CHAVEZ · GRIEVES
CONSULTING ENGINEERS, INC.

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# DRAINAGE REPORT

# FOR

# PARADISE BLUFF SUBDIVISION

***Albuquerque, New Mexico***

– 8 1996

**July, 1996**

**ENGINEER'S STATEMENT**

I certify that I am a Registered Professional Engineer in the State of New and that this report was prepared by me or under my supervision. I have personally inspected this land, and it appears that no grading, filling, or excavation has occurred thereon since the existing contour map was prepared.

Joe P. Kelley, N.M.P.E. No. 9996 — 7/5/96 Date

JOE P. KELLEY NEW MEXICO 9996 REGISTERED PROFESSIONAL ENGINEER

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# PLAN SHEETS

# Paradise Bluff Drainage Report

## LOCATION

This site is located in Paradise Hills, 500' south of Paradise Boulevard, ½ mile west of Golf Course Road.

## LEGAL DESCRIPTION

Tract A-2C, Paradise Bluff; Tract B, Martin Apartment Site.

## ZONING AND SURROUNDING DEVELOPMENT

Tract A-2C consists of 34 acres on the southerly portion of the site, and is zoned R-1. Tract B consists of 5 acres on the northern part of the site, and is zoned R-2, Paradise Hills Special Zoning District.

The land between the northern boundary and Paradise Boulevard is a developed residential area. The land next to the northwest corner is developed as an apartment complex. Along the western border of this site is a dedicated City Right-of-Way with no infrastructure improvements. The Petroglyph National Monument abuts this site on the south.

Council Bill R-339, the Northwest Mesa Escarpment Plan, outlines special requirements for the 100' strip of land adjacent to the Petroglyphs. The Plan requires that site improvements within this strip of land must be no higher than 19' above grade. "Grade" means natural (historical) grade. The Northwest Mesa Escarpment Plan also limits wall heights to 6'.

## FLOOD HAZARD ZONES

As shown by panel 3500020001 of the National Flood Insurance Program Flood Insurance Rate Maps for the City of Albuquerque, dated October 14, 1983, the site is not in or adjacent to a designated flood hazard zone.

## EXISTING SITE CONDITIONS AND DRAINAGE PATTERN

The site is presently undeveloped, and includes the escarpment that distinguishes Albuquerque's west side. The escarpment is along the eastern and northern site

perimeter; most of the site sits above the escarpment and slopes down to the east at about 4%. The ground above the escarpment is vegetated with native grasses and a few native trees and bushes. Borings indicate that much of the site is underlain by basalt, and basalt can be seen on about 10% of the surface.

A 4:1 slope with a 15-20' drop-off is on the northern perimeter along the escarpment. This slope is stable because it is primarily rock. There is no evidence of erosion along the escarpment.

The site lies at the top of the watershed, and receives off-site runoff from only one source: the Martin Apartments to the west. Developed flows from the apartments enter the site via nine 3" pipes that discharge runoff from a parking lot onto the native ground of this site, 250' from the northern property corner. A field investigation revealed no evidence of erosion from this runoff.

The apartments also discharge developed runoff into the street along their southern boundary just before it enters this site. Minor erosion has occurred at the point of discharge, but the runoff appears to dissipate after that, and there is no evidence of further downstream erosion.

## RELATED REPORTS

Research was done to determine if a drainage plan had been filed for the Martin Apartments, and none could be found. The Martin Apartments are on County land, but a drainage report could not be found at the County or the City.

This site lies within the Piedras Marcadas watershed. Molzen-Corbin and Associates has prepared a study of the Piedras Marcadas Arroyo for AMAFCA that has not yet been officially released. However, the hydrologic model that they developed was used for the design of the Golf Course Road (GCR) storm drain that is under construction. The Molzen-Corbin study modeled the existing flows from the Paradise Bluff area, and modeled several hypothetical future flow conditions in the watershed.

The Molzen-Corbin study was used by Leedshill-Herkenhoff Engineers to compute design flows for the GCR storm drain that will extend north to Paradise Blvd. The new storm drain will also extend about 400' west on the south side of Paradise Blvd. and will end in a new inlet structure. The Golf Course Road storm drain was designed for the ultimate developed Paradise Blvd watershed, including the subject area. The Molzen-Corbin study did not include sediment bulking factors in the flow rate calculations. However, bulking factors were incorporated into the calculations done by Leedshill.

## PROPOSED SITE CONDITIONS AND BASIN DEVELOPMENT PLAN

The site will be developed as a residential subdivision. Roads and storm drain improvements will be built and dedicated to the City. The escarpment portion of the site (located in Parcel A) will be dedicated to City Open Space.

There were three factors that determined how this site was graded:

1. In the 100' wide strip of land adjacent to Petroglyph National Monument, the escarpment plan allows a 19' difference between existing ground and the top of new improvements Therefore, house pads on the southern perimeter of the site were located at no higher than 4' above existing grade. This would limit houses to a 15' eve height.

2. A site survey and boring logs were done that indicate the elevation and extent of basalt. The Owner requested that 2' of fill be maintained above the basalt at each house pad. In most cases, 2-3' of cover was maintained over the basalt. But there are some pads which will require excavation into the basalt. These pads have been indicated on the plan for use by the grading Contractor.

3. The Owner also desired that the grading plan be designed such that the amount of dirt imported onto the site be minimized. With this in mind, it was found that some lots could be lowered and still fit in well with the remainder of the grading plan by providing on-site retention ponding in the backyards. These lots are all in Basin G, and the ponding quantities are summarized on page 9. The required ponding areas were computed on page 9, and these areas can be compared to the ponds indicated on the plan to confirm their compliance. Three side benefits of retention ponding are: 1) The amount of off-site runoff is reduced; 2) The amount of runoff discharged into the Open Space parcel from the developed lots is almost eliminated. The Open Space Division prefers this pattern; 3) On-site lots with backyard ponding will be able to better harvest the storm water for irrigation purposes.

3. Walls were limited in height to 6' by the Northwest Mesa Escarpment Plan. This meant that there could be only minor elevation differences along any lot line, or along the project perimeter. It was not possible to lower the new perimeter lots and drain off-site runoff onto this site because of the shallow basalt depths. Therefore the combination of the wall height limitation and shallow basalt depth meant that perimeter runoff had to be discharged in historical fashion, or individual backyard ponding must be employed. If the site received off-site runoff, the site must still receive the perimeter runoff. If the site discharged runoff off-site, it may still

discharge the perimeter runoff off-site with the consent of the downstream property owner. In all cases, as shown on the Basin Runoff Summary (page 8), the off-site discharges of developed flows are less than historical.

Provision needs to be made on all projects for storms that are greater than the 100-year design storm. In this development, there is no overflow via public right-of-way. Therefore, the storm drain was designed to convey two times the 100-year storm from the subdivision to the downstream public right-of-way in Paradise Hills Boulevard.

The hydraulic grade line for two times the 100-year discharge is shown on the plan sheets for Colby Court/Paradise Boulevard (sheet 20), with the accompanying calculations on page C-1. As shown on sheet 20, the hydraulic grade line starts at the surface of the inlet on Paradise Blvd. At this point the overflow runoff will bubble out of the inlet and discharge downstream in the public right-of-way. The new Paradise Blvd storm drain will have the capacity to carry slightly more than the 100-year discharge to Golf Course Road, as calculated on page E-2. The 100-year hydraulic grade line was not plotted at all because the pipe has sufficient capacity per Manning's equation, as calculated in the AHYMO run on page B-2 and following. Inlet calculations showing that the designed inlets have two times the 100-year capacity are on page C-2 and following. A 50% clogging factor was added to inlets in a sump condition.

## PETROGLYPH NATIONAL MONUMENT AND OPEN SPACE PARCEL A

As stated before, the site is adjacent to the Petroglyph National Monument. Therefore, the Park Service was consulted to arrive at a design that is compatible with the Monument's development.

The portion of the subdivision that contains the escarpment is on the north and west side of the site. City Open Space has agreed that they would like to have this land as part of the City's Open Space system. Therefore, this portion of land has been partitioned off from the rest of the subdivision as Parcel A. It will be deeded to City Open Space after the public infrastructure on the remainder of the site has been constructed.

On July 14, 1994 Joe Kelley of Chavez-Grieves Consulting Engineers, Inc. (agent for the owner of Paradise Bluff) met Ms. Diane Souder of the National Park Service and Mr. Matt Schmader of City Open Space at the site. They examined the preliminary runoff calculations, walked the site, and discussed its future development.

On August 17, 1994, a meeting was held at City Hydrology to discuss the development of Paradise Bluff. A copy of the meeting agenda is in Appendix D. The key results of the

meeting were:

1. The National Park Service doesn't want to lose the benefit of runoff which historically discharges to the Monument. Therefore, the Park Service has agreed to accept developed flows from lots along the common boundary, with the provision that a note be added to the plat to limit lot discharges to the amounts calculated in this drainage report. Drainage structures will be built on each lot to mitigate erosion on Monument land.

2. The developer will construct a wall along the Monument boundary that is acceptable in appearance to the Park Service.

3. The majority of the lots which abut the Open Space Parcel A will be graded to provide backyard retention ponding. A few of the lots adjacent to Parcel A will be graded so that roof runoff discharges to the new subdivision streets, while developed backyard runoff will discharge to the north in its historical pattern. This developed discharge of 17.58 cfs at Analysis Point 1 (page 8 summary) is much less than the historical discharge of 36.32 cfs. Because the discharge rate is less than historical, City Open Space has agreed accept the runoff.

4. A high-tensile wire fence will be constructed around Parcel A, similar to the fence Open Space constructs around all its parcels.

Parcel A will not be deeded to Open Space until after construction is completed. However, Open Space does not want their future property to be scarred by construction operations. Therefore, on October 14, 1994 Mr. Matt Schmader of City Open Space requested that Open Space be allowed to install a fence around Parcel A prior to construction. The Developer observed that it will be very difficult for construction operations and earthmoving equipment to operate on-site without crossing the Parcel A line. Therefore, he counter-offered to operate on Parcel A within 50' of the boundary, and to restore any damaged areas to original or better condition to the Open Space Division's satisfaction. It will be necessary to construct drainage and utility lines across Parcel A, so the construction Contractor will be required to restore the Parcel A utility crossings to as close to original conditions as possible.

