



MEMORANDUM

Director's Office
Regional Flood Control District



DATE: November 21, 2008

TO: C. H. Huckelberry
County Administrator

FROM: Suzanne Shields, P.E.
Director

A handwritten signature in black ink, appearing to read "Suzanne Shields".

SUBJECT: Sahuarita Height Flooding – Delgado Watershed Area

The attached report is in response to your October 14, 2008 memorandum requesting the Regional Flood Control District to develop a written report indicating the scope and extent of the flooding in the Delgado Watershed Area.

If you have any questions, please call me.

SS/tj
Attachments

c: John Bernal, Deputy County Administrator – Public Works
Chris Cawein, Deputy Director – Regional Flood Control District

Delgado Road Area Flooding Concerns

Introduction

At the regular Board of Supervisors meeting on October 7, 2008, the call to audience generated a series of comments related to flooding concerns from residents who live in southeastern Pima County in the vicinity of Sahuarita Road and Delgado Road. Many of the comments can be summarized as one resident put it, “too much water, not enough ditch” although related concerns of lack of road culvert cleaning, reported exacerbating impacts of upstream development, difficult access during flooding events and the need for upstream water harvesting were also raised. Many of the comments articulated during the meeting are consistent with those complaints filed with the Regional Flood Control District over the years as the area has developed.

This report provides a summary of the floodplain characteristics of the area, history of area development, recent storm events and drainage complaints, and actions taken to date. Also a brief synopsis of potential short- and long-term solutions is presented.

Floodplain and Drainage Characteristics

The area where the speakers reside is generally bound by Sahuarita Road to the north, Santa Rita Road to the west, Camino Antigua to the south and the Swan Road alignment to the east. Much of that area and the surrounding state lands are in a recognized sheet flooding area of Pima County, as defined by the District and as illustrated on the District Mapguide site. Sheet flooding areas are generally defined as areas characterized by an existing system of poorly defined natural channels that is not adequate to carry the base flood. Under high runoff conditions, the capacity of the existing channels will be inadequate to carry the floodwaters generated and waters will generally spread out across the area typically to a depth of less than six inches. **Exhibit 1** illustrates the location of the subject sheet flood area and the speakers at the October 7 Board meeting. Also illustrated are the locations of major drainage features of the area and all drainage complaints received from area residents by the District.

The subject area is tributary to the Gunnery Range drainage sub-basin which is part of the 213 square mile Lee Moore watershed. The entire Lee Moore watershed is presently being studied by the District as this is an area likely subject to experience significant development in the future. The focus of that study is to more accurately define the floodplain characteristics, formulate a comprehensive floodplain management approach, and create a system of appropriate rules for future development considering the complexity of the floodplains. Floodplain maps utilizing a two dimensional flow model (Flo-2D) have been developed for the watershed, including the subject area, which refine the boundaries of the 10 and 100 year floodplain from the existing broad-based sheet flood mapping, and are illustrated in **Exhibit 2**. As illustrated in the exhibit, much of the subject area remains within the refined floodplain area and is therefore subject to periodic inundation from flood waters.

Many of the comments at the October 7 Board meeting dealt with the inadequate flow carrying capacity of a private drainage channel that will be called the "Main Drainageway" in this summary report (see Exhibit 1 for location) carrying flow to the north through the area of residential properties along Delgado Road. As illustrated by the defined floodplain, it is evident that this earthen channel, constructed in the 1950s and located on a parcel of land owned by a private party (Freeport-McMoran), cannot fully contain and convey design storm flows. Additionally, based on anecdotal evidence reported by area residents, the channel has been losing flow carrying capacity due to sediment deposition over the years. Deposition of sediment as well as erosion are natural geomorphic processes that have occurred and will continue to occur over geologic history as flood waters flow from the mountains to the valley floors. The only difference between geologic history of erosion and deposition and those processes continuing in present times is that people now occupy the areas where these natural processes occur.

Regardless of the presence of sediment in this drainage channel, modeling estimates indicate that flood flows on the order of 1500 cubic feet per second (cfs) during the design (1% chance) storm are generated upstream of the subject area and must pass through this area but the "Main Drainageway" only can only convey less than a third of that flow (450 cfs) before overtopping. Removal of sediment by the owning party resulting in the deepening of the channel would certainly improve carrying capacity to a degree, although the Main Drainageway would not be able to fully contain the design storm. Additionally, no regulatory authority in the Flood Control Ordinance compels the owner to enhance the carrying capacity of this channel given that it was constructed before any floodplain regulation existed.

Development History of Area

The subject area has developed as a rural residential area characterized by largely unregulated lot splits over the past several decades. As is typical for this type of land division, infrastructure elements including dedicated and/or constructed drainageways, normally required under subdivision law for more contemporary developments, were not included in these land splits. Therefore, rather than relying on properly designed infrastructure to assist in the conveyance of floodwaters through the area (thus "drying up" the sheet flooding areas), more reliance is placed on the existence and implementation of flood control regulation, to help reduce the risk of residential structure flooding in the area by requiring elevation of residences above the base flood elevation. That protective regulatory benefit only applies to those structures built after regulations were developed and those that properly followed those regulations.

Research has indicated that the "Main Drainageway" referenced above is an archaic structure initially built on a privately-owned parcel of land as part of a series of earthen ditches and berms built in the 1950s and designed to channel storm flows around farm fields and protect them from sheet flooding from the east. This type of diversion was common practice at the time and occurred decades before any floodplain regulation preventing such activity existed. It should also be noted that these diversions occurred

well before any significant residential development in the area occurred. This system of diversions disrupted the natural sheet flooding pattern to the northwest and instead channeled flow north thru the Main Drainageway and secondary channels around the farm field (FMI property) to the west.

Approximately two decades later during the early 1970s, the diversions and much of the agricultural land they were designed to protect, remained in place as limited residential development began in the area. As the population of Pima County rapidly expanded, the area became subject to lot splits and increasing population density without the benefit of engineered drainage infrastructure. Until very recent times, none of the lot splits in the area (and not coincidentally none of the complainants) were part of platted subdivisions and therefore were not required to comply with the evolving system of subdivision standards for land development.

