Comments and Suggestions related to Agenda Item 8 of the February 10, 2021 GA Board Meeting, "Board Consideration and Approval of GSP Planned Project No. 4, Shallow Well (Impacts) Mitigation Program".

Written by: Don Decker, TAC member representing the IWV Domestic Well Owners, 2/6/2021

Ref: "Methods for Determining the Functional Condition of Shallow Domestic Wells with a Declining Water Table Applicable to the IWV Basin". Written by Don Decker, dated 11/2/18

Background

1) The Domestic Well Owners Association of the Indian Wells Valley recognizes and appreciates the IWV GA Board's efforts to provide financial support for the repair of the negative impacts Basin shallow well owners are experiencing in the face of seriously declining water levels. **The approximately 900 shallow well owners are the most vulnerable and most seriously impacted by this continuous decline. Many small co-op or mutual systems are presently in technical and financial difficulty and are likely to be the first candidates for mitigation funding.**

2) **The essential first step in addressing this long standing issue is a technically correct and thorough understanding of the several routes to premature well failure**. **A paper written by this author over two years ago describes the typical shallow well construction used in this Basin which was based on AWWA recommendations and modified to some extent by local practices.** This paper also describes two of the three well failure routes typically seen. These two failure routes are a) water levels dropping so as to uncover the pump intake, allowing admission of air and inherent loss of pump prime, b) periodic lowering of the pump to prevent the occurrence just described, which at some point will result in the intake being physically located in the screened zone of the well. There is then a direct flow path from the aquifer formation into the pump intake leading to subsequent clogging and abrasion from formation sand grains (well sanding). Both the well screen and the pump will be seriously damaged. The rate and magnitude of damage depends on the formation character, screen slot size, pump flow rate and other design aspects. **This second failure route described is almost always the first to be noticed and the deterioration often progresses rapidly once begun.**

3) The well failure analysis developed by Stetson Engineers is based on the Referenced paper described briefly above. However, in its present form, the Stetson analysis only takes into account uncovering of the pump, a), which will only occur after the damage described in b) is underway. **The simple analysis of the Stetson model is incomplete and results in a substantially lower failure rate than is actually observed**.

4) **The third failure path is a declining well water quality as water of poorer quality is pumped, usually from a deeper formation. This formation is now reached as well water levels decline.** This is not an imagined scenario but is the cause of abandonment of two early well fields in the Basin and the great restriction on a third. Closely related is the potential mobilization of oxidized, more soluble arsenic, as saturated formation is dried out with declining water levels. This phenomenon is widespread in occurrence in high arsenic western climate areas including this Basin. **The cost of arsenic treatment can result in a well becoming uneconomic to continue pumping. This is especially true for shallow Basin wells serving small systems, i.e., co-ops and small mutuals.**

5) **We do not claim to have a complete record of well redrilling in this Basin but do have an accurate record of several subareas that comprise a significant fraction of the total. In these areas alone, the well**

redrilling rate from premature well failure is averaging about 6 wells/yr. It has been repeatedly pointed out that it would be very useful and relatively easy to get well drilling/redrilling records from the Kern County Health Department (KCHD) which would provide a certainty missing from the model in its present form.

6) **What remains unknown is what fraction of the owners of failing wells would actually apply for assistance from the GA. Many of the recent failed well owners could have applied but did not.** The Work Plan of the existing Mitigation effort discusses the possibility of failing wells joining nearby larger systems. Such a suggestion is not going to be useful in most cases. The larger systems themselves are more likely to be first in line, asking for assistance. If the failing well is near to existing WD lines, joining the IWVWD is a viable potential solution. Through the years, many such connections have been accomplished and the WD has significantly expanded its service areas. This is a continuing activity. Virtually all of these connections have been made to properties adjoining or already within WD boundaries. Connecting remote failing wells is not likely to ever be viable. **The Basin aquifer that we are trying to repair is itself the ultimate distribution system.**

7) **The Stetson analysis as it now exists, is useful in obtaining an estimate of well failure rates**. These estimates have been used in designing a mitigation program including funding magnitudes and potential sources. Going forward, it will be likely be useful to improve the accuracy of the Stetson model. This author respectfully states the obvious, that it would be far less expensive and more accurate to create a new and simpler model using analytic continuity to project KCHD well redrilling data into the future.

