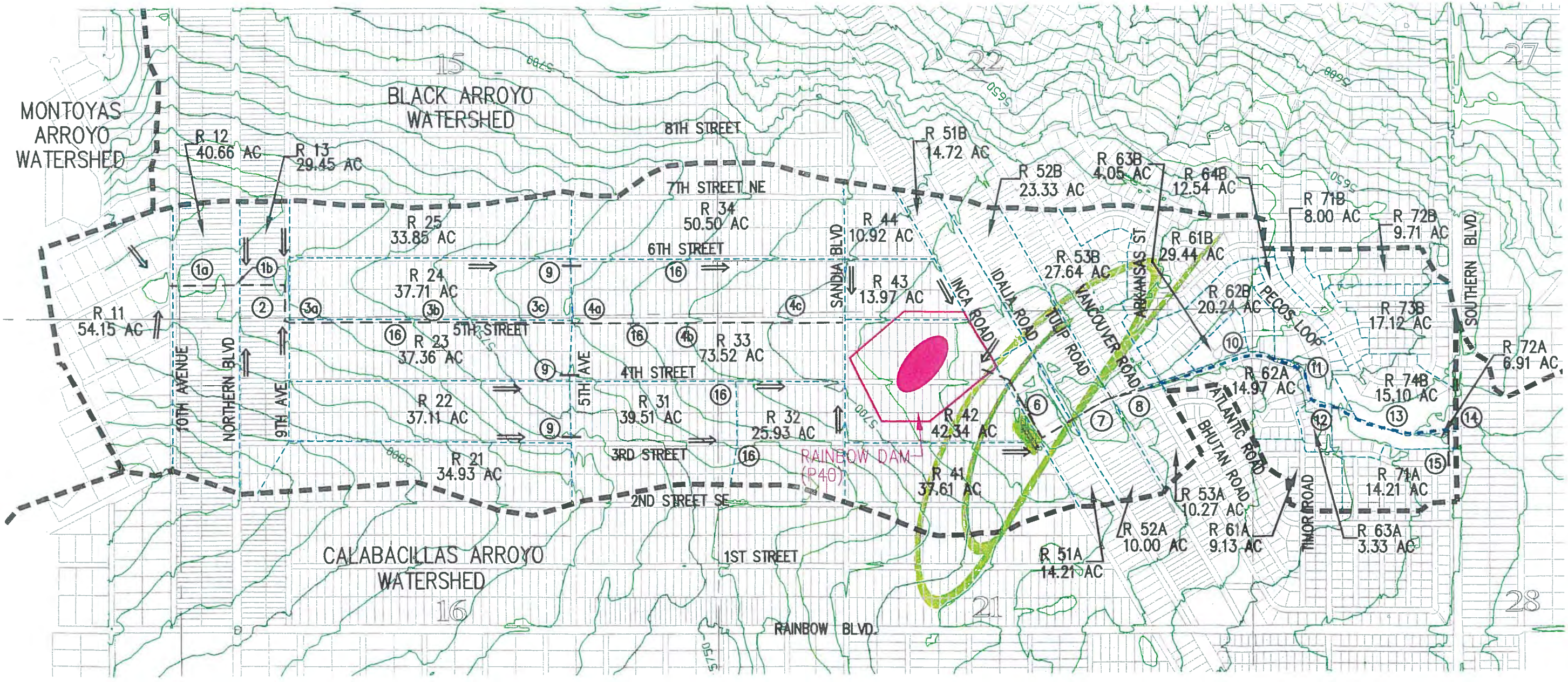
CITY OF RIO RANCHO

RAINBOW TRIBUTARY
DRAINAGE MANAGEMENT PLAN

'REGIONAL #1' ALTERNATE

ASCG INCORPORATED

FIGURE 4



LEGEND

22	SECTION NUMBERS
	SECTION LINES
	WATERSHED BOUNDARY
	RAINBOW TRIBUTARY STUDY BOUNDARY
R 21	BASIN NUMBERS
	BASIN BOUNDARIES
	LOT LINES
	FLOW ARROW
	STORM DRAINS
	CHANNELS/ARROYOS
	DETENTION PONDS/DAMS W/INTEGRATED SWQ