In order to assess the development history of the area, a series of aerial photographs were obtained and examined. Those photographs are presented as **Exhibits 3 through 6**. **Exhibit 3** is the earliest available photograph for the area from 1936 and best illustrates the subject area before any residential development had occurred. For reference purposes, the present lot lines and current road alignments are super-imposed on this photograph. The photograph illustrates farming west of the subject area and some existing drainage diversions kicking flow to the north to protect those farm fields although most of the subject area appears undisturbed. Also evident is the distributory flow pattern throughout the subject area with relatively dense vegetation, as illustrated by the dark portions of the photo, indicative of a main drainage conveying flow (only later to be truncated by additional farm berms) through the present FMI property.

Exhibits 4 and 5 are aerial photographs from 1979 and 2005. Exhibit 4 (the 1979 photo) clearly illustrates the modification of the natural drainage pattern including the cut off of flow from the farm field (present FMI property) and the concomitant formation of the south to north "Main Drainageway" along the back side of the Delgado Road properties. This cutoff was also evident in a previous aerial photo covering a portion of the subject area from 1974 although no earlier aerial coverage from the 1950s or 1960s was available to more precisely document the reported 1950s construction date of that Main Drainageway. Exhibit 5 (the 2005 aerial coverage) illustrates the most recent photograph and most closely represents the present condition of the subject area.

Exhibit 6 illustrates the development history in the area based on progression of time from 1974 through 2005. That history which illustrates an increasing development density was based on an assessment of structures visible in the series of available aerial photographs. Although detailed lot split history over time could not be determined from readily available data, it is surmised that lot splits occurred on a roughly parallel course with the appearance of structures. As shown in this Exhibit, although much of the area remains undeveloped due to the fact that it is state land, the private lands in the subject area continue to be developed with an increasing number of structures.

One commenter at the October 7 BOS meeting mentioned the perceived increased flooding impacts caused by the upstream Sahuarita Highlands development located southeast of the affected area (see previous Exhibit 2). Development of this large lot subdivided community was reviewed by County Development Services staff as well as staff from the Regional Flood Control District and was found to comply with all applicable regulations. Although it was correctly stated that no “flood abatement” measures were incorporated into the design of the subdivision, none are required by code as this is a large lot conservation subdivision. Additionally, from a practical sense, the overall increase in watershed storm flow volumes and flow rates from the increased level of imperviousness due to this subdivision are minimal. It should also be noted that an estimated half of the storm flow that originates within the Sahuarita Highlands community, drains to the adjacent subwatershed to the west and not to the Main Drainageway.

Recent Storm Events

One comment at the October 7 meeting indicated that the Main Drainageway “overflowed four times this year” and the events “were not even 100 year flows.”

It should be noted that the Sahuarita/Delgado Road area experienced some of the most significant rain events in Pima County during monsoon 2008. Although the Delgado Road area has no rain gages monitored and operated by the Regional Flood Control District (the nearest upstream gage is at Corona de Tucson approximately 8 miles east), and therefore the exact rain measurements for the area are not available, the National Weather Service was contacted to ascertain the magnitude of one of the most recent storms based on composite radar analysis.

This composite analysis, from the storm event of August 27, 2008 indicated a 3-hour storm between 4PM and 7PM that dropped an estimated 3.5 inches of rain locally in the Delgado Road area. That magnitude of 3 hour storm is greater than the 100-year recurrence interval of 3.19 inches. **Exhibit 7** illustrates the composite radar analysis for the referenced storm event.

Although detailed information was not assembled for other storms in the area this year, it is evident that significant rainfall events (ie. on the order of 100 yr events) impacted then Delgado Road area this past monsoon season. Given those significant rain events and the previously stated sheet flood condition of the area, along with the limited flow carrying capacity of the main channel, the occurrence of flooding in the area was not unexpected.

Drainage Complaints

As stated by the individuals at the BOS October 7, 2008 meeting, as well as in previous and follow up correspondence, individuals have expressed concern regarding the Regional Flood Control District’s “unwillingness” to do anything about their flooding problems. As stated by one of the individuals who spoke at the meeting, approximately

30 complaints from the referenced area have been filed with the District over the past 8 years. Many of those complaints have been repeated complaints from a relatively small group of individuals who reside within the sheet flooding area. The locations of those complainants were previously illustrated in Exhibit 1.

All past complaints have been investigated by the District and complainants informed that they live in an area subject to periodic flooding. Recent complainants have also been informed to consider purchasing flood insurance due to their location within a natural sheet flooding area. Because the area is not a federally designated flood hazard area (i.e., FEMA floodplain), residents are eligible to purchase preferred rate flood insurance policies for relatively low cost. It should be noted though that most of the complaints on record with the District and those heard at the October 7 meeting did not involve actual flooding of residential structures which flood insurance is designed to cover. Rather, most complaints appeared to be related to the flooding of yards and roadways. Without significant infrastructure investment, sheet flooding will continue to be an issue for this area, as it is for many portions of rural Pima County.

Infrastructure Status

Although characterized as “unwillingness” by the Regional Flood Control District to do anything as stated by one individual at the meeting, the reality is that there is nothing that the District can do because there are no dedicated public drainageways serving the area. Therefore there is no public infrastructure for the District to maintain. As stated earlier, the subject area developed as unregulated rural lot splits with no consideration for dedication of lands for public drainageways. The limited drainage channels that do exist in the area are on private lands and were not designed or constructed to properly convey the design storm. The District does not maintain private drainages on private property unless directed to do so by the Board. Any maintenance of any wash by the District also requires formal approval from the US Army Corps of Engineers under Section 404 of the Clean Water Act.

While there are several public roadways that have been built in the area that provide access for residents to their properties, those roadways are constructed throughout the sheet flooding area. The roadways may have dip sections that facilitate drainage across the roadway which can, during significant rain events, limit access. A few wash crossings have culverts conveying flow under the roadway (typically Sahuarita Road), to enhance all-weather access. Those areas where washes cross the road right of way are normally inspected and maintained as needed by the Pima County Department of Transportation. **Exhibit 8** illustrates the public infrastructure in the area.