The drainage structures on the Park Boundary, as mentioned above, have been designed to mitigate erosion in the Park. As shown on page C-7, the structures will slow down runoff so that the velocities are not erosive as runoff enters the Monument.

## OFF-SITE STORM DRAIN RUNOFF

The GCR storm drain bid opening was in October, 1994. The GCR storm drain was planned to discharge runoff from the fully developed North Piedras Marcadas watershed (which includes this site). Therefore, this site can discharge to the GCR storm drain. This was confirmed in conversations with Mr. Roger Paul, Molzen-Corbin's drainage engineer.

There are no plans currently or in the near future for the construction of a storm drain in Paradise Blvd. In a June 2, 1994 conversation with Mr. Larry Blaire, the Executive Engineer for AMAFCA, Mr. Blaire said that AMAFCA had no funding or definite plans for construction of a Paradise Boulevard storm drain. He also said that he was aware of no private parties interested in constructing a storm drain in Paradise Boulevard. Therefore, it will be this developer's responsibility to construct a connection to the GCR storm drain.

It is not known at this time just how much of the Paradise Blvd. watershed will eventually be connected to the GCR storm drain. Depending on the extent of the upstream watershed diverted to other watersheds, prelirminary calculations indicate that it may be necessary to construct a 54" or a 72" line (or larger) up Paradise Blvd. In September 8, 1994 discussions with Mr. Larry Blaire, and Mr. Roger Paul, acting in the capacity of drainage consultant for Bernalillo County, it was determined that it would not be prudent to construct a storm drain at this time in Paradise Blvd. for the fully-developed watershed, because the size of the line is unknown. It was also agreed that it was not the developer's responsibility to construct the storm drain to discharge the ultimate flow (which is unknown until the extent of the developed watershed is agreed upon).

A new storm drain will be built as part of this project. It will convey on-site runoff to the GCR storm drain. The off-site portion of the storm drain will be on land that is within the unincorporated part of Bernalillo County. The new storm drain alignment will be north along Colby Court, then east 1/4 mile along Paradise Blvd. to Fairfax, where it will connect to the GCR storm drain.

As shown on page E-7, the new Paradise Blvd storm drain will be located in such a manner as to permit the installation of a parallel future storm drain without encroaching on the future installation area. In this way, the new storm drain will not negatively impact a future one, and the new storm drain will reduce the amount of runoff that a future storm drain would be required to convey to the GCR storm drain.

AMAFCA was the lead governmental entity for the GCR storm drain project. But Larry Blaire of AMAFCA stated that AMAFCA will not take the lead on this one. Therefore, it was determined that the City will own and maintain the entire storm drain, including the portion that is in the Paradise Hills Blvd right-of-way, which is County-owned.

Another concern was the ownership and maintenance of the storm drain. The City has agreed to own and maintain the line. The on-site lines will be owned and maintained by the City, and the Golf Course Road storm drain will be owned and maintained by the City. Therefore, the City agreed that it made sense for them to own and maintain the portion of intervening line along Paradise Hills Boulevard. The County has agreed to this. Initially there was some confusion as to whether a separate easement would be required for the City to own and maintain the line on County right-of-way. At one point in time the issue had supposedly been resolved with the understanding that the new storm drain can be installed and maintained under the existing joint-powers agreement between the City and County. However, the two governmental entities are now re-examining this arrangement. As stated by Mr. Roger Paul on May 7, 1996, acting as County Development Review Engineer, he and Mr. Fred Aguirre of City Hydrology are now working out the details of the storm drain access/maintenance agreement.

## CONCLUSION

This site complies with the requirements of the City of Albuquerque. Each of the perimeter basins will discharge less than historical flows to the perimeter. The cumulative discharge to Paradise Boulevard complies with the constraints established by the Golf Course Road storm drain design done by Leedshill-Herkenhoff. As shown on page E-6, the Golf Course Road storm drain has a capacity of 825 cfs at Analysis Point 5, while the ultimate 100-year discharge in the pipe at that point was calculated as 642.48 cfs.

This site will be developed in accordance with the future storm runoff scenario for Paradise Blvd. It complies with the requirements of Bernalillo County, and of AMAFCA.

This site complies with the requirements of the National Park Service. The drainage parameters established by this report will be established by plat action. Therefore, future owners of individual lots within the subdivision can be forced to comply with its provisions. This has been insured by the addition of notes to the plat outlining specific runoff parameters and maintenance responsibilities.

## CALCULATIONS

Hydrologic calculations were done using the AHYMO computerized hydrologic model. The AHYMO computer run includes rating curves for the streets and storm drain. New storm drain lines were sized in accordance with Manning's equation for non-pressure storm runoff discharge. No hydraulic grade line was calculated for the 100-year storm because the hydraulic grade line will be inside the pipe. Sediment bulking factors were included in the computerized hydrologic calculations. The bulking factors that were used were identical to the ones that were used in the design of the GCR storm drain by Leedshill-

| BASIN RUNOFF SUMMARY (SEDIMENT BULKING FACTOR INCLUDED) | | | | | |
|---|---|---|---|---|---|
| | 6-HOUR UNDEVELOPED | | 6-HOUR DEVELOPED | | CAPACITY (CFS) |
| BASIN | Q (CFS) | VOLUME (AC-FT) | Q (CFS) | VOLUME (AC-FT) | (IF APP-LICABLE) |
| A | 29.42 | 0.819 | 11.37 | 0.315 | |
| A-1 | 6.27 | 0.234 | 6.27 | 0.234 | |
| B | 33.08 | 0.934 | 14.17 | 0.484 | |
| C | 6.98 | 0.197 | 5.14 | 0.174 | |
| D | 2.18 | 0.081 | 2.18 | 0.081 | |
| E-1 | | | 7.32 | 0.268 | |
| E-2 | | | 11.01 | 0.387 | |
| E-2a | | | 10.24 | 0.367 | |
| E-2b | | | 5.40 | 0.190 | |
| E-3 | | | 5.81 | 0.218 | |
| E-3a | | | 11.43 | 0.416 | |
| E-3a1 | | | 2.76 | 0.092 | |
| E-4 | | | 16.73 | 0.605 | |
| E-4a | | | 6.50 | 0.231 | |
| E-4b | | | 12.91 | 0.463 | |
| E-5 | | | 2.63 | 0.091 | |
| F | 1.35 | 0.038 | 0.63 | 0.018 | |
| A.P.1 | 36.32 | 1.133 | 17.58 | 0.549 | |
| A.P.2 | 40.06 | 1.131 | 19.31 | 0.658 | |
| A.P.3 | 6.27 | 0.234 | 6.27 | 0.234 | |
| A.P.4 | | | 28.69 | 0.831 | 67.08 |
| A.P.5 | | | 36.27 | 1.470 | 48.67 |
| A.P.6 | | | 12.91 | 0.463 | 56.18 |
| A.P.7 | | | 4.81 | 0.172 | 51.79 |
| A.P.8 | | | 2.76 | 0.092 | 13.68 |

| POND VOLUME CALCULATIONS* | | | | | | | |
|---|---|---|---|---|---|---|---|
| Basin | Q-360 (CFS) | V-360 (AC-FT) | A(d) (AC.) | V(10-day) (AC-FT) | No. of Lots in Basin | Vol/Lot (CU-FT) | Pond Area Req'd for 1.0' Depth (SQ-FT) |
| G-1 | 3.49 | 0.105 | 2.06 | 0.29 | 21 | 611 | 611 |
| G-2 | 0.41 | 0.011 | 0 | 0.01 | 1 | 479 | 479 |
| G-3 | 0.54 | 0.015 | 0.23 | 0.04 | 2 | 788 | 788 |
| G-4 | 0.43 | 0.012 | 0.12 | 0.02 | 1 | 1,004 | 1,004 |
| G-5 | 0.29 | 0.008 | 0.23 | 0.03 | 2 | 635 | 635 |
| G-6 | 1.95 | 0.057 | 0.81 | 0.13 | 7 | 819 | 819 |
| G-7 | 0.33 | 0.01 | 0.02 | 0.01 | 2 | 258 | 258 |

P(1440) PER FIGURE C-3: 2.7 INCHES/HR

P(10-DAY) PER EQUATION C-9: 3.80 INCHES

BULKING FACTOR: 1.003

*COMPUTATION OF 100-YEAR, 10-DAY VOLUME PER THE DPM, SECTION 22.2, JANUARY 1993, EQUATION A-9.

| RETENTION POND SIZING | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Basin** | **Basin Area (SF)** | **Basin Runoff Vol (CF)** | **Lot** | **Pervious Lot Area (SF)** | **Lot Runoff Vol (CF)** | **Area Req'd @ 1.0' Dp. (SF)** | **Area Prov'd (SF)** |
| G-1 | 56,600.00 | 12,831.00 | A-5 | 2742 | 621 | 621 | 758 |
| | | | A-6 | 2115 | 479 | 479 | 599 |
| | | | A-7 | 1958 | 444 | 444 | 468 |
| | | | A-8 | 1958 | 444 | 444 | 474 |
| | | | A-9 | 2154 | 488 | 488 | 759 |
| | | | A-10 | 2448 | 555 | 555 | 798 |
| | | | A-11 | 2327 | 512 | 512 | 512 |
| | | | A-12 | 3092 | 701 | 701 | 797 |
| | | | A-13 | 2585 | 586 | 586 | 906 |
| | | | A-19 | 3917 | 1089 | 1089 | 1673 |
| | | | A-20 | 2526 | 413 | 913 | 413 |
| | | | A-21 | 2711 | 589 | 589 | 589 |
| | | | A-22 | 2664 | 604 | 604 | 1416 |
| | | | A-24 | 2773 | 629 | 629 | 687 |
| | | | A-25 | 2773 | 629 | 629 | 780 |
| | | | A-26 | 2773 | 629 | 629 | 920 |
| | | | A-27 | 2773 | 629 | 629 | 920 |
| | | | A-28 | 2773 | 629 | 629 | 920 |
| | | | A-29 | 2773 | 629 | 629 | 920 |
| | | | A-30 | 3282 | 744 | 744 | 1122 |
| | | | A-31 | 3482 | 789 | 789 | 1196 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| G-2 | 7,350.00 | 479.00 | Parcel C | 7350 | 479 | 479 | 4123 |
| G-3 | 8,950.00 | 1,576.00 | A-36 | 4450 | 780 | 780 | 920 |
| | | | A-37 | 4500 | 796 | 796 | 977 |
| G-4 | 7,200.00 | 1,004.00 | A-38 | 7200 | 1004 | 1004 | 1264 |
| G-5 | 4,200.00 | 1,270.00 | A-43 | 2200 | 670 | 670 | 1047 |
| | | | A-44 | 2000 | 600 | 600 | 955 |
| G-6 | 32,950.00 | 5,733.00 | A-59 | 4244 | 738 | 738 | 1026 |
| | | | A-60 | 5597 | 974 | 974 | 1702 |
| | | | A-61 | 6338 | 1103 | 1103 | 1533 |
| | | | A-62 | 4291 | 747 | 747 | 972 |
| | | | A-63 | 3759 | 654 | 654 | 937 |
| | | | A-64 | 3759 | 654 | 654 | 950 |
| | | | A-65 | 4962 | 863 | 863 | 1319 |
| G-7 | 5,000.00 | 516.00 | A-89 | 2500 | 258 | 258 | 1164 |
| | | | A-90 | 2500 | 258 | 258 | 1129 |