CONVEYANCE — R8100D6B.DAT/SUM

	FACILITY FLOW-CFS	FACILITY		FACILITY FLOW-CFS	FACILITY
1a	141	SWALE IN 50' ROW	7	178	60" SD + SWALE
1b	200	SHALLOW BOX CROSSING	8	242	60" SD + SWALE
2	265	SWALE IN 50' ROW	9	0	WATER BLOCK
3a	346-385	42" SD + STREET-L=900	10	314	EXTEND GRADE CONTROL 1'
3b	385-464	48" SD + STREET-L=1800'	11	323	EXTEND SLOPE PAVING 1'
4a	464-524	54" SD + STREET-L=1400'	12	460	30-48" CMP
4b	524-574	60" SD + STREET-L~1500'	13	465	PARK LANDSCAPE CHANNEL
5	165	54" SD	14	548	3-48" CMP (EXISTING)
6	165	54" SD	15	41	30" SD
			16	120+	STREET CONVEYANCE DESIGN

NOTE: STREET FLOW LIMITED TO 300 CFS.

PONDS

	INFLOW Q CFS	OUTFLOW Q CFS	TOTAL VOL AC FT	SWQ VOL AC FT	TOTAL AREA (AC)
P40	1156	165	38	12.8	16.2

0 500' 1000'

1" = 1000'