The Main Drainageway, described earlier in this summary and subject to much criticism due to its failure to effectively convey storm flows through the area, is not a public drainageway but is entirely located on private property. The southern portion of this earthen drainageway and the remnant farm field that it protects from flooding are presently owned by Freeport McMoran (FMI) and the northern portion crosses parcels owned by a number of individual residents. Previous complaints related to siltation of

the northern portion of the channel and the loss of flow carrying capacity were addressed by FICO who owns downstream farm fields. FICO was previously able to dredge the channel in 2007 under the Agricultural exemption available under Section 404 (f) of the Clean Water Act.

Past Actions Taken

The District has dispatched inspectors to the area on numerous occasions to address each complaint received over the years to investigate whether the reported flooding complaints are caused by anything that the District has the authority to rectify. For instance, individuals who, without prior approval, create conditions which divert, retard or obstruct flow can be issued a violation and be compelled to mitigate. Our findings have consistently indicated that actions of individuals are not the cause of the flooding problems in the area. Rather, as stated previously, the area is subject to sheet flooding and inadequate channel carrying capacity, so when large storms occur, the existing system of drainages will quickly be over-topped. Therefore only letters can be sent reemphasizing the nature of the flooding problems in the area and recommending purchase of flood insurance to protect structural assets.

Short-term Solutions

Given the situation as described in this summary document, there are few effective short-term solutions to mitigate for flooding issues observed in the subject area during the summer of 2007. The District has worked closely with the Department of Transportation to inspect and clean out public infrastructure (i.e., roadway) crossings within the road right of way. A large box culvert carrying the Main Drainageway under Sahuarita Road was mentioned by one of the speakers at the October 7 meeting as a major problem limiting flow under the road and causing floodwater backup. It was found to be partially plugged with sediment (approximately 4 feet of sediment in the 12 foot high boxes) and, although not found to be a major contributor to area-wide flooding, it was subsequently cleaned out in late October 2008. After dredging the box culvert, it was noted that the channel invert both upstream and downstream of the culvert was several feet above the invert of the box. Therefore, it was quite apparent that the hydraulic grade line of the channel has established itself at an elevation higher than the invert of the box culvert thus making it likely that the culvert will quickly re-fill with sediment to re-establish that previous grade line. It should be noted that the channel in both directions is located on private property and therefore dredging could not extend outside the road right of way.

Because the portion of the main drainageway, about which sedimentation complaints were most significant, is located on private lands owned by FMI, the District has worked with both the property owner (FMI) and the downstream agricultural property owner (FICO) to determine whether some sort of private sediment removal activity could be accomplished to enhance the flow carrying capacity of this private channel. Results of those meetings to date have been encouraging with tacit verbal agreement between FICO and FMI to complete some dredging activity in this private channel sometime during the next few months. Although this activity will not result in the creation of a channel that

will convey the design storm and will still leave the area subject to flood risk, it will in the short term result in the increased capacity of the channel to more effectively convey the smaller, more frequent storm flows through the area.

Long-Term Solutions

Much of rural Pima County is subject to sheet flooding during significant storm events. Removing any of these rural areas from sheet flood zones requires a significant investment in infrastructure as well as thorough consideration of downstream impacts. In order to "dry up" sheet flood areas, a properly designed system of catchments, diversions and channels is required. That system must be particularly robust since concentrating large areas of sheet flooding where stormwater disperses in a relatively gentle manner into a much smaller area results in a corridor of much larger hydraulic energy which can be highly erosive. Additionally, the main issue aside from the costs for proper design and construction of any such engineered flow control system is that any such system requires significant land assets and those assets must be acquired at likely high cost and often through condemnation actions.

Recognizing that many of the developing areas of Pima County are located in sheet flood zones, the District has determined that detailed floodplain delineation and long-term flood control solutions including enhancing rules of development in advance of development pressures are prudent. As stated previously, the subject area is located along the western boundary of the 213 square mile Lee Moore Watershed Basin. That basin has been and remains presently under study by the District. Final results of that study, including analyses of potential flood mitigation options will be forthcoming in 2009. It should be emphasized however that any long-term flood mitigation will be costly and, even if sufficient funding could be identified, will likely take many years to implement due to complex property issues.

It should be noted that suggestions made at the October 7 Board meeting that stormwater can be "harvested" in basins rather than "wasted" through a drainage system would likely have limited utility. The concept on the surface seems painfully obvious in our arid area but as always, there are critical limitations which become evident upon analysis. While detention and retention basins have been and will continue to be effectively used in many areas to attenuate damaging storm flows, in practice they often drain poorly leading to nuisance problems and likely achieve only a very limited secondary benefit of increased groundwater recharge and that occurs only in areas where soil permeabilities remain very high. Issues include the large land areas required for basins, construction costs, the fact that retention of water creates mosquito breeding habitat (and the attendant West Nile virus concerns), invasive and excessive weed growth (and the attendant increased fire danger). Additionally it must also be recognized that calculated baseline soil permeabilities degrade dramatically after a single storm event transports fines into the basin and effectively seals the floor thus dramatically reducing potential recharge. Although maintenance can be used to encourage higher levels of recharge, that is a long term maintenance cost that must be considered. Additionally, studies have shown that even under ideal circumstances, much detained water is lost due to evapotranspiration

rather than recharged to the aquifer. So basins, although likely a recommended component of any storm flow management strategy for the Lee Moore Basin study area, should not be misconstrued to be a panacea for water supply issues.

Summary

In summary, the subject area near Delgado and Sahuarita Roads experienced significant storm events during monsoon 2008. These events underscored to the residents of the area that this portion of Pima County is located within a recognized sheet flood zone where existing drainages are not adequate to convey large flows through the area. The lack of public drainage infrastructure in this area due to its development history as a series of unregulated lot splits also became more apparent during the past summer.