## COMPUTATION OF BASIN SURFACE TREATMENTS

Add 3850 SF of "D" area for the house area on these lots: 1-16, block A; 88-98, block A; 1-6, block B; 1-13, block C.
Add 4250 SF of "D" area for all other houses.
Add 400 SF of "D" area in each backyard (for patio/storage).
Add 730 SF of "D" area in each front yard (18'x35' driveway, and 4'x25' front walk).
Streets will be computed as "D" area, and will be the face-face street width + 9' (4' sidewalk + 6" curb on both sides) times the length.
Non-"D" areas within the subdivision will be taken as 1/2 "b" (turf) + 1/2 "C" (rocks).
Open tract areas will be taken as "A", "B", or "C", depending on the slope.

| DEVELOPED BASIN | TREATMENT "D" AREA | | | | | | TREATMENT AREA (SF) | | | | | TREATMENT AREA (PERCENT) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NO. HOUSES (2200 SF) | NO. HOUSES (3850 SF) | NO. BACK YARDS (400 SF) | NO. FRONT YARDS (730 SF) | STREET | TOTAL | "A" | "B" | "C" | TOTAL AREA (SF) | TOTAL AREA (SM) | "A" | "B" | "C" | "D" |
| A | | | 5 | | | 2,000 | 7,500 | 137,748 | 33,800 | 181,048 | 0.0064942 | 4% | 76% | 19% | 1% |
| A-1 | | | | | | 59,400 | | 3,300 | 3,300 | 66,000 | 0.0023674 | 0% | 5% | 5% | 90% |
| B | | 18.0 | 18.0 | 18.0 | | 89,640 | | 47,929 | 47,929 | 185,497 | 0.0066538 | 0% | 26% | 26% | 48% |
| C | | 6.0 | 10.0 | 6.0 | | 31,480 | | 18,238 | 18,238 | 67,956 | 0.0024376 | 0% | 27% | 27% | 46% |
| D | | | | | | 20,520 | | 1,140 | 1,140 | 22,800 | 0.0008178 | 0% | 5% | 5% | 90% |
| E-1 | | 8.5 | | 9.0 | 24,960 | 64,255 | | 8,698 | 8,698 | 81,650 | 0.0029288 | 0% | 11% | 11% | 79% |
| E-2 | | 12.0 | 4.0 | 11.0 | 26,240 | 82,070 | | 26,340 | 26,340 | 134,750 | 0.0048335 | 0% | 20% | 20% | 61% |
| E-2a | | 9.5 | 8.0 | 10.0 | 35,670 | 82,745 | | 18,703 | 18,703 | 120,150 | 0.0043098 | 0% | 16% | 16% | 69% |
| E-2b | | 6.0 | 5.0 | 7.0 | 9,700 | 39,910 | | 13,045 | 13,045 | 66,000 | 0.0023674 | 0% | 20% | 20% | 60% |
| E-3 | | 8.0 | 4.0 | 7.0 | 18,450 | 55,960 | | 1,920 | 1,920 | 59,800 | 0.0021450 | 0% | 3% | 3% | 94% |
| E-3a | | 15.5 | 9.0 | 16.0 | 23,560 | 98,515 | 10,800 | 12,968 | 12,968 | 135,250 | 0.0048514 | 8% | 10% | 10% | 73% |
| E-3a1 | | 3.0 | 3.0 | 2.0 | | 14,210 | 43,500 | 745 | 745 | 59,200 | 0.0021235 | 73% | 1% | 1% | 24% |
| E-4 | 23.0 | 3.0 | 18.0 | 22.0 | 54,600 | 140,010 | | 26,220 | 26,220 | 192,450 | 0.0069032 | 0% | 14% | 14% | 73% |
| E-4a | 5.5 | 3.5 | 8.0 | 11.0 | 13,300 | 50,105 | | 13,835 | 13,835 | 77,775 | 0.0027898 | 0% | 18% | 18% | 64% |
| E-4b | 17.5 | 2.0 | 9.0 | 22.0 | 36,260 | 102,120 | | 24,715 | 24,715 | 151,550 | 0.0054361 | 0% | 16% | 16% | 67% |
| E-5 | | | 2.0 | | 17,670 | 18,470 | | 7,165 | 7,165 | 32,800 | 0.0011765 | 0% | 22% | 22% | 56% |
| F | | | 3.0 | | | 1,200 | | 4,450 | 4,450 | 10,100 | 0.0003623 | 0% | 44% | 44% | 12% |
| G-1 | | | 21.0 | | | 8,400 | | 24,100 | 24,100 | 56,600 | 0.0020302 | 0% | 43% | 43% | 15% |
| G-2 | | | | | | 0 | | 3,675 | 3,675 | 7,350 | 0.0002636 | 0% | 50% | 50% | 0% |
| G-3 | | | 2.0 | | | 800 | | 4,075 | 4,075 | 8,950 | 0.0003210 | 0% | 46% | 46% | 9% |
| G-4 | | | 1.0 | | | 400 | | 3,400 | 3,400 | 7,200 | 0.0002583 | 0% | 47% | 47% | 6% |
| G-5 | | | 2.0 | | | 800 | | 1,700 | 1,700 | 4,200 | 0.0001507 | 0% | 40% | 40% | 19% |
| G-6 | | | 7.0 | | | 2,800 | | 15,075 | 15,075 | 32,950 | 0.0011819 | 0% | 46% | 46% | 8% |
| G-7 | | | 2.0 | | | 800 | | 2,100 | 2,100 | 5,000 | 0.0001794 | 0% | 42% | 42% | 16% |

# AHYMO Hydrologic Output -- Proposed Conditions

```
SEDIMENT BULK       CODE=1  BULKING FACTOR=1.282
**********************************************************************
*SS  NOW ADD THE OVERFLOW FROM THE NORTH SIDE OF PARADISE BLVD TO
*SS  THE FLOW ON THE SOUTH SIDE.  THIS WILL ALL BE CAPTURED BY THE
*SS  NEW INLET DESIGNED BY LEEDSHILL.
ADD HYD             ID=2  HYD=PARA_TTL  ID I=2  ID II=12
PRINT HYD           ID=2  CODE=1

                                        HYDROGRAPH FROM AREA PARA_TTL


    RUNOFF VOLUME =     1.10466 INCHES     =      13.9308 ACRE-FEET
    PEAK DISCHARGE RATE =     372.86 CFS  AT   1.600 HOURS   BASIN AREA =   .2365 SQ. MI.


*SS  ADD THIS FLOW TO THE FLOW IN THE STORM DRAIN FOR THE TOTAL IN THE
*SS  STORM DRAIN AT GLOBUS/PARADISE.
ADD HYD             ID=2  HYD=GLOB_PIP  ID I=2  ID II=4
PRINT HYD           ID=2  CODE=1

                                        HYDROGRAPH FROM AREA GLOB_PIP


    RUNOFF VOLUME =     1.17297 INCHES     =      17.3378 ACRE-FEET
    PEAK DISCHARGE RATE =     453.54 CFS  AT   1.600 HOURS   BASIN AREA =   .2771 SQ. MI.


*SS  NOW ADD THE FLOW FROM THE CATTLE GUARD INLET NORTH OF PARADISE
*SS  ROAD AT FAIRFAX FOR THE TOTAL IN THE PIPE EAST OF GLOBUS.
ADD HYD             ID=2  HYD=TOT_PIPE  ID I=2  ID II=16
PRINT HYD           ID=2  CODE=1

                                        HYDROGRAPH FROM AREA TOT_PIPE


    RUNOFF VOLUME =     1.04537 INCHES     =      29.2452 ACRE-FEET
    PEAK DISCHARGE RATE =     594.54 CFS  AT   1.600 HOURS   BASIN AREA =   .5246 SQ. MI.


*SS  CHANGE THE BULKING FACTOR TO 1.003 FOR DEVELOPED BASINS.
SEDIMENT BULK       CODE=1  BULKING FACTOR=1.003
*S*************** CALCULATE BASIN 204.5 **********************
COMPUTE NM HYD      ID=3 HYD NO=204.5 DA=.090
                    PER A=3 PER B=77 PER C=5 PER D=15
                    TP=-.32 RAIN=-1

    K =   .175602HR    TP =   .320000HR    K/TP RATIO =   .548757     SHAPE CONSTANT, N =  7.044188
    UNIT PEAK =   22.079    CFS   UNIT VOLUME =    .9994       B =   523.34      P60 = 1.8400
    AREA =      .013500 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .033330


    K =   .311783HR    TP =   .320000HR    K/TP RATIO =   .974322     SHAPE CONSTANT, N =  3.624966
    UNIT PEAK =   78.733    CFS   UNIT VOLUME =    .9998       B =   329.34      P60 = 1.8400
    AREA =      .076500 SQ MI    IA =    .49647 INCHES    INF =   1.24012 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .033330

    BULKING FACTOR APPLIED TO HYDROGRAPH.  FACTOR =  1.00300 AT PEAK FLOW.

PRINT HYD           ID=3 CODE=10
```