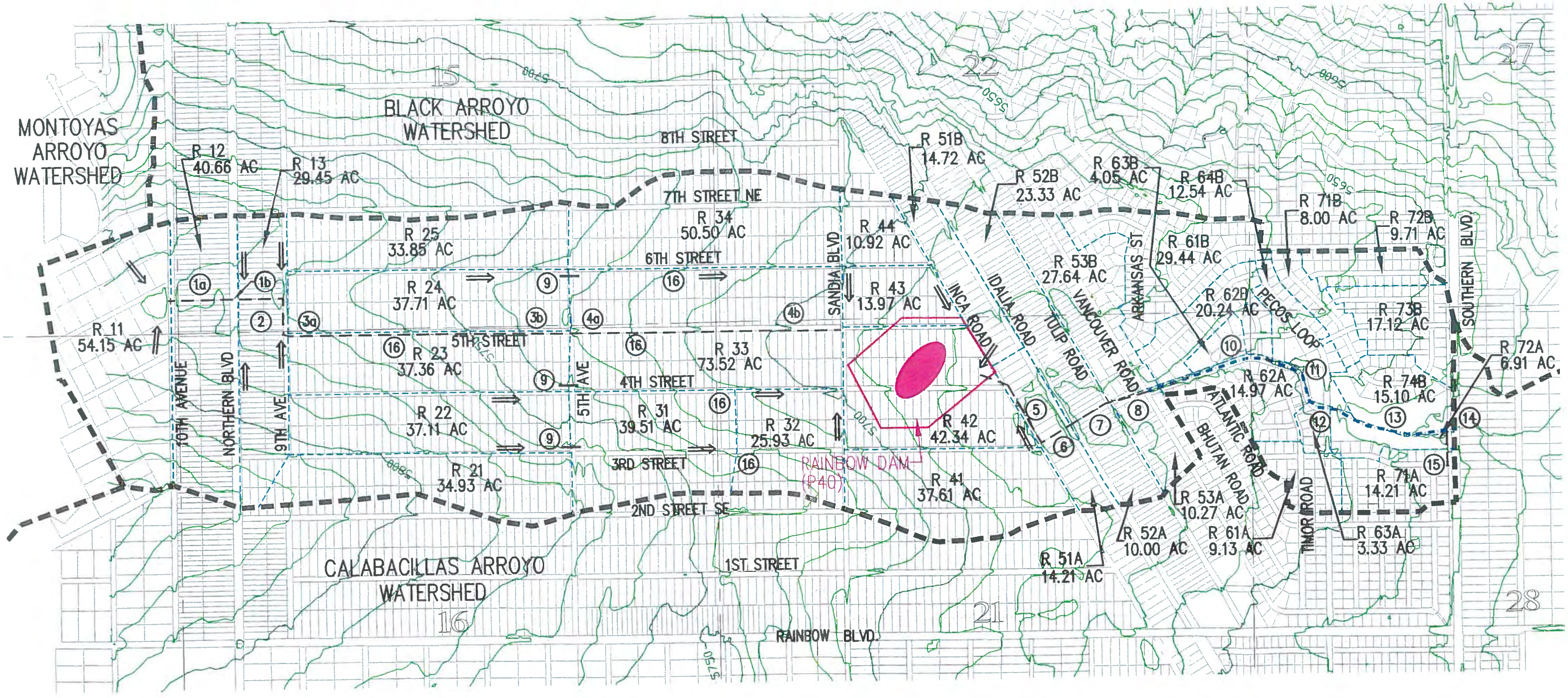
CITY OF RIO RANCHO

RAINBOW TRIBUTARY DRAINAGE MANAGEMENT PLAN

'REGIONAL #2' ALTERNATE

ASCG INCORPORATED

FIGURE 5



LEGEND

22	SECTION NUMBERS
	SECTION LINES
	WATERSHED BOUNDARY
	RAINBOW TRIBUTARY STUDY BOUNDARY
R 21	BASIN NUMBERS
	BASIN BOUNDARIES
	LOT LINES
	FLOW ARROW
	STORM DRAINS
	CHANNELS/ARROYOS
	DETENTION PONDS/DAMS W/INTEGRATED SWQ

CONVEYANCE

	FACILITY FLOW-CFS	FACILITY		FACILITY FLOW-CFS	FACILITY
1a	141	SWALE IN 50' ROW			
1b	200	SHALLOW BOX CROSSING	8	115	24" SD + SWALE
2	265	SWALE IN 50' ROW	9	0	WATER BLOCK
3a	346-385	42" SD + STREET-L=900	10	195	EXTEND GRADE CONTROL 1'
3b	385-464	48" SD + STREET-L=1800'	11	261	EXTEND SLOPE PAVING 1'
4a	464-524	54" SD + STREET-L=1400'	12	319	30-48" CMP (EXISTING)
4b	524-574	60" SD + STREET-L~1500'	13	405	PARK LANDSCAPE CHANNEL
5	5	24" SD	14	428	3-48" CMP (EXISTING)
6	38	24" SD + SWALE	15	41	30" SD
7	52	24" SD + SWALE	16	120-300	STREET CONVEYANCE DESIGN

NOTE: STREET FLOW LIMITED TO 300 CFS. PAVED STREET CONVEYANCE REQUIRED.
DATA IS SUBALTERNATE 3b. BASIN R41 IS DIVERTED INTO P40.

PONDS

	INFLOW Q CFS	OUTFLOW Q CFS	TOTAL VOL AC FT	SWQ VOL AC FT	TOTAL AREA (AC)
P40	1245	5	57	12.8	22

NORTH

0 500' 1000'

1" = 1000'