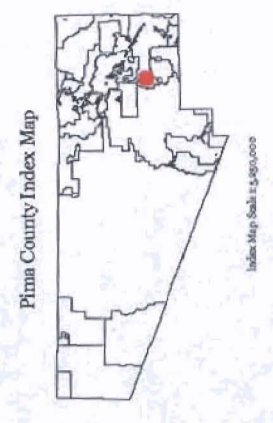
Short-term improvements including the cleaning out of a major box culvert under Sahuarita Road and facilitating discussions and apparent agreement between two private parties who have an interest in the private archaic "Main Drainageway" that runs parallel to Delgado Road have been completed. The Districts' study of the Lee Moore Watershed will be completed in 2009 in order to provide the framework for potential future long-term solutions to area-wide flooding problems. It must be recognized however that long-term solutions will likely be costly and take a systematic phased approach to implementation.

Exhibit 1

- ★ Speakers at October BOS Meeting
- Drainage Complaints on Record
- Main Drainageway
- Washes
- FMI Property
- FICO Property
- ▨ Sheet Flooding Area
- Parcels

The following speakers are not shown on the spatial extent of the map;

Nancy Freeman, Green Valley
Weyranch, 17151 S Anson Ln



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Pima County Regional Flood Control District

Scale 1:12,000

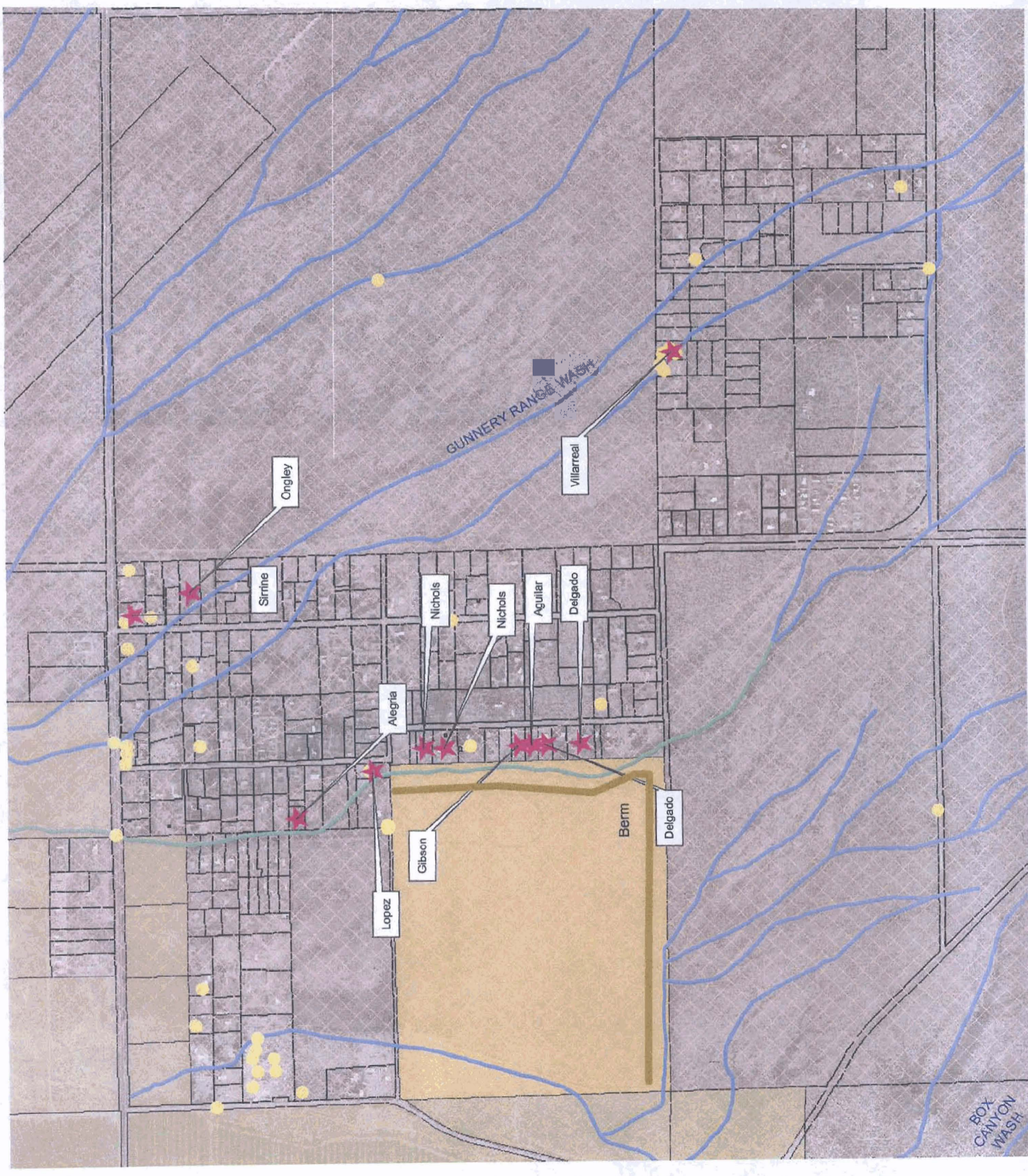






Exhibit 2 Gunnery Range Wash at Sahuarita Rd

Floodplain Map

-  100 yr Floodplains
-  10yr Flow Corridors
-  Regional Parcels
-  County Maintained Rds

Floodplains from JE Fuller
FLO-2D mapping 08-07-08.

Information shown on this map represents the best available data for known flood hazards. Flood hazards may exist that are not shown on the map. These hazards may necessitate conditions on development on the subject property. Erosion hazards are not shown on this map. For more information on flood hazards please visit the Flood Control District.