# AHYMO Hydrologic Output -- Proposed Conditions

PARTIAL HYDROGRAPH 204.50

| TIME HRS | FLOW CFS | TIME HRS | FLOW CFS | TIME HRS | FLOW CFS | TIME HRS | FLOW CFS |
|---|---|---|---|---|---|---|---|
| .000 | .0 | 2.000 | 40.9 | 4.000 | 1.5 | 5.999 | .4 |
| 7.999 | .0 | | | | | | |
| .333 | .0 | 2.333 | 15.6 | 4.333 | 1.1 | 6.333 | .3 |
| 8.333 | .0 | | | | | | |
| .667 | .0 | 2.666 | 6.8 | 4.666 | .8 | 6.666 | .1 |
| 8.666 | .0 | | | | | | |
| 1.000 | .0 | 3.000 | 4.4 | 5.000 | .6 | 6.999 | .1 |
| 1.333 | 1.5 | 3.333 | 3.0 | 5.333 | .5 | 7.333 | .0 |
| 1.666 | 71.3 | 3.666 | 2.1 | 5.666 | .4 | 7.666 | .0 |

RUNOFF VOLUME = .85894 INCHES = 4.1229 ACRE-FEET
PEAK DISCHARGE RATE = 72.91 CFS AT 1.700 HOURS BASIN AREA = .0900 SQ. MI.

```
*SS  ADD 204.5 TO REMAINDER OF THE FLOW.  THIS WILL RESULT IN THE TOTAL
*SS  COMBINED PIPE AND STREET FLOW AT THE PARADISE BLVD/GOLF COURSE ROAD
*SS  INTERSECTION.  THE GOLF COURSE ROAD STORM DRAIN HAS BEEN DESIGNED
*SS  FOR ULTIMATE DISCHARGE AT THIS POINT OF 825 CFS.
ADD HYD              ID=4 HYD=GRANDTTL ID I=2 II=3
PRINT HYD            ID=4 CODE=10
```

HYDROGRAPH FROM AREA GRANDTTL

| TIME HRS | FLOW CFS | TIME HRS | FLOW CFS | TIME HRS | FLOW CFS | TIME HRS | FLOW CFS |
|---|---|---|---|---|---|---|---|
| .000 | .0 | 4.000 | 7.8 | 7.999 | .4 | 11.999 | .3 |
| 15.998 | .3 | | | | | | |
| .333 | .0 | 4.333 | 6.1 | 8.333 | .3 | 12.332 | .3 |
| 16.332 | .3 | | | | | | |
| .667 | .0 | 4.666 | 5.1 | 8.666 | .3 | 12.665 | .3 |
| 16.665 | .3 | | | | | | |
| 1.000 | .0 | 5.000 | 4.7 | 8.999 | .3 | 12.999 | .3 |
| 16.998 | .3 | | | | | | |
| 1.333 | 39.3 | 5.333 | 4.5 | 9.332 | .3 | 13.332 | .3 |
| 17.332 | .3 | | | | | | |
| 1.666 | 617.4 | 5.666 | 4.5 | 9.666 | .3 | 13.665 | .3 |
| 17.665 | .3 | | | | | | |
| 2.000 | 262.4 | 5.999 | 4.7 | 9.999 | .3 | 13.999 | .3 |
| 17.998 | .3 | | | | | | |
| 2.333 | 106.5 | 6.333 | 2.7 | 10.332 | .3 | 14.332 | .3 |
| 18.331 | .3 | | | | | | |
| 2.666 | 48.1 | 6.666 | 1.3 | 10.666 | .3 | 14.665 | .3 |
| 18.665 | .3 | | | | | | |
| 3.000 | 27.0 | 6.999 | .8 | 10.999 | .3 | 14.998 | .3 |
| 18.998 | .3 | | | | | | |
| 3.333 | 16.3 | 7.333 | .6 | 11.332 | .3 | 15.332 | .3 |
| 19.331 | .3 | | | | | | |
| 3.666 | 10.8 | 7.666 | .4 | 11.665 | .3 | 15.665 | .3 |
| 19.665 | .3 | | | | | | |

RUNOFF VOLUME = 1.01807 INCHES = 33.3681 ACRE-FEET
PEAK DISCHARGE RATE = 655.64 CFS AT 1.600 HOURS BASIN AREA = .6146 SQ. MI.

**Chavez-Grieves Consulting Engineers, Inc.**
**Paradise Bluff Storm Drain**
**Hydraulic Grade Line Calculations**
**By: Joe Kelley**
**Date: July 1, 1996**
**Analysis of pipe under surcaharged conditions: 2 x 100-year storm.**

| Station | Structure | Pipe Diameter (inches) | Q Flow (cfs) | Pipe Area (s.f.) | Velocity (fps) | K Factor | Friction Slope Sf | Pipe Length (feet) | Pipe Curve (degrees) | Bend Angle (degrees) | Junction Angle (degrees) | Friction Loss Hf | Curve Loss Hc | Junction Loss Hj | Manhole Loss Hmh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16+18.86 | MH/outlet | | | | | | | | | | | | | | |
| | | 36 | 164.9600 | 7.0686 | 23.3371 | 666.9833 | 0.0612 | 154.1500 | 0.0000 | | | 9.4291 | 0.0000 | | |
| 14+64.71 | MH | | | | | | | | | | | | | | 0.6498 |
| | | 30 | 164.9600 | 4.9087 | 33.6054 | 410.1708 | 0.1617 | 137.4300 | 0.0000 | | | 22.2285 | 0.0000 | | |
| 13+27.28 | MH | | | | | | | | | 50.0000 | | | | | 0.6498 |
| | | 36 | 164.9600 | 7.0686 | 23.3371 | 666.9833 | 0.0612 | 225.8600 | 0.0000 | | | 13.8155 | 0.0000 | | |
| 11+01.42 | MH | | | | | | | | | | | | | | 0.4228 |
| | | 36 | 164.9600 | 7.0686 | 23.3371 | 666.9833 | 0.0612 | 101.4200 | 0.0000 | | | 6.2037 | 0.0000 | | |
| 10+00 | MH | | | | | | | | | | | | | | 0.2114 |
| | | | 164.9600 | 0.0000 | | 0.0000 | | | 0.0000 | | | | 0.0000 | | |
| | | | | | | | | | | | | | | | |

**Manning's N =** 0.013

| Transition Loss Ht | Bend Loss Hb | Total Losses (feet) | Hydraulic Grade Line (downstream) | Hydraulic Grade Line (upstream) | Pipe Invert | Soffit Elevation | Ground Surface Elevation | Velocity Head Hv | Energy Grade Line (downstream) | Energy Grade Line (upstream) | Junction (3) Diameter (inches) | Junction (3) Area (s.f.) | Junction (3) Vel. Head (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.0000 | | 34.66 | 26.60 | 29.10 | 34.66 | | | 43.12 | | | |
| | | 9.4291 | | | | | | 8.46 | | | | | |
| | 0.0000 | 0.6498 | 44.09 | 44.74 | 37.60 | 40.10 | 46.37 | | 61.63 | 62.27 | | 0.0000 | |
| | | 22.2285 | | | | | | 17.54 | | | | | |
| | 1.9374 | 2.5872 | 66.97 | 69.55 | 54.50 | 57.00 | 62.12 | | 75.42 | 78.01 | | 0.0000 | |
| | | 13.8155 | | | | | | 8.46 | | | | | |
| | 0.0000 | 0.4228 | 83.37 | 83.79 | 79.90 | 82.40 | 85.98 | | 91.83 | 92.25 | | 0.0000 | |
| | | 6.2037 | | | | | | 8.46 | | | | | |
| | 0.0000 | 0.2114 | 90.00 | | 84.64 | 87.64 | 93.33 | | 90.00 | | | 0.0000 | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | 0.0000 | |

| Comments |
|---|
| Begin HGL at surface (allow water to run out of inlet). |
| |
| HGL below ground surface, above soffit of pipe. |
| |
| HGL below ground surface, above soffit of pipe |
| |
| HGL above ground. Use locking manhole lid |
| |
| HGL below surface: allows for entrance of runoff into inlet. |
| |
| |

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SHEET NO. 1 OF 5
JOB
SUBJECT
CLIENT
JOB NO.
BY JPK DATE 10/11/94

# STORM INLET CAPACITIES / DESIGN

- INLETS ON GRADE:

1) AT A.P.5:

Q IN STREET = 36.27 CFS

48' F-F STREET WITH 4' MEDIAN @ .537%. PER ADYMO RATING CURVE: D=0.60

THE CAPACITY OF ONE DOUBLE A INLET, PER PLATE 22.3 D-6 IS:

13 cfs. (PAGE C-4; PAGE B-24)

THE CAPACITY OF TWO INLETS (ONE EACH SIDE OF STREET) IS:

26 cfs.

2) JUST WEST OF A.P.4:

Q IN STREET = 28.69 cfs

32' F-F STREET @ 1.02% SLOPE HAS A DEPTH OF 0.50'. (PAGE B-36)

THE CAPACITY OF ONE DOUBLE C INLET IS: 9.3 cfs. (PAGE ...)

THE CAPACITY OF BOTH INLETS IS: 18.6 cfs.

- INLETS IN A SUMP:

3) IN BASIN E-2a:

Q INTO INLET = 9.80 cfs

THIS INLET IS IN A SUMP WITH NO OVERFLOW TO A PUBLIC R.O.W.

THEREFORE, DESIGN IT TO CONVEY 2 x 100-YEAR FLOW:

$Q_{DESIGN} = 9.80 \times 2 \times 1.5 = 29.4$ CFS (← 50% CLOGGING FACTOR)

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DESIGN A TYPE "A" INLET WITH (2) 4' "WINGS".

PER FIG. 2 (PAGE C-5), THE WINGS ALLOW IN 2.2 CFS/FOOT.

8' × 2.2 CFS/FT = 17.6 CFS.

PER FIG. 1 (PAGE C-5) THE SINGLE GRATE HAS A CAPACITY OF 17.0 CFS. THIS GIVES A TOTAL CAPACITY OF 34.6 CFS > 29.4 CFS.

FINAL CHOICE: SINGLE "A" INLET WITH TWO 4' WINGS.