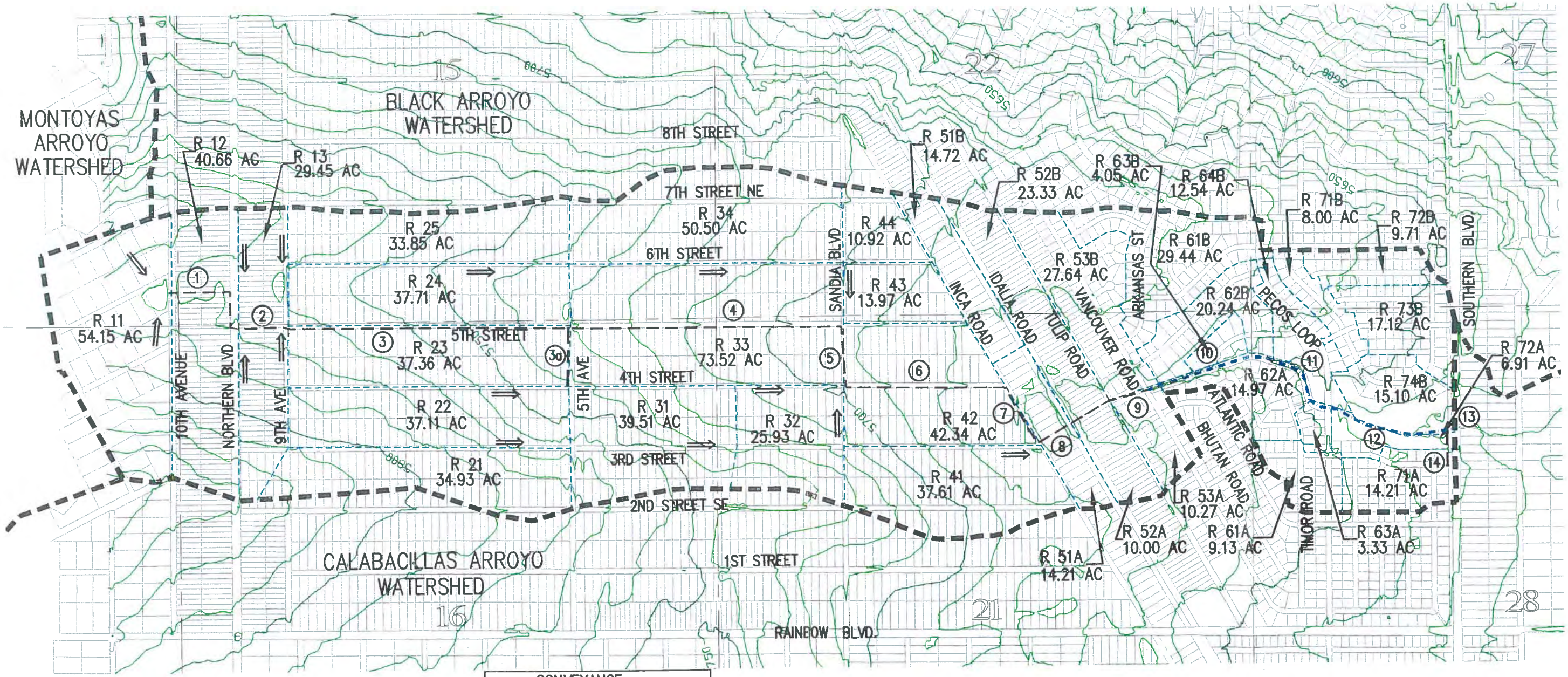
CITY OF RIO RANCHO

RAINBOW TRIBUTARY
DRAINAGE MANAGEMENT PLAN

'REGIONAL #3' ALTERNATE

ASCG INCORPORATED

FIGURE 6



CONVEYANCE		
	FACILITY FLOW-CFS	FACILITY
1	141	48" SD
2	262	60" SD
3	350	66" SD
3a	40	30" SD
4	737	90" SD
5	1016	96" SD
6	1164	102" SD
7	1265	102" SD
8	1465	10' BW PCC CH
9	1595	10' BW PCC CH
10	1681	30' BW PCC CH
11	1710	30' BW PCC CH
12	1797	30' BW PCC CH
13	1887	30' BW PCC CH
14	40	30" SD

LEGEND

- 22 — SECTION NUMBERS
- SECTION LINES
- WATERSHED BOUNDARY
- RAINBOW TRIBUTARY STUDY BOUNDARY
- R 21 — BASIN NUMBERS
- BASIN BOUNDARIES
- LOT LINES
- FLOW ARROW
- STORM DRAINS
- CHANNELS/ARROYOS
- DETENTION PONDS/DAMS W/INTEGRATED SWQ

0 500' 1000'

1" = 1000'

CITY OF RIO RANCHO

RAINBOW TRIBUTARY DRAINAGE MANAGEMENT PLAN

'NO POND' ALTERNATE

ASCG INCORPORATED

FIGURE 7