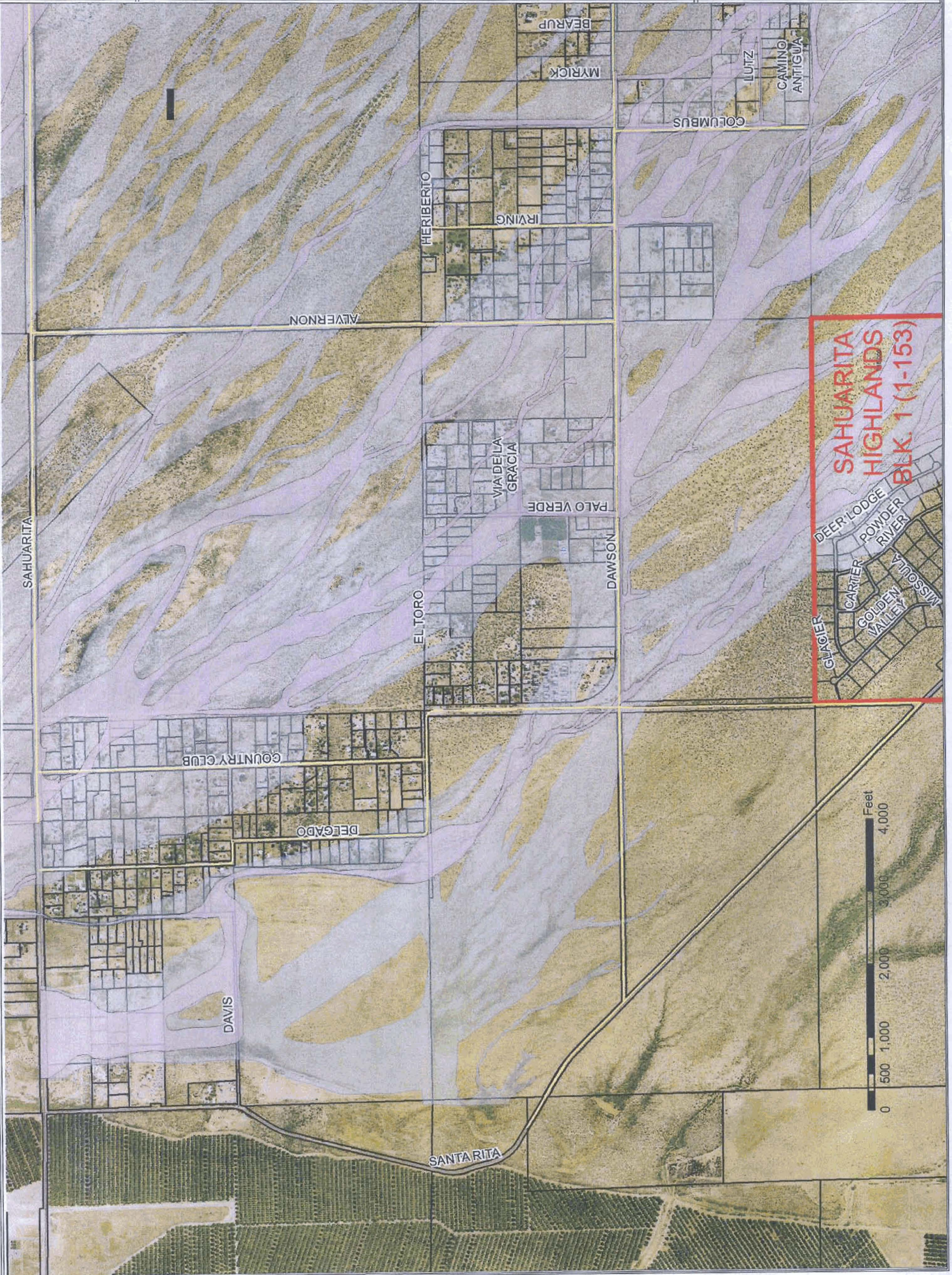
Locations and maps are available at <http://rfcd.pima.gov/loc/>

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DOT Geographic Information Services