4) IN BASIN E-2:

$Q_{INTO\ INLETS} = 22.90$ CFS

THESE INLETS ARE IN A SUMP. SIMILAR TO 3) (ABOVE), IT WILL BE DESIGNED TO CATCH 2× 100-YEAR STORM. IN THIS CASE, 2× 100-YEAR APPLIES TO THE UPSTREAM WATERSHED. THEREFORE: ← THE $Q_{INTO}$ THE UPSTREAM INLETS.

$$Q_{DESIGN} = [(76.73 - 22.90) \times 2 - (26 + 18.6)] \times 1.5 = 94.59 \text{ CFS}$$

(76.73 ← THE 100-YEAR Q IN THE PIPE DOWNSTREAM; 1.5 ← 50% CLOGGING)

DESIGN TWO "A" TYPE INLETS WITH DOUBLE 4' WINGS:

$Q_{INTO\ WINGS} = 16' \times 2.2\ CFS/FT = 35.2$ CFS

C-5 ←

PER FIG. 1, CHOOSE TWO TRIPLE GRATES IN THE SUMP:

TOTAL CAPACITY = 33.5 + 33.5 + 35.2 = 102.2 > 94.6 CFS REQ'D

FINAL CHOICE: TWO TRIPLE "A" INLETS WITH TWO 4' WINGS.

5) IN BASIN E-1:

$Q_{INTO\ INLET} = 7.32$ CFS. SIMILAR TO SITUATION 3 (ABOVE):

$Q_{DESIGN} = 7.32 \times 2 \times 1.5 = 21.96$ CFS

USE A DOUBLE "C" INLET → $Q_{CAP} = 25.5$ CFS PER PAGE C-5.

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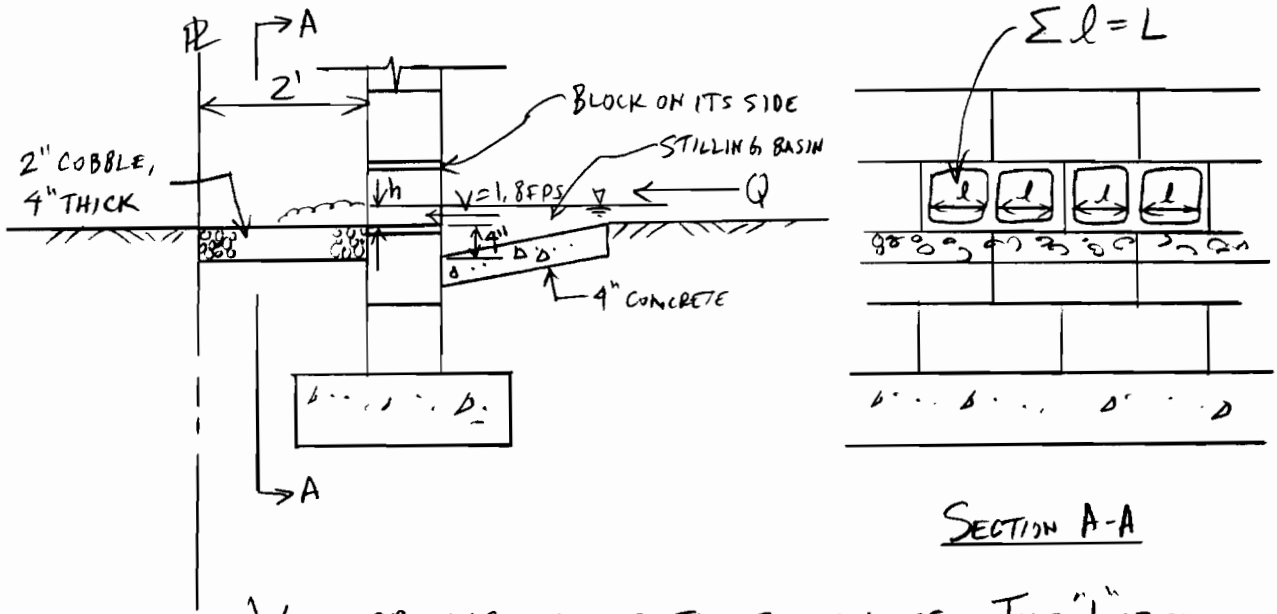
SHEET NO. 1 OF 4
JOB
SUBJECT
CLIENT
JOB NO.
BY JPK DATE 10/17/94

# DESIGN OF DISCHARGE STRUCTURES AT LOTS

DESIGN WATER DISCHARGE STRUCTURES FROM EACH LOT THAT WILL RELEASE THE FLOWS AT NON-EROSIVE VELOCITIES.

1) USE THE ATTACHED CHART (PAGE C-9) FROM THE CORPS OF ENGINEERS TO DETERMINE THE ALLOWABLE DISCHARGE VELOCITY. ACCORDING TO THE SOILS REPORT, SITE SOILS ARE FINE TO MEDIUM-GRAINED SANDS. FROM THE CHART, ALLOWABLE VELOCITIES WOULD BE 1.8 FPS OR LESS. THEREFORE, DESIGN THE WALL OPENINGS TO LIMIT VELOCITIES TO 1.8 FPS.




SECTION A-A

WALL OPENINGS WILL BE TWO BLOCKS WIDE. THE "L" OF ONE BLOCK = 12". TOTAL L = 24" = 2'

USE THE WEIR EQUATION AND CONTINUITY EQUATION TO ANALYZE:

WEIR EQ'N: $Q = 3.0 L h^{1.5}$

CONTINUITY: $V = Q/A = Q/Lh \rightarrow Q = VLh$

EQUATE: $VLh = 3.0 L h^{1.5} \rightarrow h^{0.5} = \frac{1}{3} V$

SUBSTITUTING V = 1.8 FPS YIELDS h = 0.36' = CONSTANT

C-7

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THE Q ASSOCIATED WITH h=.36' AND L=2' IS:

$Q = 3(2)(.36)^{1.5} = 1.30$ CFS (CAPACITY OF 2-BLOCK OPENING).

THE DISCHARGE FROM LOT 74, BLK (A) IS 3.35 CFS. INSTALLING 3 OPENINGS ON THIS LOT WILL GIVE IT A CAPACITY OF $3 \times 1.30 = 3.90$ CFS. THE DISCHARGE FROM THE REMAINDER OF THE LOTS VARIES FROM 0.15 TO 0.97 CFS. THEREFORE, A SINGLE 2-BLOCK OPENING WILL WORK ON ALL THE OTHER LOTS.

2) 2" GRAVEL (OR COBBLE) WILL BE PLACED DOWNSTREAM OF THE OPENINGS TO FURTHER ALLEVIATE EROSION. PER ATTACHED PAGE C-10, NO GRAVEL IS REALLY NEEDED DUE TO THE LOW VELOCITY. HOWEVER, IT WILL BE ADDED AS "INSURANCE". 2" GRAVEL WILL BE USED RATHER THAN 6" OR LARGER BECAUSE LARGER GRAVEL WILL TEND TO PROMOTE EROSION AND WASH-OUT OF THE FINER SOILS BENEATH. THE GREATER THE SIZE DIFFERENCE BETWEEN STABLE PARTICLES AND SMALLER PARTICLES UNDERNEATH, THE GREATER THE POTENTIAL FOR WASH-OUT.

3) WE HAVE OBSERVED SIGNIFICANT EROSION AT THE OUTFALLS OF BLOCK OPENINGS SIMILAR TO THE ONES SHOWN HERE. THIS OCCURS BECAUSE OF INADEQUATE DETAILING AND CONSTRUCTION. THEREFORE, THE FOLLOWING ELEMENTS WILL PREVENT EROSION ON THIS PROJECT:

1) A SMALL STILLING BASIN WILL BE CONSTRUCTED UPSTREAM OF THE OPENING.
2) THE OUTFALL FROM THE OPENING WILL BE "AT GRADE" (NO DROP-OFF).
3) 2" GRAVEL OR COBBLE INTSIDE THE OPENING WILL DISPERSE RUNOFF.

4) THE ONLY POSSIBLE DRAWBACK TO THIS DESIGN IS THAT THE POTENTIAL FOR WATER STANDING BEHIND THE 4" LIP AFTER EVERY STORM. THEREFORE, MORTAR WILL BE ELIMINATED IN THE VERTICAL JOINT JUST DOWNSTREAM OF THE OPENING.

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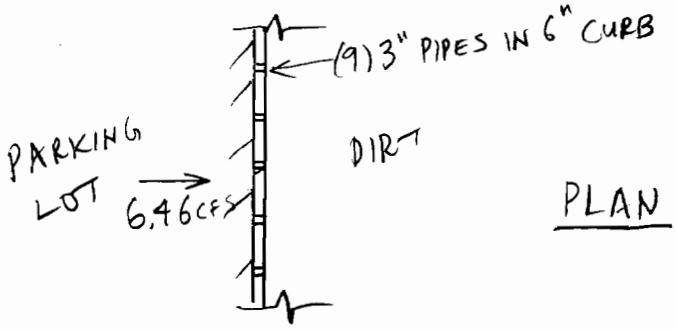
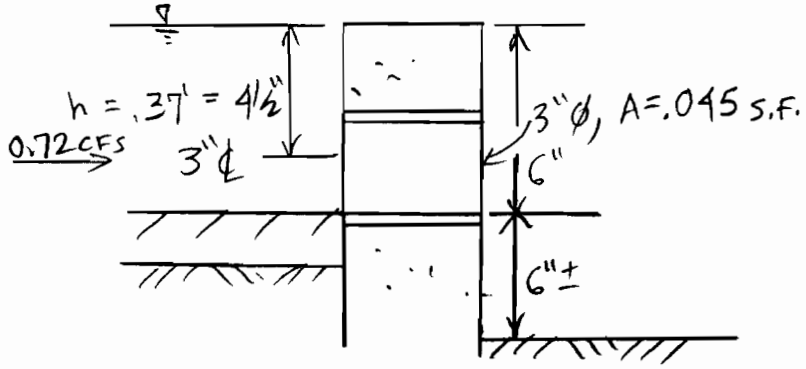
SHEET NO. 1 OF 2
JOB
SUBJECT
CLIENT
JOB NO.
BY JPK DATE 8/11/94

DISCHARGE FROM EXISTING PIPES AT LOW POINT FROM MARTIN APARTMENTS




6.46/9 = .72 CFS / PIPE




CAPACITY PER ORIFICE EQUATION:

$Q = .6A\sqrt{2gh} = .6(.045)\sqrt{2(32.2).37} = 0.13$ CFS

VELOCITY = $Q/A = .13/.045 = 2.9$ FPS

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JOB
SUBJECT
CLIENT
JOB NO.
BY DATE

Q THROUGH THE PIPES = 0.13 x 9 = 1.17 CFS

Q OVER THE TOP = 6.46 - 1.17 = 5.29 CFS

THE VELOCITY OF THE RUNOFF THROUGH THE PIPES IS 2.9 FPS. THEN THE DISCHARGE DROPS 6" BEFORE HITTING THE GROUND. THE REMAINDER OF THE RUNOFF SPILLS OVER THE TOP OF THE CARB AND DROPS AT LEAST 12" TO THE GROUND.