<u>The Existing GA Shallow Well Mitigation Program Under Discussion in Agenda Item 8</u>

1) The purpose of this agenda item is to provide enough background to justify Board approval of the Well Mitigation Budget for 2021. What is missing is a current POAM and associated Finance Plan. <u>It is virtually impossible to actually manage even a small program without an accurate top level financial plan, a line item budget, and a properly constructed timeline.</u>

2) The Shallow Well Mitigation Program has been a topic of discussion for over three years. Approximately $150K has been spent on administration, modeling and outreach. At this time, not a penny has been dispensed on an actual well repair. **Much of the current planned activity appears to be the same ground that has been repeatedly plowed over in the past years.**

3) There are only two areas that could justify additional work in anticipation of actual requests for mitigation support: 1) preparation of an appropriate application form and 2) development of a set of guidelines to evaluate an application in a uniform and fair manner. Every failed well will present some unique aspects and it is clear that development of accurate guidelines will require careful examination of the actual failed well requests when they are available. Lacking such information, we have gone about as far in this regard as can be imagined already.

<u>Summary</u>

The IWV Groundwater Sustainability Program is a complex undertaking with many unresolved issues. Proper management of public funds is paramount to good governance and is no doubt fully appreciated by the GA Board. However, the lack of an accurately constructed and focused, current POAM and associated Financial Plan is a sure recipe for ever increasing costs that have little to no project justification. Responsibility for correction of this issue is for the GA Board and to no one else.

Methods for Determining the Functional Condition of Shallow Domestic Pumped Water Wells with a Declining Water Table Applicable to the IWV Basin.
(This report supports Data Gap agenda item 3c.i) of the 11/1/2018 IWVGA TAC meeting.)

By Dr. Don Decker, IWV Domestic Well Owner Association representative, 11/2/2018 6

1) **Introduction** The critically overdrafted IWV Basin has experienced nearly continuous declining water levels for the past 50 years and more. The relatively shallow domestic (and many mutual wells) in the Basin are being severely impacted. It is essential for both individual well owners and the Basin Groundwater Authority (GA) to track the functional condition of wells under their respective responsibilities. It has been repeatedly claimed that lack of reporting by domestic well owners of well documentation is a serious omission that must be addressed by the GA. At this point in time, the GA does not have the legal power to require registration and well data disclosure for de minimis wells. Even if such authority did exist, many de minimis well owners do not have knowledge of their well. **Of essential importance is the prediction of the remaining life duration of existing shallow domestic wells and the full life span of new wells.** These lifetimes will vary greatly depending on location relative to the existing major pumping activity.

The purpose of this report is to provide details of methods of evaluation of the functional condition of IWV Basin domestic wells. These results will ultimately be incorporated into a Sustainability Management Plan. **Some approaches suggested in this report are viable even when fully documented well construction information is not available**. **Such methods of evaluation are based on the observation of consistent use of American Water Works Association (AWWA) guidelines for drilled domestic wells in unconfined aquifers in the IWV**. Such wells are drilled to a depth so as to provide 100 feet of standing water in the completed well. As is ordinarily required by code, the well will then be cased to provide durability and sanitary protection. From AWWA recommendations the bottom 40 feet of casing in such a well will be perforated to provide access to the well bore by the aquifer water. At the time of completion, there is then 60 feet of standing water in the well above the top of the perforated section. A serious "data gap" does not actually exist in this Basin knowledge area. Much of the apparent unknown Basin well function and life can be obtained from existing data by further analysis.

2) **Summary of typical domestic well pump installation** A portion of this 60 feet will be taken up by a certain amount of water coverage to ensure that the pump intake is always submerged. In a properly developed and functioning low horsepower domestic well, the pumping water level will be no more than a few feet below the static level. If the water table were stable in time, the minimum static safe intake coverage then might be as small as 10 feet. However, 20 feet or more is actually necessary with consideration of the inevitable consequences of the seriously declining water levels in the IWV basin. Many wells in the IWV Basin are experiencing declines in the range of 1.5 to 2 ft/yr. Reported domestic well motor/pump normal life span in the IWV is typically in the 10 to 15 year range (often dependent on the corrosiveness of the well water). It can easily be seen that the suggested minimum coverage of 20 feet is necessary even for a planned short 10 year motor/pump life. **A not very conservative 40 ft of useful water is thus available under these conditions in a newly drilled well prepared to AWWA recommendations under present conditions in the IWV Basin.**