**SAHUARITA
HIGHLANDS
BLK. 1 (1-153)**



SAHUARITA ROAD



1936 AERIAL PHOTO

S. ALVERNON WAY

EXHIBIT 3

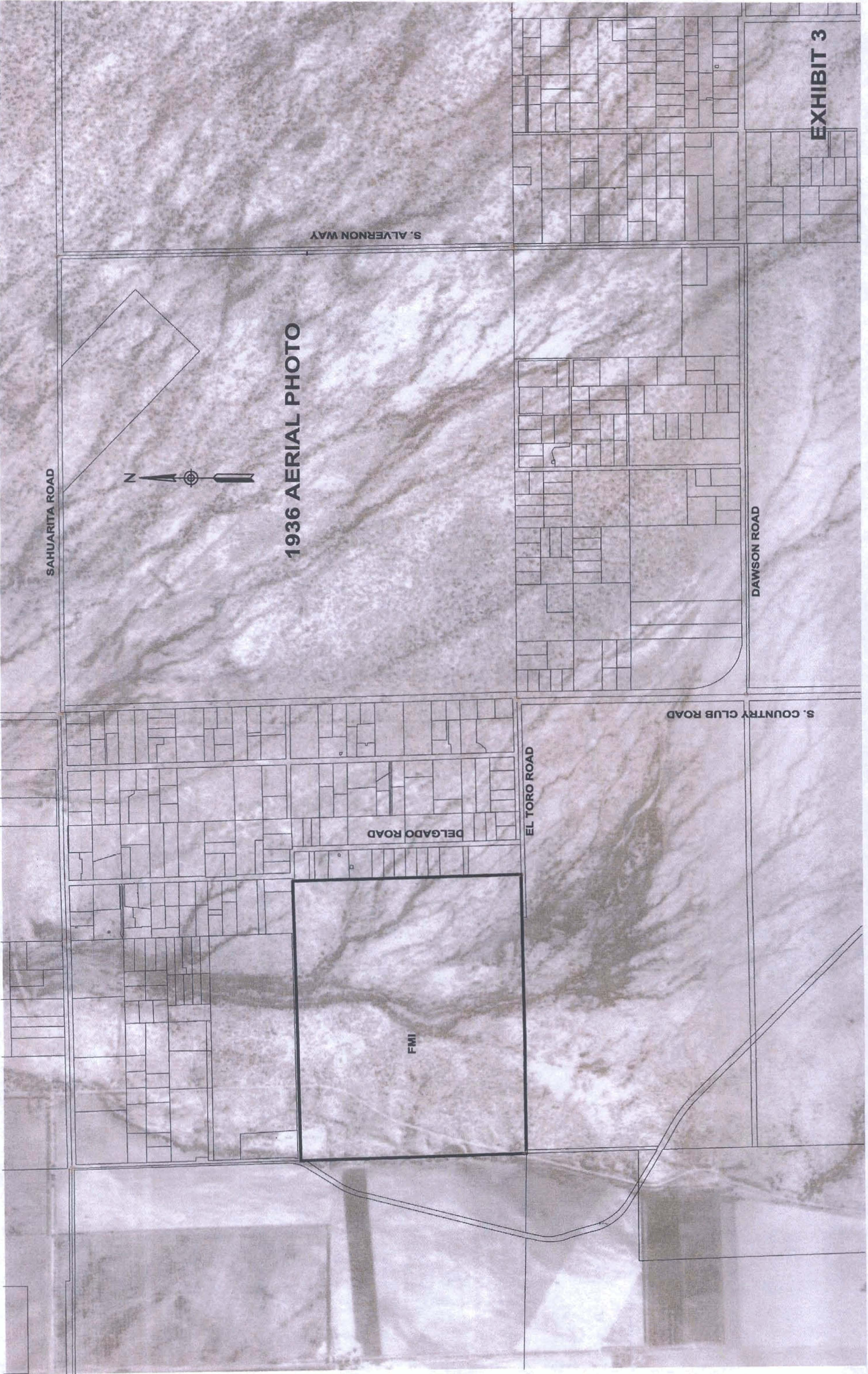
DAWSON ROAD

S. COUNTRY CLUB ROAD

EL TORO ROAD

DELGADO ROAD

FMI



S. ALVERNON WAY

1979 AERIAL PHOTO



SAHUARITA ROAD

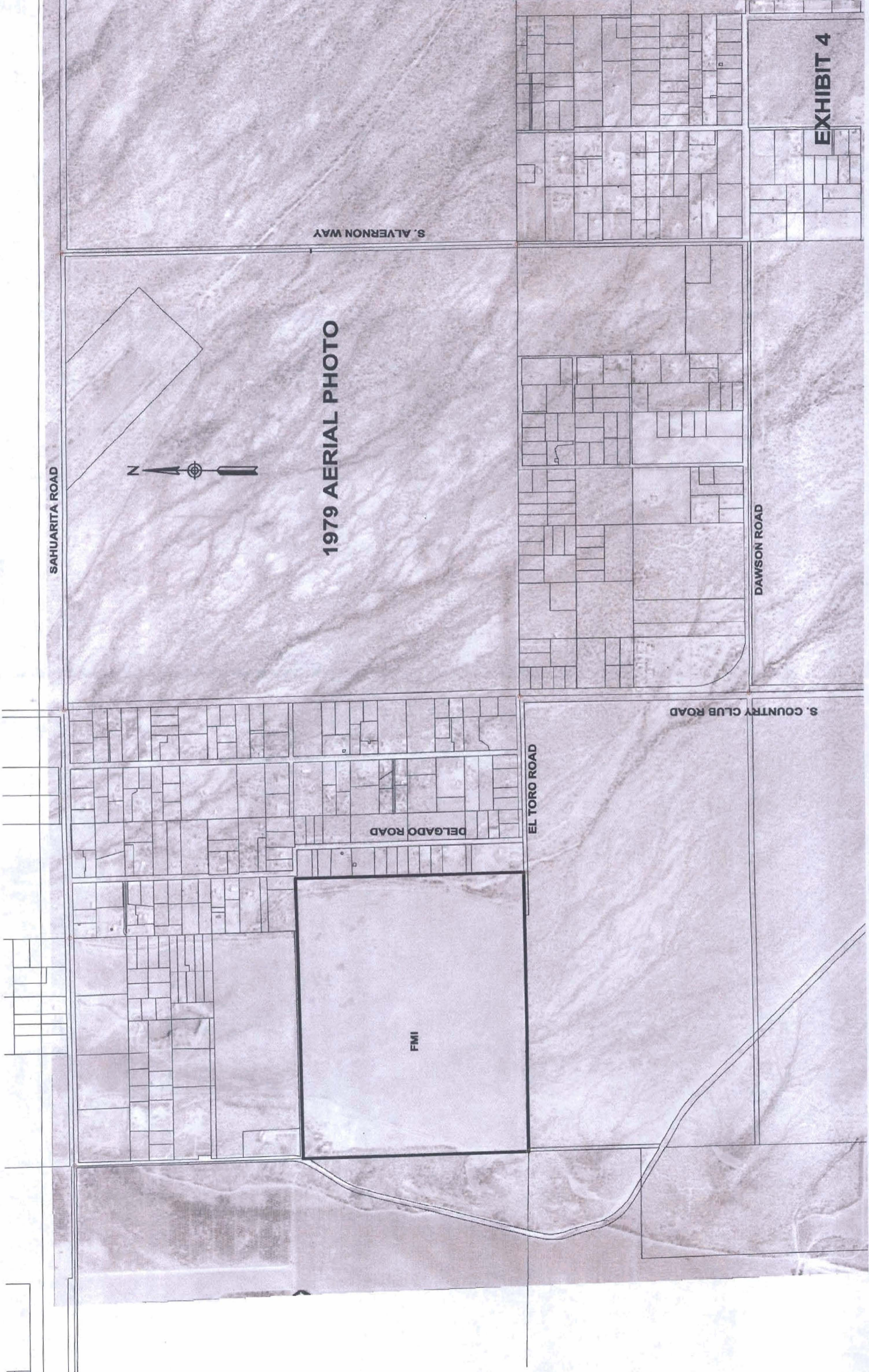
DAWSON ROAD

S. COUNTRY CLUB ROAD

EL TORO ROAD

DELGADO ROAD

FMI



SAHUARITA ROAD



2005 AERIAL PHOTO

S. ALVERNON WAY

EXHIBIT 5

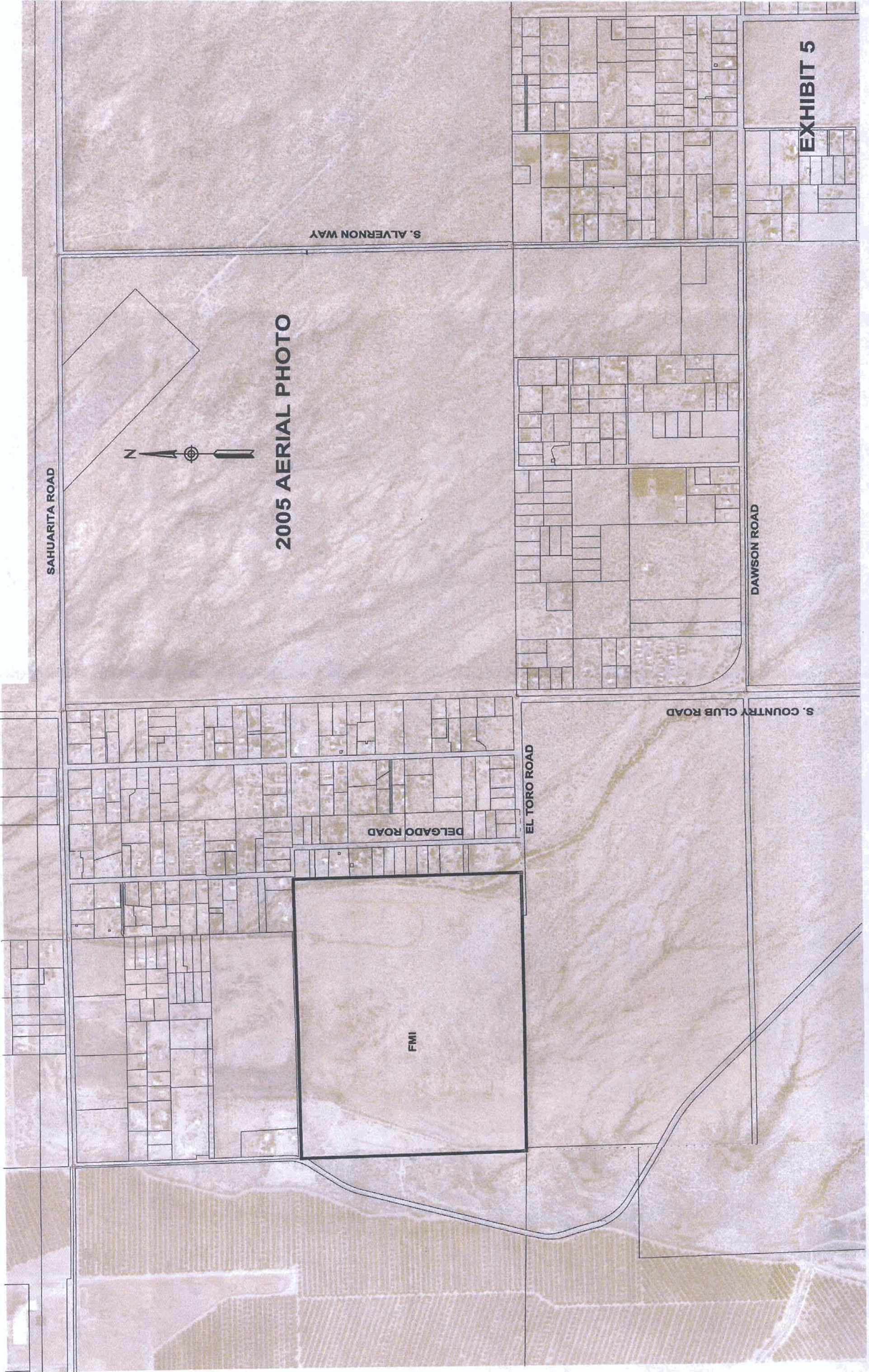