THIS DRAINAGE SCHEME APPEARS TO WORK FINE. THERE IS NO EVIDENCE OF EROSION FROM THE PIPES OR THE OVERFLOW, EVEN THOUGH THE APARTMENTS HAVE BEEN THERE FOR ABOUT 15 YEARS.

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SHEET NO. _____ OF _____
JOB _____
SUBJECT HYDRAULIC JUMP ANALYSIS
CLIENT _____
JOB NO. _____
BY JPK DATE 5/29/96

AS SHOWN ON THE DRAINAGE BASIN MAP EXHIBIT (SHEET DB-2), THE ONLY STREET THAT IS ANYWHERE NEAR CAPACITY IS MIDNIGHT VISTA JUST ABOVE ANALYSIS POINT 5. IT WILL NOW BE EXAMINED FOR THE DEPTH OF A POSSIBLE JUMP.
THE RATING CURVE FOR THIS STREET SECTION IS ON PAGE B-26.

$Q_{100} = 33.53$ CFS

→ PER PAGE B-26, $D = 0.59'$, $V = Q/A = 33.53/12.51 = \underline{2.68}$ FPS

$$\text{FROUDE \#} = \frac{V}{\sqrt{gD}} = \frac{2.68}{\sqrt{32.2(0.59)}} = 0.61 < 1$$

FLOW IS SUB CRITICAL. NO HYDRAULIC JUMP CAN OCCUR.

THE TWO STEEPEST POINTS IN THE SUBDIVISION ARE AT:

1) CASSIDY DRIVE, JUST BELOW SUR VISTA (3.11%) $Q \approx 1$ CFS

2) MIDNIGHT VISTA, JUST BELOW A.P.4 (2.95%) $Q = 20.84 - 18.60 + 5.40 = 7.64$ CFS

THERE IS VERY LITTLE RUNOFF AT EITHER OF THESE LOCATIONS, AND NO ABRUPT CHANGES IN ALIGNMENT OR GRADE. PER PAGE 87, SECTION 22.3 OF THE DPM, HYDRAULIC JUMPS SHOULD BE EXAMINED WHERE THERE IS A POTENTIAL FOR A RELEVANT JUMP. IN THIS CASE THERE IS NO SUCH POTENTIAL.

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# A G E N D A

TO ALL ATTENDEES:

Matt Schmader, COA Open Space
Carol Dumont, COA Parks and Recreation
Diane Souder, National Parks Service
Steve Whitesell, National Parks Service
Scott Davis, COA Hydrology
Fred Aguirre, COA Hydrology
Michael Nash, Paradise Bluff Owner
Simeon Chow, Paradise Bluff Owner
Vic Chavez, Chavez-Grieves Engineers

FROM: Joe Kelley

DATE: 8/10/94

RE: AUGUST 17, 1994, 2:00 P.M. MEETING AT CITY HYDROLOGY (ROOM 301, CITY/COUNTY BUILDING)

MESSAGE: The purpose of this memo is to let everyone know why we are meeting, and what questions we are trying to answer.

Chavez-Grieves submitted a drainage plan to City Hydrology for rough grading and preliminary plat approval on June 24, 1994. One area addressed by the plan was perimeter runoff. The southern boundary of the subdivision abuts Petroglyph National Monument. The subdivision owner has proposed to give a northern portion of the site to City Open Space. Thus, the northern and eastern boundary of the subdivision will abut the Open Space property. The proposed drainage plan is to discharge some of the runoff across these boundaries to the Open Space and National Park Service land. The proposed conditions of the off-site discharge are:

1. The proposed runoff received by the perimeter properties will be less than under existing (historical) conditions.

2. The proposed runoff will not be discharged at a single point, but will be discharged on an incremental basis from the rear of each lot.

3. There will be no need for large retaining walls at the rear of the lots. (If each lot were required to discharge to the street, it would be necessary to raise the rear corners of the lots by about 3 feet to make this happen. Raising the rear corners would require retaining walls to hold the dirt up.)

On July 14th, I visited the site with Matt Schmader and Diane Souder. I also gave them copies of the drainage report and requested their review at that time. They were in general agreement with the proposed boundary conditions, and confirmed their agreement after reading the report. One point that Ms. Souder made should be noted: The Park Service does not favor losing all of the runoff that has historically discharged across their property because the runoff may benefit the Park's vegetation.

Scott Davis called me on July 19th to give me Hydrology's initial response to the drainage plan. He said that all developed runoff must be discharged to public right-of-ways. The only way that developed runoff can be discharged across a property line is if the two parties execute a drainage covenant.

After my discussion with Mr. Davis, I asked Ms. Souder and Mr. Schmader if their respective departments would execute drainage covenants with the owner. I sent them each a representative covenant for review. Again they were in general agreement, if some conditions could be met. The conditions and their proposed resolutions are:

1. The drainage report needs to be modified to show how much runoff will be discharged from each lot.

   Resolution: See attached diagram (which will be incorporated into the Drainage Report).

2. There needs to be a mechanism whereby the Park Service, City Open Space Division, and the individual lot owner can know whether or not they are exceeding the allowable discharge.

   Resolution: The proposed discharges were each computed on the basis of certain land treatment parameters. Lot owners must develop their lots within the parameters to be within their allowable discharge. Enforcement will still be a City Open Space/National Park Service response.

3. Drainage structures need to be designed to reduce the erosive potential of the runoff.

   Resolution: We did a study to design these structures (attached).

   We would also like to point out a situation similar to the one that we are proposing which appears to be working well: 6.47 cfs discharges from the Martin Apartments onto what will become the open space tract. We calculated the velocity of the runoff (attached), and it is greater than the allowable

velocity that will be discharged from the backyards of the new subdivision. So there should be no erosion resulting from the new drainage structures.

4. A rear yard fence/wall needs to be designed that is acceptable to Park Service and Open Space.

Resolution: We have wavered back and forth on this one. There are many issues to think of when determining what kind of fence to construct, and one type of fence will not satisfy them all. If a 6' block wall is built, it provides a barrier that is somewhat difficult to climb and will intercept the runoff, but it is not very natural. If a 6' cedar fence is built, it is difficult to climb, but is not very natural or visually appealing and will not intercept the runoff. If the existing 6-strand wire fence with wood posts remains it may be more "natural", but it will not intercept the runoff and may be easier to climb. It will also allow views into backyards which may not be desirable from the monument or afford the property owners with privacy.

After discussing this with Mr. Nash and Mr. Chavez, we are now leaning toward a combination solution: Leave the wire fence, and construct a 6" brown-tinted barrier curb under the fence that will direct the runoff to the discharge structures. In this way the runoff is intercepted, and a more natural barrier has been created. Also, people will not be staring at a big ugly block wall in their back yards, but will be able to enjoy seeing the backdrop of the mountains and the National Park.

5. There needs to be an enforcement mechanism. We had originally proposed the drainage covenant. After reviewing the drainage covenant, Mr. Whitesell called to ask for a different mechanism. He said that before the Park Service could execute something like that, their lawyers would have to review it. And he said that his lawyers would almost certainly require that an environmental assessment be done. He does not want to have to do an environmental assessment, and neither does Mr. Nash. Mr. Whitesell asked if there was some other way to allow the discharge, enforce the upkeep of the drainage structures, and require that lot owners develop their lots strictly as specified.

Resolution: Place a note on the plat as follows:
The surface treatment of lots 4 through 52, and 68 through 79, block A, shall be in accordance with the following parameters: There shall be no more than 4250 square feet of roof area; one hard surface driveway no wider than 35 feet extending from the street to the front of the house; no more than 500 square feet of hard pavement surfaces; at least half of the remainder of the surface shall be covered with vegetation (e.g., trees, grass, etc.). Drainage structures at the rear lot lines of these lots shall not be blocked, altered, or modified in any way, but shall be open at all times to convey storm runoff as designed.

DISCHARGE FROM EACH LOT SHALL NOT EXCEED THE VALUES STATED ~~IN~~ IN TABLE A.

D-3

We believe that this will have the same effect as a drainage covenant. When the title search is done prior to buying a house, the new owner will see the conditions of his lot development. If he is found to be in violation of the conditions by the Park Service or Open Space, City Zoning can enforce the requirements stated on the plat. Also, the signatures of Park Service and Open Space on the plat show that Park Service and Open Space will allow the discharge.

QUESTIONS WE WANT TO ANSWER:

1. Will Park Service and Open Space allow the subdivision to discharge runoff to their property?

2. What fence treatment is desired?

3. What legal mechanism can be used to provide for the discharge of runoff across the boundary line?

If you have any questions or comments prior to the meeting, please call me.

Thank you,

CHAVEZ-GRIEVES CONSULTING ENGINEERS, INC.

Joe Kelley

Joe P. Kelley, P.E.

JPK/cjr

Enclosures

# United States Department of the Interior

NATIONAL PARK SERVICE
Petroglyph National Monument
123 Fourth Street SW
Room 101
Albuquerque, New Mexico 87102

IN REPLY REFER TO

L30(PETR)
xD3219

August 23, 1994

Mr. Fred Aquirre
Hydrology Division
Public Works Department
P.O. Box 1293
Albuquerque, New Mexico 87103

Dear Fred:

This letter is in response to our meeting of August 17, 1994 concerning the discharge of stormwater from the Paradise Bluffs Subdivision into Petroglyph National Monument. It is our understanding that Chavez Grieves Consulting Engineers are proposing, on behalf of their client, to discharge up to 14.98 cfs of developed flow from a six-hour storm into the monument. Several engineering solutions have been discussed regarding the treatment of that flow so as to assure that no erosion will occur on monument lands.