3) **Well end of life** The practical end of life of a well is reached when the pump intake is located in the casing perforated zone. At this point, it is very likely that the pump production of abrasive fines (including casing rust) will significantly increase, resulting in an accelerated wear of pump impeller eye seals and pump bearings, leading to mechanical failure. Even as serious as this condition is, it is

customary to assume that the pump will function for its usual full life. The intake coverage is designed accordingly and is identical to the earlier value described above. With these assumptions and observations, the projected life of a new AWWA based well in the IWV is a very short 27 years even for water level declines of 1.5 ft/yr (40 ft/1.5 ft/yr). For declines of 2 ft/yr the projected life is only 20 years. If a more conservative pump inlet coverage (more than 20 ft) is assumed, these life values become even smaller. **These short well life numbers illustrate the reason so many shallow domestic wells in the IWV basin have already failed or will do so shortly.** Of course, it is possible in some wells to operate with the pump placed below the top of the perforated zone and to thus obtain some additional well life. This mode is very likely to be short lived.

4) **<u>Well deepening</u>** Short of drilling a new well it is possible in some circumstances to deepen an existing failed well. In so doing it may be possible to bring it back into service by further drilling in the same bore. **It is common for such a repaired well to be completed to the AWWA recommended specifications taking into account the water table level at the time of the repai**r. The repaired well will be usually sleeved inside of the original casing with a PVC liner extending to the surface. This sleeve becomes the well casing below the original depth. The repaired well will then have 100 ft of standing water with 40 ft of perforations at the bottom of the water column. The repaired well will not have a gravel pack in the perforated zone and will typically have a lower well efficiency than the original and often will pump more fines than the original. **It is very important to track the construction/repair completion dates for every well.**

5) **<u>Use of existing reported data</u>** The details of the construction of a given well are sometimes not known but the standard practices of the well drillers in a given area are easily discovered by an examination of the wells for which completion data is available. The great majority of domestic and co-op wells in this Basin were drilled by Kirschenman Well Drilling from 1970 to 2000+ following AWWA guidance. These wells were drilled with permits from the Kern County Health Department and the date of completion is part of the well report. This report also provides confirmation of the well design and location and depth to water. Most IWV Basin domestic wells are located on properties of 10 acres or less. A location description for a well within a 10 acre area is more than adequate for most parcels for the purpose described herein.

The Kern County Water Agency (KCWA) has provided biannual water level measurement data for selected IWV wells for about 30 years. This data is readily available and covers in considerable detail all of the productive area of the Basin. For those wells being monitored, wellhead elevation has been carefully measured by GPS. For wells monitored by KCWA and for which permits can be found, the assessment process is simple. Present measured water levels can be compared to the elevation of the top of the perforated section and using the observed local rates of groundwater decline, a projected remaining life is easily calculated using the pump coverage guidance above.

6) **<u>Analysis of well condition where no well construction data is available</u>** For wells for which permits or completion reports cannot be found and which are not being monitored by KCWA, it is still possible to infer present well condition under certain circumstances. One will assume that the AWWA guidelines were followed for well drilling and the KCWA water depth contours can be used to estimate present depths to water and rates of water level decline in the vicinity of the subject well. It is possible to infer the depth of the top of the perforated section by indirect means. If the well completion date can be determined from real estate, tax or other records, it is easy to calculate the depth (or elevation) of the top of the screened section using KCWA water elevation data appropriate for the time of completion. Another useful approach is to use known data from nearby wells completed at about the same time as the subject well. With these assumptions, a well

completion date and KCWA data it is easy to estimate the remaining life of the well, again using the intake coverage guidance above.

7) **Basin wide new well life evaluation** It is an easy and valuable task to develop an overall Basin plot showing projected new shallow domestic well life based solely on the measured rates of decline in water levels and an assumed initial useful well water level based on AWWA well construction recommendations and proper pump coverage. Such information will be most valuable, independent of any other analysis. One could directly show calculated new well life contours plotted on a basin map.

It obviously would be possible to show similar results for other well types including deeper commercial and municipal wells. A map could then be plotted to show amortized costs of replacement for different classes of wells. Such a map would be very revealing and invaluable for strategic planning.