DAWSON ROAD

S. COUNTRY CLUB ROAD

EL TORO ROAD

DELGADO ROAD

FMI



S. ALVERNON WAY

- 1974 CONDITIONS
- 1979 CONDITIONS
- 1994 CONDITIONS
- 2005 CONDITIONS



SAHUARITA ROAD

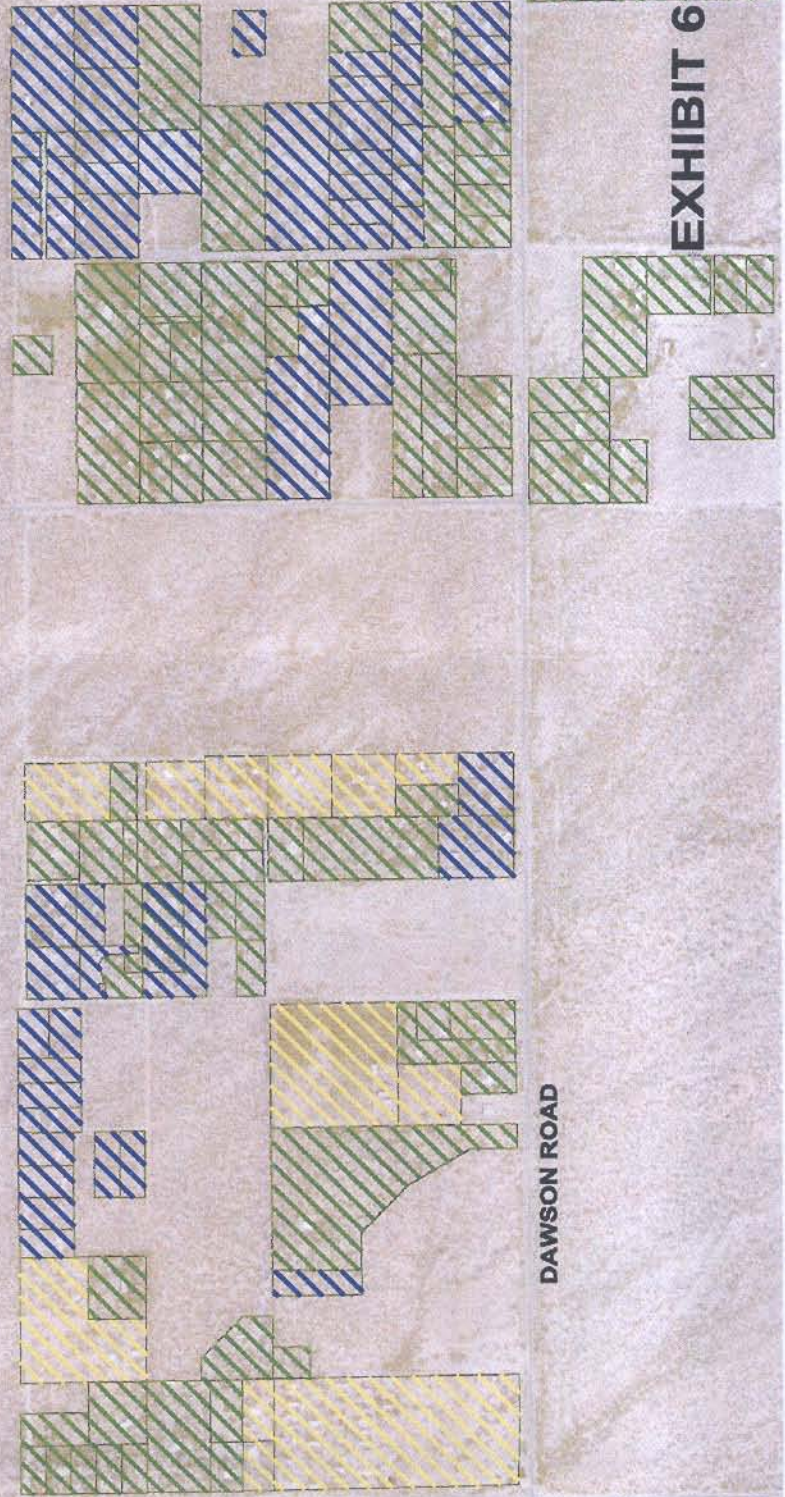
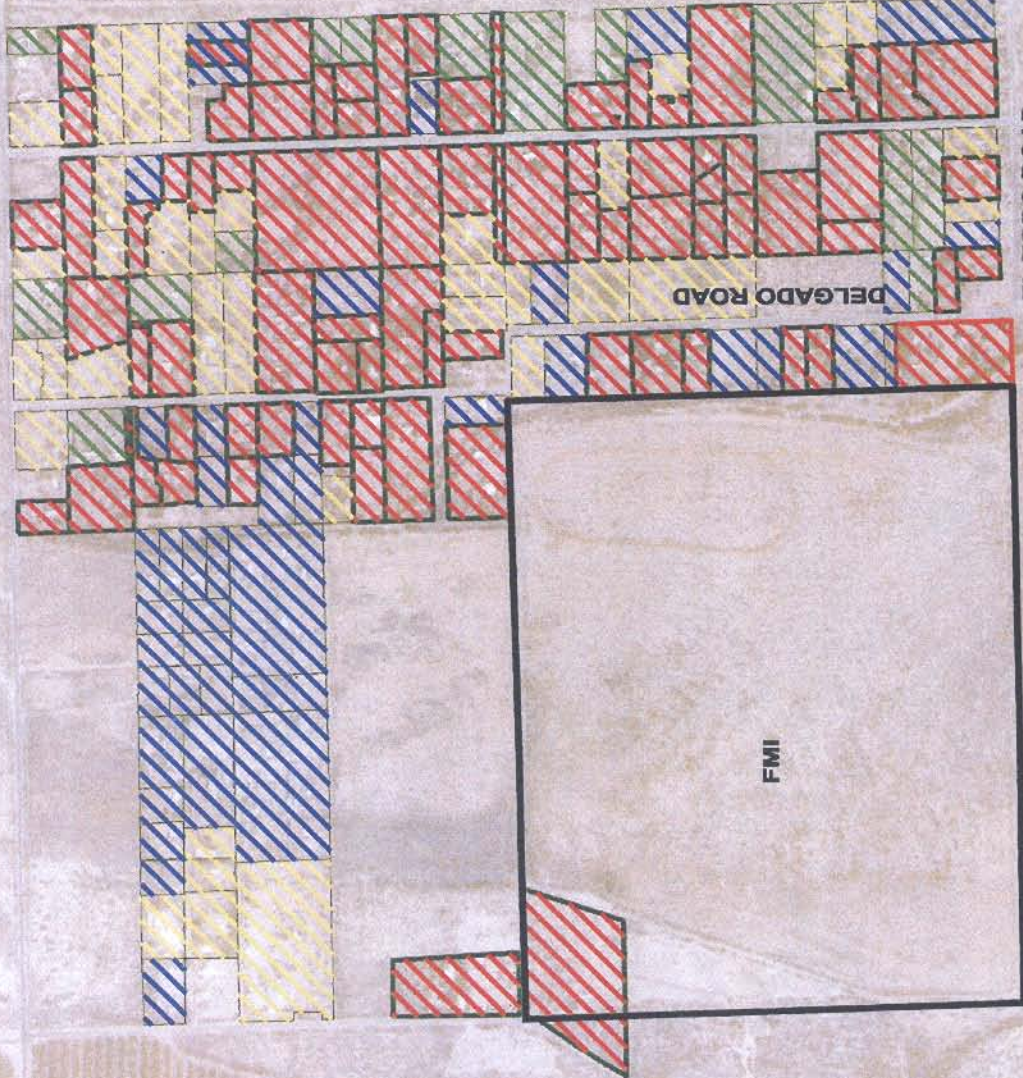
DAWSON ROAD

S. COUNTRY CLUB ROAD

EL TORO ROAD

DELGADO ROAD

FMI

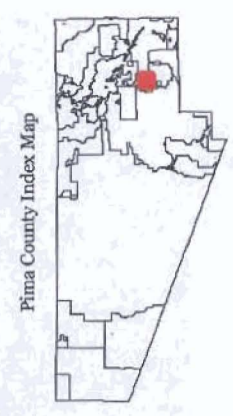


August 28, 2008 Radar Estimate of Total Rainfall Depth



Exhibit 8 Public Infrastructure

- Existing Infrastructure
- SymbolType**
- Major Street
- Administrative Boundaries
- Subdivision Boundary
- Pima County Government Property Rights - Subdivision Dedications**
- Public Utility Easement
- Subdivision Right-of-Way
- Pima County Government Property Rights - Acquisitions**
- Drainage Easement
- Roadway
- Roadway State Lease
- Parcel Boundaries
- State of Arizona



Index Map Scale 1:500,000

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Scale 1:24,000