We will agree to accept discharge from the Paradise Bluffs subdivision basins B and C in accordance with the drainage plan once the plan has been reviewed by our office. We would like to see the language we requested specifically on the plat map as well as maximum flow limits for each lot and a requirement for the 4-6 foot high adobe wall between the monument and the perimeter residential lots. It is our understanding that you have agreed to draft a letter of concurrence which both representatives from the Open Space Division and the National Park Service will sign. This letter should reference the drainage report document number.

We appreciate your willingness to work on resolution of this issue of mutual concern. Should you have any questions, please

contact Steve Whitesell or myself at 766-8375.

Sincerely,

Diane E. Souder
Chief of External Affairs

cc: ✓Chavez Grieves Consulting Engineers, Joe Kelly
City of Albuquerque, Parks and General Services Department,
Open Space Division, Matthew Schmader
Design and Development Division, Carol Schneider Dumont

# United States Department of the Interior

NATIONAL PARK SERVICE
Petroglyph National Monument
123 Fourth Street SW
Room 101
Albuquerque, New Mexico 87102

IN REPLY REFER TO:

L30(PETR)
xD3219

October 11, 1994

Mr. Fred Aquirre
Hydrology Division
Public Works Department
P.O. Box 1293
Albuquerque, New Mexico 87103

Dear Fred:

The purpose of this letter is to clarify our letter of August 23, 1994 regarding the discharge of stormwater from the Paradise Bluffs Subdivision into Petroglyph National Monument.

We have agreed to accept discharge from the Paradise Bluffs subdivision basins B, C and G-3a1. The total runoff discharge from the subdivision to the monument should not exceed 20.93 cfs. In our August letter we incorrectly stated that the total discharge would be 14.98 cfs, when in fact that was the discharge only from basin B.

Please contact us if you have any questions regarding this letter.

Sincerely,

Diane E. Souder

Diane E. Souder
Chief of External Affairs

cc: Chavez Grieves Consulting Engineers, Joe Kelly
City of Albuquerque, Parks and General Services Department,
Open Space Division, Matthew Schmader
Design and Development Division, Carol Schneider Dumont

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SHEET NO. 1 OF 3
JOB PARADISE BLUFF
SUBJECT PARADISE HILLS BLVD STORM DRAIN
CLIENT
JOB NO.
BY JPK DATE 1/5/95

1. A STORM DRAIN WILL BE BUILT AS PART OF THIS PROJECT TO CONVEY THE ON-SITE RUNOFF TO THE GOLF COURSE ROAD STORM DRAIN. A SURVEY HAS BEEN DONE FOR THE NEW ALIGNMENT, AND CONSTRUCTION PLANS ARE BEING PREPARED FOR THE STORM DRAIN. AT THE TIME THE ALIGNMENT HAS BEEN AGREED UPON WITH THE CITY AND COUNTY, THE FINAL STORM DRAIN DESIGN WILL BE DONE, AND A HYDRAULIC GRADE LINE COMPUTED. IN THE MEANTIME, THE ATTACHED PAGES SHOW THE APPROXIMATE ALIGNMENT AND THE CAPACITY OF THE STORM DRAIN.

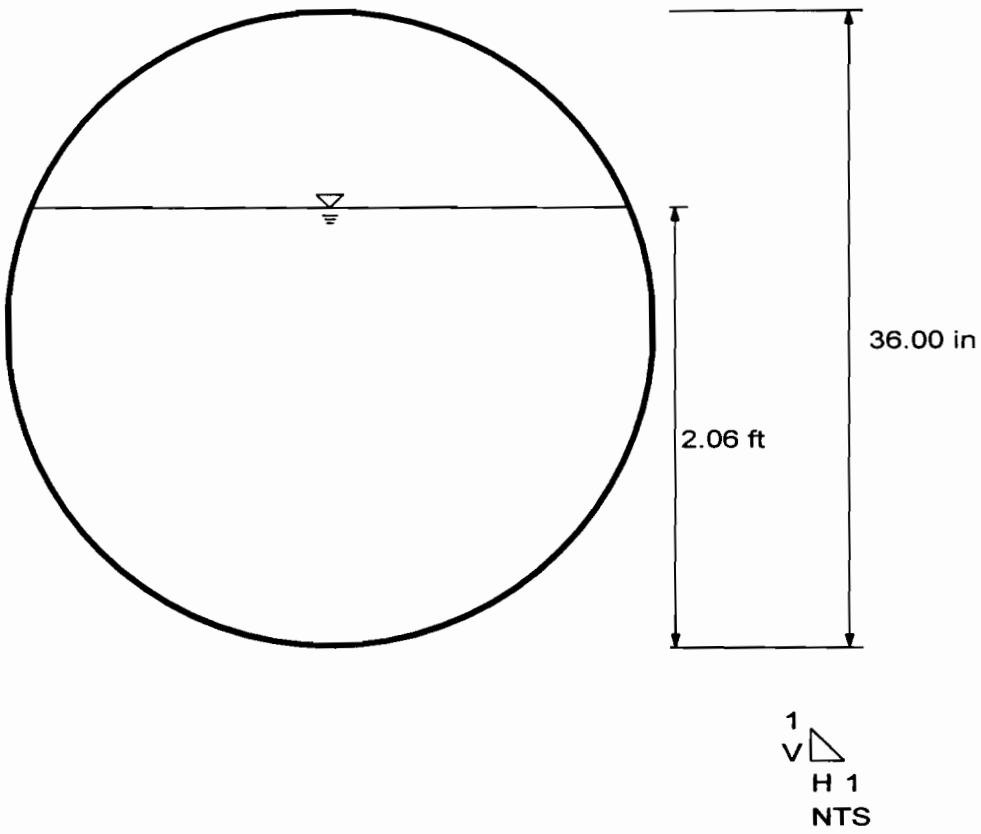
2. BECAUSE THIS PROJECT IS "LAND-LOCKED" WITH NO OVERFLOW FOR STORMS GREATER THAN THE 100-YEAR, THE OVERFLOW OUTLET WILL BE THE STORM DRAIN ITSELF.

   THE NEW STORM DRAIN WILL BE DESIGNED TO CONVEY 2 x 100-YEAR RUNOFF FROM THE SUBDIVISION TO PARADISE HILLS BLVD. AT THAT POINT, AN "INLET" WILL BE CONSTRUCTED THAT WILL ALLOW THE EXCESS WATER TO LEAVE THE PIPE, AND ONLY THE 100-YEAR RUNOFF WILL REMAIN IN THE PIPE TO BE TRANSPORTED THE 1/4 MILE TO THE GOLF COURSE ROAD STORM DRAIN.

# Paradise Blvd Storm Drain
## Cross Section for Circular Channel

| Project Description | |
|---|---|
| Project File | g:\n08\100\document\pipe.fm2 |
| Worksheet | Paradise Blvd Storm Drain |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Section Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.016700 | ft/ft |
| Depth | 2.06 | ft |
| Diameter | 36.00 | in |
| Discharge | 70.30 | cfs |




E-2

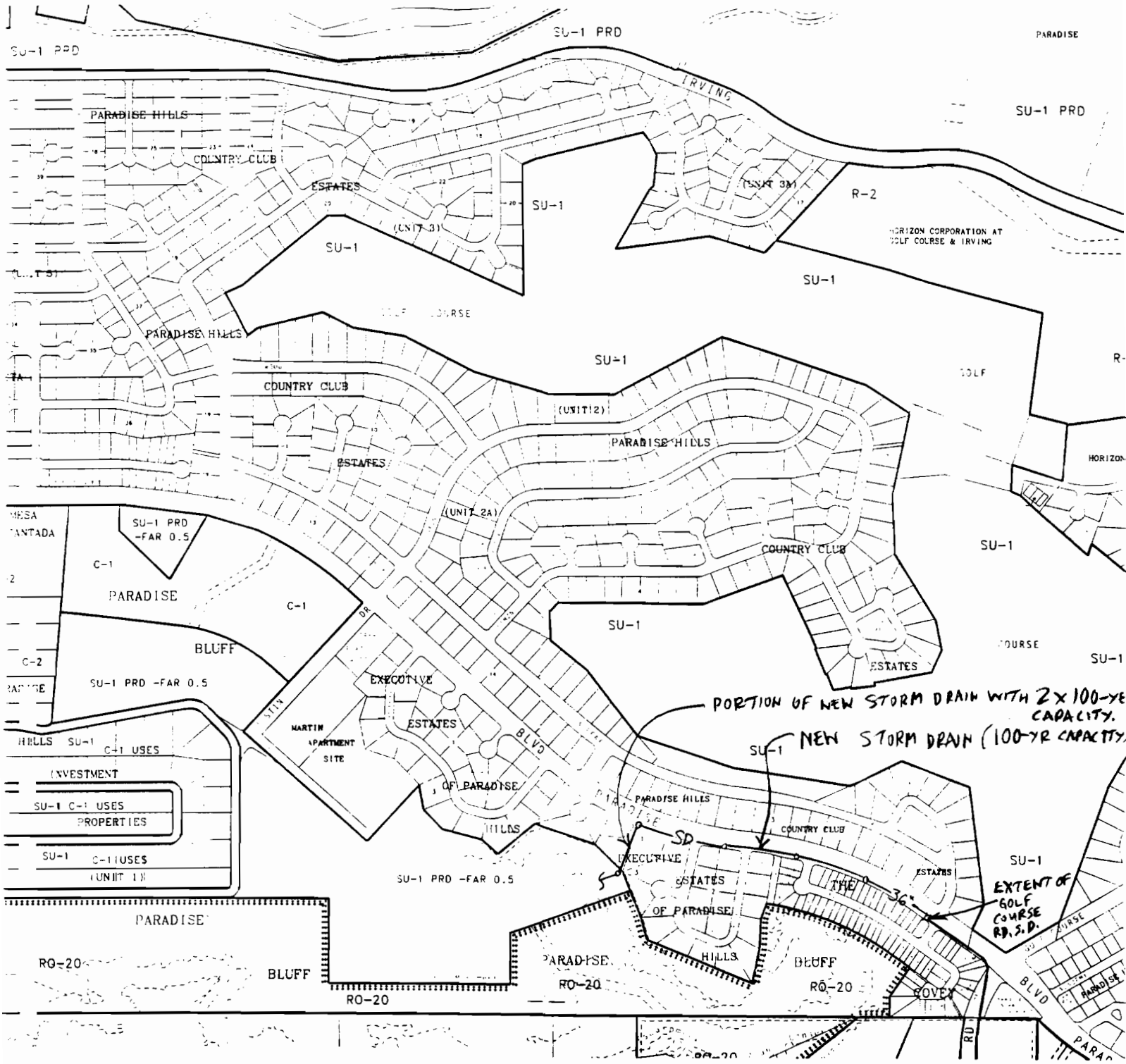
# Paradise Blvd Storm Drain
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | g:\n08\100\document\pipe.fm2 |
| Worksheet | Paradise Blvd Storm Drain |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.016700 | ft/ft |
| Diameter | 36.00 | in |
| Discharge | 70.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 2.06 | ft |
| Flow Area | 5.17 | ft² |
| Wetted Perimeter | 5.86 | ft |
| Top Width | 2.78 | ft |
| Critical Depth | 2.66 | ft |
| Percent Full | 68.63 | |
| Critical Slope | 0.009910 | ft/ft |
| Velocity | 13.59 | ft/s |
| Velocity Head | 2.87 | ft |
| Specific Energy | 4.93 | ft |
| Froude Number | 1.76 | |
| Maximum Discharge | 92.71 | cfs |
| Full Flow Capacity | 86.19 | cfs |
| Full Flow Slope | 0.011110 | ft/ft |
| Flow is supercritical. | | |

