How to Analyze Space Issues Related to PGA and SGA Using AWR Report

Space issues related to **PGA (Program Global Area)** and **SGA (System Global Area)** can lead to degraded database performance, including excessive disk I/O, contention, and memory-related wait events. The AWR report provides detailed metrics to diagnose such issues.

---

1. Analyzing PGA Utilization

AWR Sections to Review:

- **PGA Memory Statistics**
- **Instance Efficiency Percentages**

Key Metrics and Indicators:

1. **PGA Target vs. PGA Allocated:**
   - Example AWR Output:

     PGA Aggr Target Stats

     Aggregate PGA Target Parameter: 2,048 MB
     Aggregate PGA Auto Target: 1,800 MB
     PGA Memory Allocated: 2,150 MB
     Maximum PGA Allocated: 2,400 MB

     Analysis:

     - PGA Memory Allocated (2,150 MB) exceeds the target (2,048 MB), indicating PGA memory pressure.
2. **Over-allocated Count:**
   - Example AWR Output:

     Over-Allocated Count: 120

     Analysis:

     - A high over-allocated count suggests frequent allocation beyond the PGA target, forcing operations to use disk.

3. **PGA Cache Hit Ratio:**

- Example AWR Output:

  PGA Cache Hit %: 75.2

  Analysis:

  - A cache hit ratio below 90% means a significant number of memory operations are spilling to disk.

---

2. Analyzing SGA Utilization

AWR Sections to Review:

- **SGA Memory Summary**
- **Buffer Cache Advisory**
- **Shared Pool Statistics**

Key Metrics and Indicators:

1. **SGA Target vs. Allocated:**
   - Example AWR Output:

     SGA Target Size: 4,096 MB
     SGA Memory Allocated: 4,200 MB

     Analysis:

     - SGA Memory Allocated exceeds the target, indicating memory contention.
2. **Shared Pool Free Memory:**
   - Example AWR Output:

     Shared Pool Statistics:
     Free Memory: 15 MB
     Shared Pool Size: 800 MB

     Analysis:

     - Low free memory (< 50 MB) in the shared pool can lead to frequent flushing, affecting query performance.

3. **Buffer Cache Advisory:**
    - Example AWR Output:

      Buffer Cache Advisory
      Size Factor: 1.0
      Estimated Physical Reads: 2,500,000

      Analysis:

        - High physical reads (> 1,000,000) suggest insufficient buffer cache, leading to excessive disk I/O.

---

3. Reviewing Instance Efficiency Percentages

AWR Section to Review:

- **Instance Efficiency Percentages**

Key Metrics and Indicators:

1. **Buffer Cache Hit Ratio:**
    - Example AWR Output:

      Buffer Cache Hit Ratio: 82.5%

      Analysis:

        - A buffer cache hit ratio below 90% indicates inadequate buffer cache, leading to excessive physical reads.
2. **Library Cache Hit Ratio:**
    - Example AWR Output:

      Library Cache Hit Ratio: 85%

      Analysis:

        - A low ratio (< 90%) indicates frequent hard parsing, often due to shared pool memory pressure.

---

4. Reviewing Wait Events

AWR Sections to Review:

- **Top 10 Foreground Events**
- **Wait Class: Memory**

Key Metrics and Indicators:

- Example AWR Output:

  Top Foreground Wait Events

Event	*Waits*	*Time (s)*	*Avg Wait (ms)*
latch: shared pool	*50,000*	*5,000*	*100*
free buffer waits	*10,000*	*2,000*	*200*

  Analysis:

  - The latch: shared pool event indicates contention for shared pool memory.
  - The free buffer waits event points to insufficient buffer cache.

---

5. Analyzing Temporary Tablespace Usage

AWR Sections to Review:

- **Temporary Tablespace Statistics**
- **Segment Statistics**

Key Metrics and Indicators:

1. **Temporary Tablespace Usage:**
   - Example AWR Output:

     Temporary Tablespace Stats
     Temp Tablespace Size: 2,000 MB
     Temp Space Used: 1,950 MB

     Analysis:

     - High temporary tablespace usage indicates sorts or hash joins spilling to disk due to insufficient PGA.

Consolidated Table for Analysis

Metric/Indicator	AWR Section	Threshold	Conclusion
PGA Allocated vs. Target	PGA Memory Statistics	Allocated > Target	Insufficient PGA memory, causing disk spills.
Over-allocated Count	PGA Memory Statistics	> 0	Frequent allocations beyond PGA target indicate memory pressure.
PGA Cache Hit Ratio	PGA Memory Statistics	< 90%	Low ratio indicates excessive disk I/O due to inadequate PGA.
SGA Allocated vs. Target	SGA Memory Summary	Allocated > Target	Insufficient SGA memory, leading to contention.
Free Memory in Shared Pool	Shared Pool Statistics	< 50 MB	Low free memory indicates flushing and hard parsing.
Buffer Cache Hit Ratio	Instance Efficiency Percentages	< 90%	High disk I/O due to inadequate buffer cache.
Library Cache Hit Ratio	Instance Efficiency Percentages	< 90%	Excessive hard parsing, indicating shared pool pressure.
Wait Events: latch: shared pool	Top Foreground Wait Events	High Waits	Contention in shared pool memory.
Wait Events: free buffer waits	Top Foreground Wait Events	High Waits	Insufficient buffer cache, leading to wait events.
Temporary Tablespace Usage	Temporary Tablespace Statistics	Temp Space Used ≈ Temp Size	High usage indicates PGA pressure and disk spills.

By systematically analyzing the above sections and metrics in the AWR report, you can effectively diagnose and conclude potential space issues related to PGA and SGA. For resolution, consider tuning memory parameters such as **PGA Target Size**, **SGA Target Size**, and optimizing query execution plans to reduce memory usage.