E-3




North

0 750

Scale: 1" = 750'

LEGAL DESCRIPTION

T11N

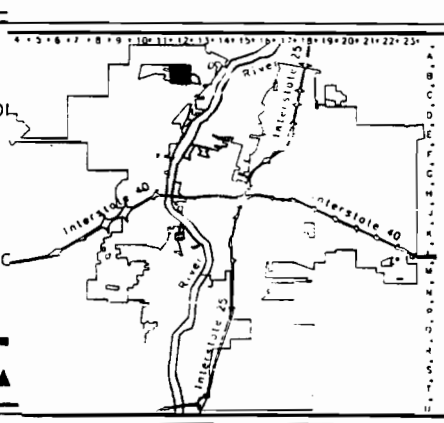
R2E

SEC 11

UNIFORM PROPERTY C

1-011-065

B-11-




E-4

North

750 375 0

Scale: 1" = 750'

Albuquerque Geographic Information System

City of Albuquerque

Planning Department June 30, 1993

© Planning Department July (

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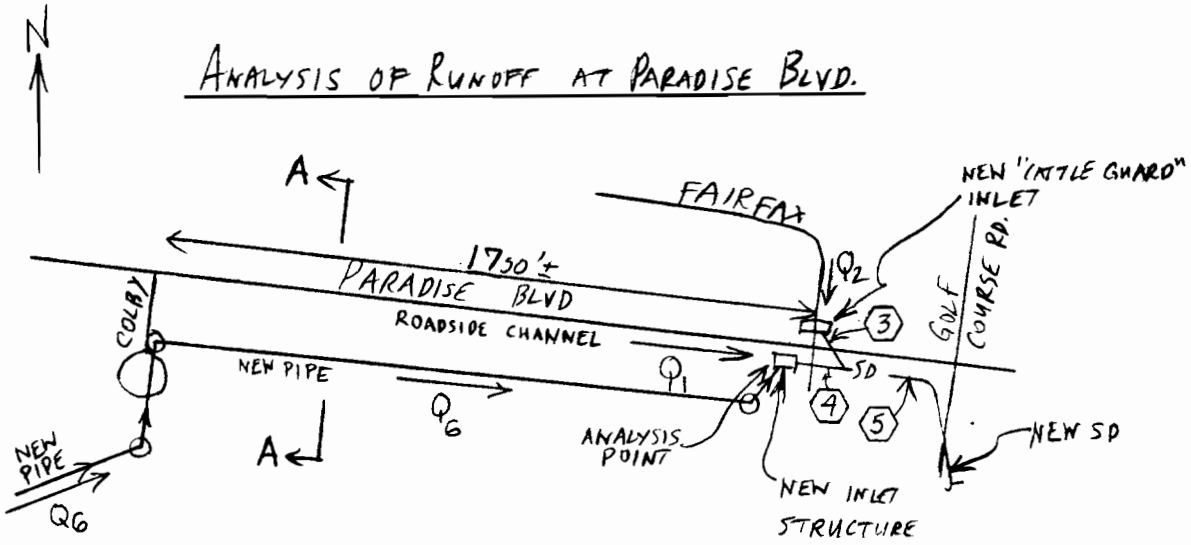
SHEET NO. 1 OF 4
JOB
SUBJECT
CLIENT
JOB NO.
BY JPK DATE 9/21/94
REV 1/5/94




# ANALYSIS OF RUNOFF AT PARADISE BLVD.

1. PER MOLZEN-CORBIN (PIEDRAS-MARCADAS NORTH BRANCH STUDY):

   UNDER EXISTING CONDITIONS,

   $Q_1 = 213$ CFS

   $Q_2 = 276$ CFS

2. PER LEEDSHILL-HERKENHOFF (GOLF COURSE RD. SD DESIGN):

   ADDING A SEDIMENT BULKING FACTOR GIVES THESE EXISTING CONDITIONS:

   $Q_1 = 273$ CFS

   $Q_2 = 277$ CFS

   $Q_{③}$ IN PIPE = 141 CFS (136 CFS OVERFLOWS PARADISE AND ENTERS THE NEW INLET SOUTH OF THE ROAD)

   $Q_{④}$ IN PIPE = 273 + 136 = 409 CFS

   $Q_{⑤}$ IN PIPE = 409 + 141 = 550 CFS

THE PIPE AT ⑤ IS DESIGNED TO CONVEY THE ULTIMATE DEVELOPED FLOW OF 825 CFS.

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3. PER THIS STUDY'S AHYMO RUN, WHICH IS EXISTING CONDITIONS WITH THIS NEW SUBDIVISION DEVELOPED:

$Q_1$ = 239.53 CFS (INCLUDES BULK FACTOR)

$Q_2$ = 277 CFS "

$Q_{③ \text{ IN PIPE}}$ = 141 CFS "

$Q_{④ \text{ IN PIPE}}$ = 453.54 CFS "

$Q_{⑤ \text{ IN PIPE}}$ = 594.54 CFS "

$Q_6$ IN PIPE = 82.48 CFS "

4. IN ORDER TO CONFIRM THAT THE DEVELOPED AREA WILL NOT INCREASE THE DISCHARGE BEYOND THAT ALLOWABLE, A COMPUTATION OF THE ULTIMATE DEVELOPED FLOWS FROM PARADISE BLVD, EAST OF LYONS, WAS PERFORMED:

$Q_1$ = 287.47 CFS (INCLUDES BULKING FACTOR) PER THE DEVELOPED AHYMO RUN. THIS IS AN INCREASE OF 47.94 CFS. THIS MEANS THAT AFTER THE REMAINDER OF THE UNDEVELOPED PROPERTIES ON THE EAST SIDE OF LYONS ARE DEVELOPED, THERE WILL BE A 47.94 CFS INCREASE IN FLOW INTRODUCED INTO THE GOLF COURSE ROAD STORM DRAIN. THE RESULTING NUMBERS ARE:

$Q_1$ = 287.47 CFS (INCLUDES BULKING FACTOR)

$Q_2$ = 277 CFS "

$Q_{③ \text{ IN PIPE}}$ = 141 CFS "

$Q_{④ \text{ IN PIPE}}$ 501.48 CFS "

$Q_{⑤ \text{ IN PIPE}}$ = 642.48 CFS "

$Q_6$ IN PIPE = 82.48 CFS "

< 825 CFS (THE CAPACITY OF THE GOLF COURSE RD STORM DRAIN PER LEEDSHILL).

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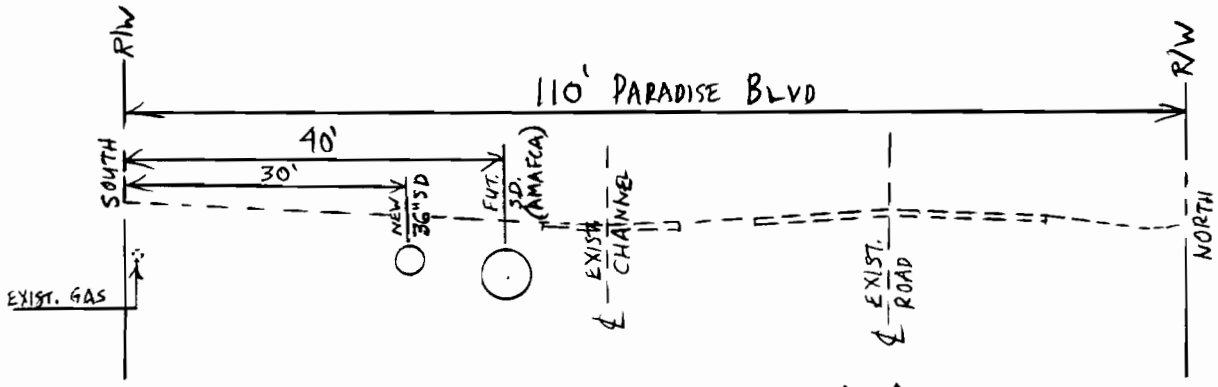
SHEET NO. 3 OF 4
JOB
SUBJECT
CLIENT
JOB NO.
BY DATE

STORM DRAIN IN R/W: SCALE 1"=20'




APPROXIMATE SECTION A-A

E-7


BASINS NUMBERED 200 DISCHARGE TO THE NORTH BRANCH PER THE MOLZEN STUDY. BASINS NUMBERED 300 DISCHARGE TO THE MIDDLE BRANCH PER THE MOLZEN STUDY.
PORTION OF DRAINAGE BASIN MAP FROM UNPUBLISHED PIEDRAS MARCADAS ANALYSIS BY MOLZEN-CORBIN.
BASIN BOUNDARY PER MOLZEN-CORBIN, TYP.
BASIN BOUNDARY FOR THIS DEVELOPMENT, TYPICAL
2044
2042
2045
DOUBLE EAGLE GOLF COURSE
N
SCALE: 1"=500'
PAGE 4 OF 4